DISTRICT HEATING POTENTIAL IN ROMANIA AND LATVIA

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European success stories and their applicability to Romanian and Latvian municipalities, with a focus on geothermal and flexible low-carbon heating solutions



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About the author

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1. Executive Summary

Romania and Latvia need different district-heating transition strategies. Romania must improve the reliability of ageing systems while preparing renewable heat projects. Latvia already uses substantial renewable heat, much of it from biomass, and now needs to diversify its heat sources and make networks more flexible. This study assesses municipal starting points, draws lessons from Szeged and Helsinki, and proposes actions that municipalities can test before committing to large investments.

Romania.

Szeged shows how geothermal heat can be added to an existing district-heating system one heating circuit at a time, with a municipal utility buying heat from a specialist source developer. For **Bucharest**, the immediate task is to select a network zone with stable demand, verify the geothermal resource and reinjection route, and agree ownership, heat-purchase terms and exploration-risk allocation. Wells, plant conversion and network connection should form one pilot package followed by a full heating season of measured results. **Oradea** and **Beiuș** should focus on return temperatures, reinjection and geothermal dispatch. Fossil-dependent systems such as **Craiova** need coordinated source and network plans, while towns without an operating district-heating system should establish demand and a viable service area before choosing a technology.

Latvia.

Helsinki demonstrates the value of operating heat pumps, recovered heat, electric boilers and storage as one portfolio. **Riga** already has several of these projects advancing; its priority is to coordinate them through shared operating data, dispatch rules, heat-purchase contracts and network renewal. **Salaspils** can first improve storage and biomass operation, then test a suitably sized non-combustion heat source. Smaller municipalities should assess heat demand, electricity capacity and source availability before investing. Geothermal opportunities such as **Nīca** remain at the resource-screening stage.

The first steps are practical and measurable.

Operators should establish heat balances by source and network zone, correct faulty meters and controls, reduce excessive return temperatures, repair visible leaks and review contracts that discourage renewable dispatch. Pipe replacement should target sections with measured losses or failure risk and be coordinated with substations and future source temperatures. Larger heat pumps, storage and advanced controls should be sized from verified operating data.

Each municipality needs an accountable project lead, a clear division of decisions among the utility, producers and building owners, and early engagement on service quality and affordability. Finance should match project risk: preparation support for studies, explicit risk sharing for exploration, and investment grants or loans once a pilot is bankable. Shared PV and building heat pumps should be installed where they complement district heating. Household heat pumps are most appropriate where a viable network cannot serve the area. The guiding sequence is to **measure and optimise, demonstrate through one heating season, then scale what performs.**

Abbreviations

4GDH	Fourth-generation district heating
ANRE	Autoritatea Națională de Reglementare în Domeniul Energiei — Romanian energy regulator
CEE	Central and Eastern Europe
CEO	Chief Executive Officer
CET	Centrală electrică de termoficare — combined heat and power plant; used in “CET Grivița”
CFO	Chief Financial Officer
CHP	Combined heat and power
COP	Coefficient of performance
DH	District heating
DHC	District heating and cooling
DSO	Distribution system operator
EIB	European Investment Bank
ELCEN	Electrocentrale București S.A.
ELENA	European Local Energy Assistance
EPG	Energy Policy Group
ERDF	European Regional Development Fund
ESCO	Energy service company
EU	European Union
FY	Financial year; the study uses FY2024/25
GEOSZ	Geotermikus Szolgáltató Kft., a Hungarian geothermal company
HP	Heat pump
HSY	Helsinki Region Environmental Services Authority
ISO	International Organization for Standardization
KEHOP	Környezeti és Energiahatékonysági Operatív Program — Hungary’s Environmental and Energy Efficiency Operational Program
KPI	Key performance indicator
MEKH	Hungarian Energy and Public Utility Regulatory Authority
NECP	National Energy and Climate Plan
NFP	Nemzeti Fejlesztési Programiroda — Hungary’s National Development Programme Office
NREL	National Renewable Energy Laboratory
PV	Photovoltaic
QM	Quality management; used in QM Holzheizwerke
RES	Renewable energy sources
SACET	Sistem de Alimentare Centralizată cu Energie Termică — Romanian centralised thermal-energy supply system
SCADA	Supervisory control and data acquisition
SECAP	Sustainable Energy and Climate Action Plan
SIFEE	SIFEE New Energy
SVP	Senior Vice President
SZETÁV	Szegedi Távfűtő Kft., the Szeged district-heating company
TSO	Transmission system operator

2. Introduction

2.1 Bankwatch

Bankwatch Romania commissioned this study to support evidence-based municipal decisions on low-carbon district heating in Romania and Latvia. The analysis focuses on technical performance, governance, finance and public participation because these factors jointly determine whether renewable-heat projects can be implemented and sustained.

2.2 Baseline

This study supports a broader initiative to help municipalities in Romania and Latvia integrate renewable energy sources (RES) into district heating (DH) systems and accelerate heating sector decarbonisation. A preliminary profiling assessed DH system characteristics, municipal capacity, governance, policy frameworks and barriers and potentials to renewable energy integration, providing the baseline for this study. Romania's DH sector faces significant challenges, including ageing infrastructure, high network losses, declining consumer connections and continued reliance on fossil fuels (~34% natural gas). Municipalities often lack the technical and financial capacity to prepare and implement transition projects. Although some have successfully introduced renewable solutions, particularly geothermal energy. Key barriers include limited investment capacity, weak strategic planning and institutional fragmentation. Latvia has a more mature DH sector, with biomass supplying around 70% of district heat. While this has reduced fossil fuel use, it has also limited interest in diversifying renewable technologies. Additional barriers include inconsistent policy signals, limited uptake of waste heat and solar energy, and varying stakeholder commitment.

Romania and Latvia therefore require different transition sequences. This study validates the municipal typologies, tests two European reference cases against the identified clusters and converts the comparison into investment and implementation recommendations.

3. Task 1: Municipal Profiles

3.1 Romania – Potentials

2025, the Romanian energy regulatory agency (ANRE Romanian: Autoritatea Națională de Reglementare în Domeniul Energiei) recorded 48 active SACET operators running 49 centralised thermal energy supply systems (SACET – Romanian: Sistem de Alimentare Centralizat ă cu Energie Termică) systems in 49 localities across Romania. Together the systems supplied ~ 1 million households, ~2,000 public institutions and ~8,000 economic operators. [1]

ANRE classifies 14 systems as large (>10,000 consumers), 17 as medium (1,000-10,000) and 18 as small (<1,000); Bucharest had ~536,000 total consumers, Oradea/Sânmartin ~75,000 and Craiova ~53,000. [1]

Consumer retention remains a system-level issue. ANRE recorded disconnections in 33 of the 49 localities during 2025, while Oradea/Sânmartin maintained an upward reconnection trend, the North-West region registered 789 reconnections. [1] [2]

Romania's highest-quality conventional geothermal resources are concentrated in the west, with additional occurrences in the Carpathians and east of Bucharest; the EPG (Energy policy group) review characterises typical mapped resource temperatures as roughly 60-120 °C at about 3,000 m in the main high-potential areas and notes that much of the national subsurface evidence still depends on old or fragmented datasets. [3]

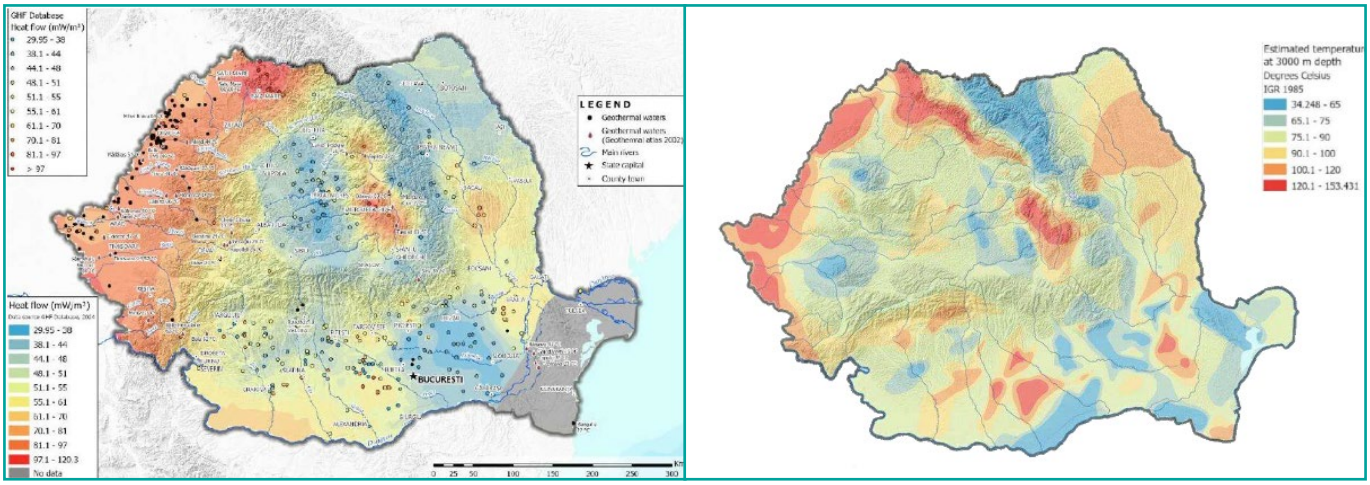


Figure 1: Estimated heat flow (left) and subsurface temperature at 3000m depth (right) [3]

The EPG study identifies Oradea and Beiuș as the strongest operating DH references but identifies the lack of a consolidated, accessible subsurface dataset as a barrier. In addition, fragmented permitting, early-stage drilling risk, limited specialist drilling capacity and reinjection are among the principal barriers to wider deployment. [3]

The 2025 geothermal country update documents further municipal projects in Ștei and Salonta and emphasises that reinjection into Pannonian sandstone can be technically difficult. It also notes chemical constraints, including phenolic compounds, that make responsible reinjection important for reservoir management and environmental compliance. [4]

Some developer evidence is directionally consistent with this western concentration: [5] [6]

- SIFEE New Energy states that it holds licensed geothermal perimeters and is developing deep-drilling projects in western Romania
- Green Tech reports a portfolio of more than 80 Romanian wells and identifies Bucharest, Timișoara and Oradea among its district-heating focus markets

3.1.1 Analysis of Municipal profiles – Status Quo

Romania's DH sector has contracted sharply since 1989, and the remaining systems differ in scale, ownership, fuel mix and technical condition. The 2025 ANRE operating baseline therefore provides a more reliable basis for comparison than a national average. [1]
ANRE recorded 49 operating SACET systems in 2025. Their scale ranges from Bucharest to small local systems. [1]
Four clusters could be identified:

- **Advanced geothermal systems (A)** that require optimisation and scale-up, represented by Oradea/Sânmartin and Beiuș. [1] [2] [3] [4]
- Clusters B and C comprise operating systems requiring coordinated network renewal and source transition. Bucharest and Timișoara are grouped by large-system integration needs (B); Craiova and Râmnicu Vâlcea by structural transition needs (C). Each must additionally record the reference-year contribution of coal/lignite, gas and other sources, because fuel retirement and replacement schedules differ. [1] [7]
- **Just-transition (D)** or re-establishment locations where an active municipal DH baseline, heat density and governance model must be verified before technology selection, including Petroșani, Rovinari and Turceni. [1]

The principal system-level constraint is the interaction between ageing networks, high return temperatures, fossil-source dependence and declining customer confidence. [1] [7]
The Task 1 screening therefore uses the following indicators:

- Verified heat losses and recurrent outage locations [1]
- Current connections, disconnections and reconnections as indicators of service confidence [1] [2]
- Source temperatures, reinjection conditions and water chemistry for geothermal projects [3] [4]
- Ownership, decision rights, project-development capacity and access to staged finance [1] [3] [7]

Table 1: Strongest geothermal supplied sources [1] [2] [3] [4] [7] [8] [6]

Municipality	2025 operating baseline	Renewable / transition evidence	Proposed role
Oradea / Sânmartin	• 73,305 users • 25 disconnected • 788 reconnected in 2025 • Natural gas remains main source.	• Geothermal is already integrated • EPG reports about 15% of Oradea's DH heat from geothermal, while Nufărul expands the source/heat-pump combination.	A — advanced geothermal / scale-up
Beiuș	• 2,230 users • no 2025 disconnections or reconnections reported.	• EPG and the 2025 country update describe a geothermal-led system • country update lists 21 MWth geothermal capacity and a **geothermal production share towards 100%.**	A — advanced geothermal / optimisation
Bucharest	• 532,760 users • 2,572 disconnected and 28 reconnected in 2025. • Natural gas is the main heat source	• Large-scale geothermal is project-stage, not yet an operating success: Green Tech reports a EUR 200 million strategic project under development.	B — large DH modernisation + renewable integration
Timișoara	• 44,080 users • 1,140 disconnected and none reconnected in 2025. • Coal/lignite and natural gas are the main sources	• The wider Timiș area has documented geothermal wells and Green Tech lists Timișoara as a DH focus market, but this is opportunity evidence rather than proof of geothermal integration today.	B/C — large DH + geothermal-screening opportunity
Craiova	• 52,624 users • 1,043 disconnected and none reconnected in 2025. • Coal/lignite and natural gas are the main sources	• ANRE records 2025 distribution-system modernisation financed under Modernisation Fund • geothermal is not evidenced as a current heat source.	C — operating fossil-DH structural transition
Râmnicu Vâlcea	• 23,543 users • no 2025 disconnections or reconnections reported. • Natural gas is the main source	• The current SACET remains an operating transition case • nearby Vâlcea geothermal use does not establish a bankable municipal resource for Râmnicu Vâlcea itself.	C — operating fossil-DH structural transition
Petroșani	• No active SACET operator reported by ANRE for 2025.	• No active SACET operator reported by ANRE for 2025.	D — just transition / possible DH re-establishment

Municipality	2025 operating baseline	Renewable / transition evidence	Proposed role
Rovinari	No active SACET operator reported by ANRE for 2025.	• The profiling identifies geothermal exploration interest and coal-transition relevance	D — just transition / resource screening
Turceni	No active SACET operator reported by ANRE for 2025.	• The profiling identifies geothermal/ PV transition plans around the energy complex	D — just transition / resource screening

The table updates the preliminary typology with the 2025 ANRE operating baseline and the strongest geothermal evidence available in the supplied sources. “No active SACET reported” means that the locality does not appear in ANRE’s 2025 monitored operator list and does not by itself prove that every local heat installation is absent. [1] [2]

3.1.2 Best practice examples in Romania

Beiuș – geothermal district heating

Beiuș is an operating geothermal-led reference. The 2025 country update reports 21 MWth of geothermal capacity and a geothermal production share approaching 100%. The relevant next questions are optimisation, reinjection and long-term resource management. [4]

Oradea – large-scale geothermal integration

Oradea combines geothermal integration with network expansion and modernisation. ANRE recorded 788 user reconnections and only 25 disconnections in 2025, making customer retention a measured outcome rather than an assumed benefit. ANRE reports 73,305 users supplied by Termoficare Oradea at the end of 2025. [1] [2]

ANRE also records primary-network extension and modernisation in 2025. These works show that renewable-source integration is being prepared alongside network development [1] [7]

EPG reports that geothermal energy supplies about 15% of Oradea’s total DH heat, while the Nufărul project shall deliver 19 MWth in its first phase and up to 50 MWth when the combined geothermal source and heat-pump capacity is considered. [3] [4]

The Nufărul design described by Ban et al. includes two production and two reinjection wells, an 11.2 km thermal network and 277 building-level thermal modules serving 6,217 apartments plus public and commercial users. Ban et al. also describes the technical difficulty of high-rate reinjection into sandstone and the importance of geothermal-water chemistry. [4]

The Nufărul investment was about 19 million €, of which about 15 million € came from EU funding. The project is part of a wider municipal program involving the local administration and the University of Oradea. [9]

Vatra Dornei (and other biomass systems)

Vatra Dornei, Tașca and Rădăuți provide operating smaller-system biomass references, rather than a verified sustainability benchmark. Their relevance is conditional on sustainable fuel supply, local air-quality limits and lifecycle cost. They should not be treated as direct analogues for large urban systems. [10]

For Vatra Dornei, the municipal 2024 report describes 18 MW of installed boiler capacity: two 6 MW wood-fuel boilers and one 6 MW liquid-fuel boiler. The reported biomass is sawdust and chipped wood from broadleaf and coniferous species. This supports a technical operating reference, but not a conclusion that all feedstock is sustainable or consists exclusively of unavoidable residues. Before recommending replication, obtain annual fuel quantities and origin, residue categories, competing uses, moisture, traceability, lifecycle greenhouse-gas performance and local emissions compliance; compare non-combustion alternatives on the same service boundary. Municipalities still dominated by fossil fuels and under transition.

Bucharest

Bucharest remains predominantly natural gas-fired while network rehabilitation and geothermal feasibility work proceed in parallel. Its transition is therefore both an engineering and an institutional coordination problem. [1] [7] [6] [11]

The institutional structure is split between the municipal distribution/supply operator and several independent heat producers, including Electrocentrale București S.A. (ELCEN), CET Grivița and Vest Energo, which makes source-transition planning a governance as well as an engineering problem. [1]

Green Tech describes a strategic Bucharest DH decarbonisation project under development with an estimated EUR 200 million investment, integration of geothermal energy into SACET, annual thermal production above 595,000 MWh and an estimated reduction of about 127,000 tCO_2/a. (company presentation – not verified) [6]

A separate 2024 feasibility initiative between ELCEN, Sage Geosystems and NREL was announced to assess geothermal integration into Bucharest's district heating, confirming that geothermal interest. [11]

For more detailed technical information (load profile, temperature curves etc.) the study of Kalina et al. is highly recommended. [12]

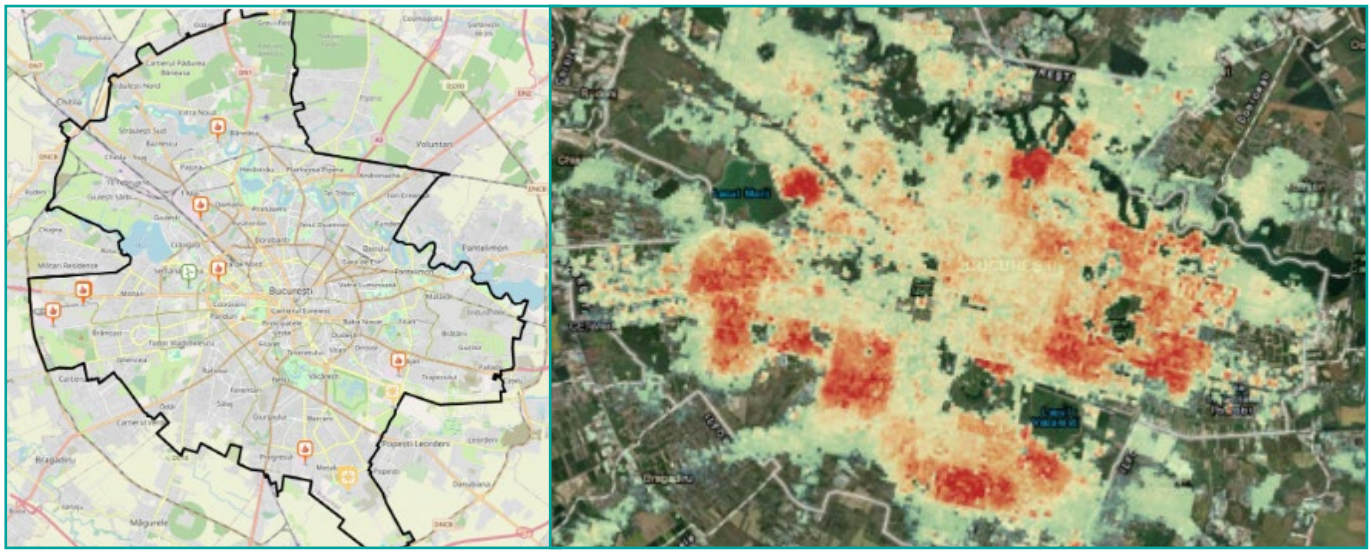


Figure 2: District heat network (left) and heat demand density (right) in Bucharest [13] [12]

Craiova

Craiova remains an operating fossil-DH transition case. ANRE records network modernisation supported by the Modernisation Fund. [1] [7]

3.1.3 Renewable Energy Potential

The Romanian energy system is highly based on fossil fuels. In 2024 approximately 25,8% of the energy share was renewable. [14]

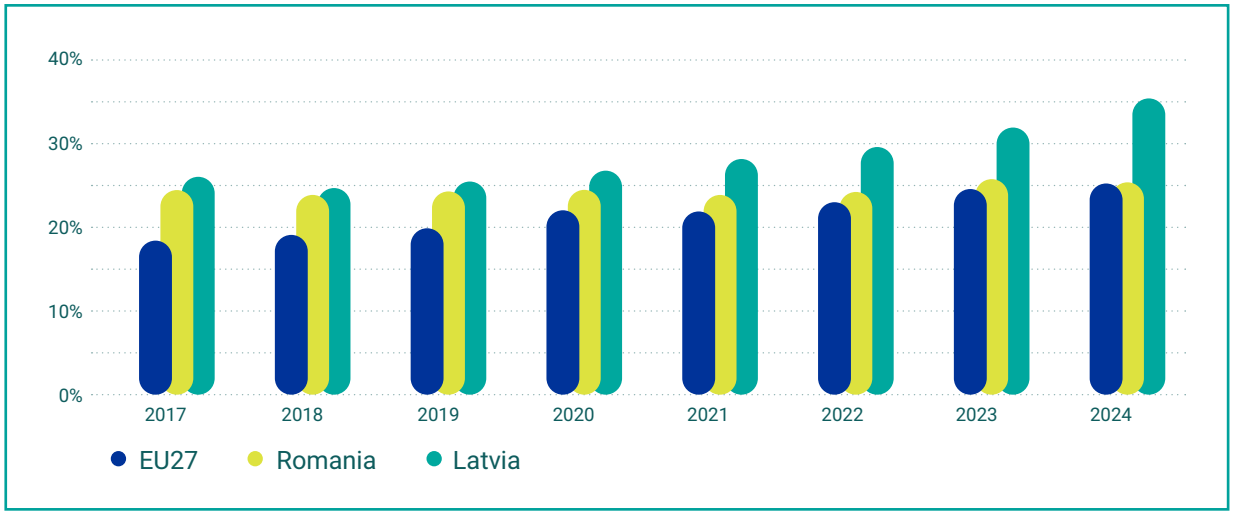


Figure 3: Gross renewable share in heating; EU27 (blue), Romania (yellow) and Latvia (green) [14]

Romania's 2030 energy plans combine lower final demand with further wind and photovoltaic deployment. For DH, the practical implication is to link building renovation, lower network temperatures, renewable heat and electricity-system capacity in the same spatial plan. [10]
Urban DH remains strongly exposed to fossil fuels. Biomass may be suitable in smaller systems with secure sustainable supply, while dense urban systems require higher-capacity combinations such as geothermal, recovered heat, large heat pumps, thermal storage and peak boilers. The current renewable energy share in the heating (and cooling) sector is reported by 28%. [3] [10] [15]

3.1.4 Efficiency of the district heating system and network optimisation

Energy efficiency and network optimisation require separate work packages. The first quantifies avoidable generation, network and building losses; the second improves temperatures, flows, pressure and dispatch within the existing system. Pipe renewal should follow this diagnosis and be coordinated with substation and building improvements.

Before pipes are selected for replacement, each operator should establish a **zone-based energy balance** comparing heat supplied to the zone with metered heat delivered to consumers. The assessment should include absolute and relative heat losses, heat loss per kilometre, make-up water, pumping electricity, supply and return temperatures, flow rates, interruption frequency and expected future heat demand. This distinguishes losses caused by leaking or poorly insulated pipes from those caused by oversized networks, excessive circulation, bypasses, poorly performing substations or unbalanced customer installations. Pipe replacement should be prioritised using avoided-energy cost, failure risk and lifecycle cost rather than pipe age alone.
Measures that do not require extensive excavation should be implemented before or in parallel with network replacement. These include:

- weather-compensated supply-temperature control
- hydraulic balancing and differential-pressure optimisation
- variable-speed pumps
- removal of unnecessary bypasses
- repair or replacement of defective control valves and heat exchangers
- remote heat metering, leak detection and SCADA integration
- optimisation of customer substations, beginning with large consumers displaying high return temperatures
- continuous monitoring of temperature difference, make-up water and pumping energy

A reduction of return temperatures and unnecessary flow increases transport capacity can reduce pumping demand. It also facilitates the integration of geothermal energy, recovered heat and large heat pumps, whose performance depends strongly on the required network temperature. Electri-

fied generation additionally requires digital control, thermal storage and coordinated dispatch in response to heat demand and electricity-system conditions

Pipe replacement should then concentrate on verified high-loss or failure-prone sections. Old and oversized pipes should be replaced with correctly dimensioned pre-insulated pipes, including integrated leak-detection cables. Pre-insulated twin pipes may be appropriate for smaller distribution branches but should not automatically be specified for major transmission mains. Network renewal should be coordinated with substation modernisation, temperature reduction and the future location of renewable or recovered-heat sources. Otherwise, new pipes may preserve unnecessarily high temperatures and flow rates for another investment cycle. [1] [7] [10]

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A concrete Romanian investment example is Timișoara's Stage III, Lot 1 network project (SMIS 330430). It specifies 13.439 km of route, equivalent to 26.878 km of supply/return pipe, with correctly sized pre-insulated pipes, monitoring and control, leak detection and sectioning valves. Its stated annual savings are project estimates, not verified operating results. For Bucharest and other large systems, use the same integrated specification but select the zones from the operator's own loss, failure and future-demand data. [16]

3.2 Romania – Selection of European Case Study

Szeged is the selected Romanian reference because its operating geothermal transition addresses the following implementation questions: modular geothermal integration, reinjection, plant-side retrofit, municipal utility control, specialist source ownership and staged finance. [17] [18] [19] [20]

The European Commission announced the Szeged geothermal heating system's inauguration in May 2023 and reported EU investment of EUR 23 million, 27 wells, 16 heating plants and roughly 250 km of distribution network supplying renewable heat to more than 28,000 households and over 400 public buildings. [18]

SZETAV's own project website states that the company supplies 27,256 apartments and 433 public buildings and describes the geothermal cut pollution by about 60% and localises roughly half of the system's energy supply. Szeged therefore matches both Romanian deep-dive directions: [3] [18] [21] [22]

- **Oradea**: reference for scaling geothermal penetration across multiple urban heating circuits
- **Bucharest**: completed example of retrofitting renewable baseload into a previously natural gas-based municipal DH system.

Heat-pump integration and electrification are cross-cutting options for Romanian cities as well as Latvia. Bucharest should therefore test the Helsinki lessons on recovered heat, electricity capacity, thermal storage and source contracts alongside geothermal feasibility. Municipal heating and cooling plans should map major cooling loads and opportunities to recover rejected heat; this screening does not require a third case study or commit the municipality to a district-cooling network. [37] [55]

3.3 Latvia – Potentials

Latvia should not be framed primarily as a low-renewable district-heating market. Statistics show a 61.4% renewable share in heating (2023) and 61,8% in 2024, while biomass still accounted for 76.7% of gross renewable-energy consumption in 2024. The study therefore needs to distinguish high renewable penetration from diversification beyond combustion-based biomass. [23]

Table 2: District heating baseline and selection criteria for an European best practice for Latvia [21] [23] [24] [25] [26] [8]

Dimension	Current situation	Implication for case selection
Renewable position	• Renewables supplied 61.8% of heating/ cooling consumption in 2024; Latvia's NECP target for gross final renewable share is 62% by 2030.	The benchmark should address the quality, flexibility and diversification of renewable heat, not merely demonstrate biomass substitution.
Biomass concentration	• Biomass represented 76.7% of gross renewable-energy consumption in 2024	Relevant lessons are large heat pumps, electric boilers, residual heat, storage and smarter dispatch alongside sustainable biomass.
CHP / natural gas legacy	• CHP supplied 3.7 TWh of heat in 2024, 51.0% of total heat production • natural gas remained 54.5% of CHP fuel consumption.	Electrification and heat-market flexibility have to coexist with a legacy CHP and natural gas system during transition.
Network condition	• Rīga Siltums reported 12.5% network losses in FY2024/25.	Generation decarbonisation should be coupled to pipe renewal, new connections and control/ temperature optimisation.
Waste heat	• Riga's climate plan and current utility program explicitly develop wastewater and other residual-heat recovery.	A benchmark with mature wastewater/data-centre heat integration is highly relevant.
Urban concentration	• Continuing urbanisation toward the largest municipalities and potential DH expansion there.	The benchmark should show how an expanding large-city system can decarbonise while maintaining service reliability.

Riga and Salaspils are the priority Latvian municipalities for further engagement. Riga offers the highest system-level leverage because electrification, purchased heat, residual-heat projects and network renewal already need to be coordinated. Salaspils is the strongest smaller-system test bed for short-term storage control to balance variable solar output and heat demand and second-stage diversification beyond biomass. Nīca should remain a resource-screening case until modern well, brine-management and heat-demand evidence is available. [24] [25] [26] [27] [28] [29] [30] [31]

Table 3: Clustering for Latvia [21] [23] [26] [25] [24] [32] [27] [28] [29] [30]

Working cluster	Latvian examples	Primary transition question
A. Advanced renewable and flexible municipal DH	Salaspils: 1,720 solar collectors, 3 MW wood-chip boiler and 8,000 m³ heat accumulator; municipal utility has remote data reading.	How to move from a successful solar–biomass–storage base toward heat pumps, residual heat, deeper digital optimisation and lower combustion dependence?
B. Large hybrid system in 4GDH transition	Riga: large multi-producer system; own generation is predominantly wood chips plus natural gas, while a 49 MW electrode boiler (in operation since 02/26), residual-heat work (finished by 09/28) and network investment are advancing .	How to coordinate electrification, third-party heat, storage, residual heat and pipe renewal in a large legacy network without compromising reliability or affordability?
C. Biomass-led municipal systems needing second-stage diversification	The national renewable position and biomass concentration imply a broad class of systems where biomass has already decarbonised fuel supply, but diversification remains limited.	Which non-combustion heat sources and flexibility options are economic at smaller scale, and what network/temperature conditions are required?
D. Local renewable-resource opportunity systems	Nīca / south-west Latvia: research identified Lower Cambrian geothermal resources as a potential small-DH option, but the concept depends on resource, well and brine-disposal conditions and was not a realised DH scheme.	How should a small municipality derisk exploration, environmental permitting and reservoir/brine management before committing capital?

3.4 Latvia – Selection of European Case Study

Riga

Riga is the highest-value Latvian transfer target for Helsinki because both cases require the coordination of multiple heat sources, electrification, residual heat, grid-responsive operation and a capital-intensive urban network rather than a single renewable technology. [24] [33] [25] [31] [34] [35] [36]

Table 4: Overview of the district heating in Riga [24] [25] [26] [32]

Topic	Evidence-based profile
System / ownership	• Rīgas Siltums serves the capital's DH system; • Main shareholders Riga municipality 49%, Republic of Latvia 49%, Enerģijas Risinājumi.RIX 2%
Heat sourcing	• In FY2024/25 the Rīgas Siltums delivered 3 TWh to the network (48% own production, 52% purchased from other producers) • Own heat production 70% wood chips / 30% natural gas
Network	• Rīgas Siltums reported 12.5% losses, reconstructed 5.72 km and built 2.67 km of new network during FY2024/25; its 2026 review reports 11.05 km reconstructed or newly constructed and estimated annual heat-loss savings of 10 GWh.
Electrification	• A 49 MW electrode water boiler was installed at Imanta; • Rīgas Siltums describes it as Latvia's first such installation and as a way to produce heat during low electricity prices while supporting power-system balancing.
Residual heat[1]/ heat pumps	• Absorption heat pumps recover flue-gas/condensate heat at three heat sources • feasibility work covers Daugavgrīva[2] wastewater heat and residual-heat/cooling pilot.
System strategy	• Riga's climate action plan assigns Rīgas Siltums implementation responsibility for a fourth-generation DH transition including electric boilers, wastewater/other heat pumps, storage/ efficiency and integration of individual producers.
Finance	• he EIB signed a EUR 47 million loan (04/26) toward an approximately EUR 135 million four-year DH rehabilitation/extension process (09/28), with focus on lower losses and continuity of supply.

1 Delska inaugurated its 10 MW EU North Riga LV DC1 data centre in April 2026. https://delska.com/about/news-resources/delska-newsroom/delska-launches-one-of-the-baltics-most-advanced-and-sustainable-data-centers-in-riga/

2 Daugava should be screened as a possible water-source heat-pump input. Feasibility study should resolve winter temperature and low-flow conditions, intake location, icing and fouling, pumping demand, discharge effects, grid capacity and the permitted thermal regime. [81]

Salaspils

Salaspils already demonstrates the solar–biomass–storage integration that many municipalities would regard as an end-state. For this study its higher-value learning question is how to add low-temperature residual heat and electricity-linked flexibility to that mature renewable base. [32] [27]

Table 5: Overview of district heating in Salaspils [32] [27]

Topic	Evidence-based profile
Scale	• Salaspils Siltums reports about 22 km of networks, 35 MW installed thermal capacity and roughly 65 GWh annual heat production.
Integrated solution	• The operating system includes 1,720 solar thermal collectors, a 3 MW wood-chip boiler with flue-gas condenser and an 8,000 m³ heat accumulator.
Performance transition	• Solar field 20% of annual DH heat and that renewable heat rose from 56% to 94% • heat-related CO_2 emissions fell by 88%.
Governance reinvestment	• The municipal-owned operator reinvests 50% of profit in the DH system
Next step	• Heat pumps and data-centre waste heat

Helsinki was selected as the Latvian reference case because it provides measured post-coal performance and an integrated model for heat pumps, electric boilers, recovered heat, storage, third-party supply and digital optimisation. [33] [34] [37] [38]
Helsinki has a completed coal-exit milestone and measured first-year performance, mature wastewater-heat integration, operating electric-boiler capacity and a continuing portfolio of large heat pumps, waste heat, storage and digital optimisation. [33] [34] [35] [36]
Tallinn is unusually close to Latvia in climate and Baltic context, but its flagship 110 MW heat-pump development was (08/2026) still a delivery-stage. [39] [40]
Szeged supplies the geothermal/legacy-network lesson that is relevant to Romanian geothermal municipalities and potentially to future south-west Latvian exploration, while Helsinki supplies the non-combustion diversification and system-integration lesson that directly fits Riga and Salaspils, so Helsinki will be the best practice study for Latvia. [25] [28] [27] [29] [34] [35] [36]

Table 6: European case screening [35] [33] [34] [36] [39] [40]

Criterion	Helsinki, Finland	Tallinn, Estonia
Demonstrated transition	• Coal ended in 2025 • first full coal-free year with DH-production emissions down 56%, >99.9% reliability and lower customer prices.	Tallinn/Maardu reported 77% renewable and waste heat in DH at end-2025.
Heat-pump residual-heat maturity	• Katri Vala already supplies >1,000 GWh/a from wastewater/other low-grade heat; new Eiranranta heat-pump plant is part of portfolio	Large heat-pump electrification is highly relevant, but the flagship Paljassaare plant remains a current delivery project rather than a long operating record.
Electrification flexibility	• 100 MW of electric-boiler capacity was commissioned in 2025, with a further 200 MW Hanasaari electric-boiler plant plus 1 GWh storage under construction in 2026.	Electrification and heat-market flexibility have to coexist with a legacy CHP and natural gas system during transition.
Transfer to Riga	• Strong match to Riga's electric boiler, wastewater/ residual-heat pilots, multi-source heat market and need for system-level optimisation.	Very strong Baltic climate and institutional proximity, giving value as a comparator and reserve case.
Complementary with Szeged	• electrification, waste heat, storage and digital optimisation complement Szeged's geothermal-centred retrofit pathway.	electrification/waste-heat relevance, but less differentiated from Helsinki's core lessons.

3.5 Latvia – Other municipalities with advanced DH systems

Beyond Riga, Salaspils and Nīca, Daugavpils, Liepāja, Jelgava and Ventspils represent four important Latvian district-heating configurations.

Daugavpils operates one of Latvia's largest regional district-heating systems through the municipally owned company Daugavpils siltumtīkli. The system includes three principal heating plants and several local boiler houses. In 2024, the municipality reported approximately 288 MW of installed heat-production capacity and network losses of around 17%, slightly above the company's target. Daugavpils is therefore particularly relevant for measures addressing network rehabilitation, temperature reduction, hydraulic optimisation and the diversification of a historically fossil-dependent production portfolio. [41]

Liepāja has a comparatively extensive and diversified district-heating system operated by Liepājas Enerģija. District heating supplies approximately 1,240 buildings, including 669 apartment buildings, 262 private houses and 110 state or municipal facilities. Heat is generated in two CHP plants, a biomass boiler plant and several autonomous boiler houses serving more distant neighbourhoods. Liepāja is therefore a useful example of how a city can progressively convert decentralised production sites while expanding renewable heat and retaining backup capacity. [42]

Jelgava differs institutionally because its district-heating system is operated by the private energy company Gren. The approximately 75 km network supplies more than 16,000 households and around 200 commercial and public-sector customers. The system is based predominantly on locally sourced biomass CHP. In 2026, a 20 MW electrode boiler entered operation to use electricity during favourable market conditions and reduce natural-gas consumption during peak loads and biomass-plant maintenance. Jelgava consequently provides a strong example of combining biomass, power-to-heat, private utility investment and network expansion. [43]

Ventspils operates a municipally owned district-heating system divided into two separate networks serving the two sides of the Venta River. The system is strongly biomass-based: Ventspils siltums reported that wood chips supplied 99.6% of its heat production during the first half of 2025. Flue-gas condensation contributed approximately 15% of the heat output, recovering energy that would otherwise be lost. Ventspils is therefore especially relevant for biomass-efficiency improvements, flue-gas heat recovery and the management of geographically separated networks. [44]

4. Task 2: European Case Studies

4.1 Szeged

Szeged's geothermal transition is best understood as a split-asset, public-private heat-supply model rather than as a vertically integrated municipal geothermal utility. The municipality owns SZETÁV, while the geothermal production and injection installations were assigned to the private geothermal partner and the municipal utility retained the district-heating plants, network interface and customer relationship; geothermal heat is therefore purchased into the public DH system. [19] [20] [45] [46] [47]

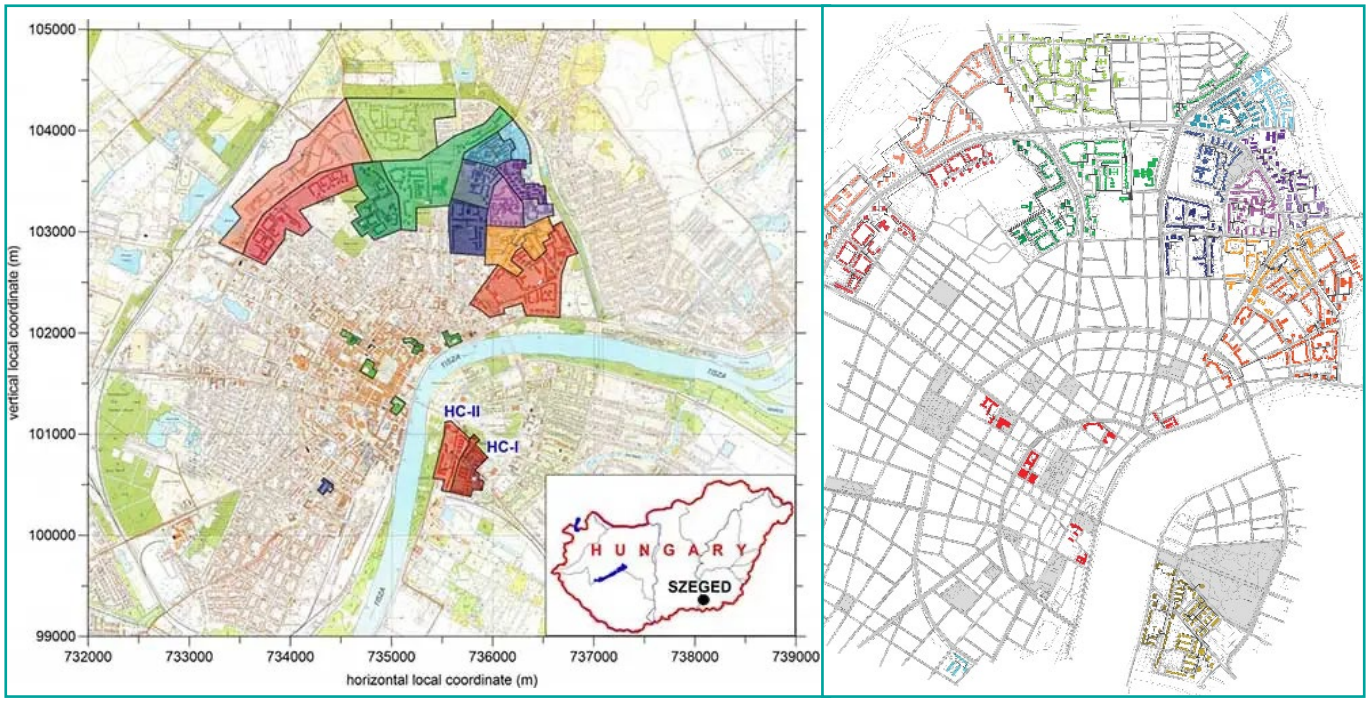


Figure 4: Szeged: geothermal energy grid [17]

Table 7: Baseline [17] [18] [48]

Indicator	Current evidence
DH customers	• About 27,000 apartments; January 2026 city reporting states that 95% receive at least part of their heat from renewable sources.
Geothermal portfolio	• nine production wells, a 27-well system architecture
Current renewable share	• About 40% of the district-heating energy mix reported after completion of Rókus II in January 2026.
Current natural gas reduction	• About 10 million m³/year relative to a pre-project average of 27-28 million m³/year.
Heat-source model	• Geothermal base/mid-load through heat exchangers, with natural gas retained for colder periods, peak demand and backup.
System status	• Retrofit completed in January 2026 • methane-separation and heat-recovery project is scheduled 03/27

The transition was initiated through municipal corporate governance:

- in 2015 a new management team at SZETÁV with a mandate to integrate renewables was appointed
- earlier geothermal schemes serving university and municipal buildings had reduced perceived technical and political risk.

By January 2026 the city reported nine geothermal systems completed, a renewable share of about 40% in district heating, partial renewable supply to 95% of roughly 27,000 DH-connected apartments, annual natural gas use reduced by about 10 million m³ from a pre-project level of 27-28 million m³, and CO_2 emissions reduced from about 55,000 t/a to roughly 35,000-40,000 t/a. [17] [18] [49]

4.1.1 Transition process & timeline

Table 8: Implementation timeline [17] [18] [19] [46] [50]

Period	Transition step	Governance/implementation significance
2011-2013	Early geothermal cascade systems for university/ municipal buildings become operational.	Demonstration reduced perceived risk and built local expertise.
2015	new expert team at SZETÁV directs renewable integration.	Political-owner decision and professional utility leadership become aligned.
2017-2018	KEHOP project packages begin; Szeged approves its SECAP in 2018.	Financing and municipal climate strategy are coupled to the investment program.
2019-2022	Urban drilling and pipeline construction proceed across the main heat circuits.	Noise, smell, traffic and siting concerns require dedicated communication and mitigation.
May 2023	European Commission marks the inauguration of the large geothermal system.	Portfolio is operational at major scale, but not every sub-project is yet closed.
Jan. 2026	Rókus II is completed and the city reports the nine-system program complete.	Best current cut-off for realised portfolio performance.
2025-2027	Methane-separation/heat-recovery equipment is procured for all nine production wells.	Next phase addresses a residual environmental and energy-efficiency issue.

Szeged did not move directly from natural gas to a city-wide geothermal program. Two earlier geothermal cascade systems serving municipal and university buildings were designed and built after a long development period and operated from the early 2010s, giving local institutions practical experience before the municipal DH conversion was scaled. [22]

In 2015 the district-heating company began formal preparation for geothermal integration. The technical literature identified reinjection into “Upper Pannonian sandstone”, interactions with existing wells and the siting of wells in dense urban areas as the principal hydrogeological and above-ground risks. [47]

The city subsequently embedded decarbonisation in its 2018 Sustainable Energy and Climate Action Plan, while the geothermal investment was split into multiple heat-circuit projects. [49] [50]

4.1.2 Technical structure

The Szeged system is a multi-circuit district-heating system built around separate boiler-house/heat-circuit areas rather than a single geothermal trunk supplying the entire city. The geothermal program therefore replicated a modular concept across selected heat circuits. The typical geothermal module comprises one production well and two reinjection wells. Thermal water is generally produced from about 1.7-2.0 km depth at around 90 °C, transported in insulated geothermal pipework to a heating plant, and separated from the district-heating water by plate heat exchangers before the cooled geothermal fluid is reinjected. At Rókus II, completed in January 2026, the production well draws roughly 80 m³/h at 93-94 °C from the 1,675-1,950 m borehole. Heat is transferred to the district-heating plant through plate heat exchangers, and the cooled fluid is returned through two approximately 1,800 m reinjection wells. [17] [22] [45] [46] [47]
Natural gas has not been eliminated. Geothermal heat can cover the demand by itself in mild conditions, while natural gas plant is required as outdoor temperatures fall and supply temperatures and peak heat demand rise. [48]
The remaining technical optimisation potential: [17] [49]

- reinjected water can still be around 40-50°C
- building insulation and heat pumps could reduce required network temperatures and increase the geothermal share
- in January 2026 SZETÁV estimated that 80-90% of former natural gas use could ultimately be displaced if building-side measures and heat pumps were implemented

4.1.3 Governance and decision makers

The core governance insight is a clear separation between public ownership/control of the DH utility and private ownership/development of the geothermal source assets. The model works through contracts and coordinates investment rather than through a single legal entity controlling the full chain from reservoir to final customer. [19] [45]
Szeged Municipality is the sole owner of SZETÁV. Current 2026 council agendas also treat SZETÁV within the group of 100%-municipally-owned companies whose annual business plans and accounts are submitted through the municipal governance process.
Szeged cannot set the complete economics of DH locally: the national price regime determines regulated heat-purchase and customer-tariff conditions, while SZETÁV's accounts are also subject to sector-specific support and profit rules overseen by MEKH. [20] [51] [52]

4.1.4 Financing & stakeholders

The investment model combined EU cohesion funding, private geothermal capital and municipal-utility investment rather than financing the entire conversion from one balance sheet.
The commercial interface is a heat-purchase relationship: SZETÁV's public-service rules list Geo Hőterm among its major suppliers. Geo Hőterm supplies geothermal heat in order to reduce natural gas use. [20] [45]
Urban drilling created direct local impacts. Resident complaints about noise, smell and construction mess, to SZETÁV were reported. The project responded with measures including noise-protection walls, site tours, public hearings, interviews and a broader Green Szeged communication campaign. [19]

4.1.5 Key challenges and lessons learned

Szeged's experience shows that renewable integration can be technically successful yet commercially curtailed by fossil-fuel contracting. Geothermal heat was temporarily subordinated to natural gas-based production because natural gas consumption fell below the contracted threshold and the utility expected an under-consumption penalty. This is an example of fossil contractual lock-in affecting dispatch. By 2024 the utility reported that where both geothermal and natural gas heat were available, geothermal utilisation had priority, although actual geothermal heat use still fell below plan because of mild weather and technical problems. [20]

- The municipality used its ownership position to change utility management direction and make renewable integration. [20] [46]
- Earlier university/municipal geothermal systems created local operating evidence before the much larger municipal DH program was launched. [22] [47]
- SZETÁV remained responsible for customers, district-heating plants and system integration, while specialised geothermal companies carried the source-side development role. [19] [45]
- The conversion was implemented through multiple heat-circuit systems with repeated production/reinjection architecture, which allowed to scale across the city's fragmented DH topology. [19] [22] [50]
- EU grants lowered geothermal capital requirements, private investment supported the source side and SZETÁV funded major plant modernisation [17] [18] [19] [50]
- The University of Szeged, InnoGeo, GEOSZ and other regional players provided geology, design, drilling and operational expertise alongside the utility's own technical team. [19] [46] [47] [48]

- The current project continues with methane recovery[1], heat-pump options, lower network temperatures and building-side efficiency rather than treating the first geothermal commissioning as the end state. [17] [49] [48]

  The central governance lesson from Szeged is the creation of a stable interface between a politically accountable municipal heat utility and specialised private geothermal asset owners. Municipal ownership anchored the public-service objective and the customer/off-take base, while private and specialist partners supplied reservoir and drilling capability. National/EU programs bodies and regulators shaped the financial envelope around both sides. [19] [20] [45] [50]

Table 9: Key challenges [18] [19] [47] [17] [49] [48] [50]

Challenge	Issue	Governance/implementation significance
Sandstone reinjection and well interaction	Reinjection was identified early as a principal technical risk.	• One production + two reinjection wells hydrogeological modelling; filtration and controlled reinjection.
Dense urbanisation	Noise, smell and construction disturbance still generated complaints.	• Multiple smaller heat-circuit projects • noise barriers and public engagement.
High-temperature DH (old system)	Building insulation and lower feed line temperatures remain important for a higher geothermal share.	• Heat exchangers and heating-plant modernisation • Retain natural gas for cold-period peak duty.
Financing / Drilling capital		• EU KEHOP grants + private geothermal investment + SZETÁV own-funded plant upgrades.
Natural gas-contract/regulatory lock-in	In 2023 a natural gas under-consumption penalty risk led SZETÁV to prioritise natural gas over geothermal temporarily.	• Operational merit order later restored to prioritise geothermal where technically possible.
Methane in thermal water	Project completion is scheduled for March 2027; outcome is not yet an operating result.	• Natural gas-separation and methane-to-heat equipment is being procured for all nine production wells.
Residual low-grade heat	Reinjection temperatures still leave additional usable heat potential.	• Consider network extension • Heat pumps and demand reduction.

1 Geothermal water from Szeged's nine production wells contains dissolved methane. A planned recovery project will separate gas and use it in district-heating boilers. Preliminary calculations indicate enough recovered energy to displace approximately 1.8 mio m³ natural gas annually, equivalent to 54,000 GJ (15,000 MWh) per year. (~6-7% of SZETÁV heat sales in 2025). The numbers are indicative, not a heat delivery. Actual contribution will depend on recovered gas volumes, boiler and network.

4.2 Helsinki

Helsinki is not a single-technology success story. Helen (local DH operator) sequenced coal retirement with wastewater and environmental heat pumps, electric boilers, biomass conversion, thermal storage, third-party waste heat, heat/cooling integration and digital network optimisation. The result is measurable: [33]

- first full year after coal exit, district-heating production emissions decreased down 56%
- reliability stayed high above 99.9%
- lower customer heat prices could be established

This system-level pathway closely matches Riga's next challenges and gives Salaspils a credible "next-stage" reference beyond solar–biomass–storage. [24] [25] [27] [29] [31] [33] [37]

4.2.1 Transition process

Helsinki's coal exit was a multi-year transition. The City Council decided in 2015 to close Hanasaari. 2021 Helen brought closure forward to 2023 as emission-allowance economics and replacement investments changed the business case. Salmisaari coal-fired production ended on 1 Apr. 2025, after replacement capacity had been developed across heat pumps, electric boilers and converted biomass capacity. Helen states that coal had still supplied 21% of its district heat in 2024. [33] [37]



Figure 5: Hanasaari electric boiler plant (left) and Eiranranta heat pump plant (right) [37]

Table 10: Timeline [33] [34] [37]

Period	Milestone	Significance
2015–2021	• City decision to close Hanasaari • Helen accelerated closure to Apr. 2023.	Sets the owner mandate while allowing the utility to sequence replacement assets and respond to carbon-price economics.
2022–2023	• Vuosaari bioenergy heating plant began heat production • Katri Vala wastewater-heat-pump expansion brought installed heating capacity to 160 MW and cooling capacity to 100 MW.	Adds dispatchable renewable heat and scales low-grade heat recovery before the final coal exit.
2025	• Salmisaari coal ends • 100 MW electric-boiler capacity and a pellet-converted boiler commissioned • industrial air–water heat pump began operation in Dec.	Provides an observed operational result rather than only a future target.
2025	• Helen reports DH-production emissions −56%, >99.9% reliability and two customer-price reductions during the first full coal-free year.	Deepens non-combustion heat and heat/cooling integration.
2026	• Helen publicly described the Eiranranta plant as using low-emission electricity and environmental heat for DH and cooling • additional waste-heat projects continue	Shows the next flexibility stage; these assets should be treated as committed/current projects, not as already demonstrated 2025 performance.
2026/27 forward pipeline	• A 200 MW Hanasaari electric-boiler plant and adjacent 1 GWh thermal storage were under construction for the 2026/27 heating season	Best current cut-off for realised portfolio performance.

4.2.2 Technical approach

Helen's published 2025 district-heating accounting classifies the heat origin as 55% renewable, 20% fossil, 19% nuclear electricity and 6% excess heat. [37]
The core engineering lesson is that new sources are integrated in one interconnected DH system rather than treated as isolated plant projects. Low-grade heat first requires temperature lift via heat pumps, while electric boilers and thermal storage create dispatch freedom between electricity and heat markets. Helen's digital-twin project digitises pipes, plants and connections and uses continuous operational data for supply/demand forecasting, bottleneck analysis and evaluation of new assets. This control layer (13,000 measuring points) becomes more valuable as marginal heat cost varies with electricity prices, recoverable heat availability and heat-pump conditions. The 200 MW Hanasaari electric-boiler development is paired with 1 GWh thermal storage, explicitly demonstrating the role of heat storage in decoupling electricity-market timing from customer heat delivery. [37]

Table 11: Heat producing devices [34] [37]

Asset / mechanism	Technical role	Evidence / status
Katri Vala heat-pump plant	Recovers low-grade heat including purified wastewater and integrates district heating with district cooling.	• After the 2023 expansion: 160 MW heating, 100 MW cooling and more than 1 TWh annual heat production.
Salmisaari electric boilers	Convert electricity into DH heat and provide fast dispatch flexibility when electricity conditions are favourable.	• Two boilers, 100 MW combined, introduced as part of the 2025 coal-replacement portfolio.
Salmisaari air–water HP	Uses ambient air and provides cooling useful outside the coldest conditions.	• 14 MW heat / 8 MW cooling, designed down to −8 °C and estimated at about 60 GWh heat plus 10 GWh cooling annually.
Vuosaari bioenergy plant	Large dispatchable renewable combustion capacity with flue-gas heat recovery.	• DH output exceeds 260 MW, with recovered flue-gas heat raising useful output.
Eiranranta HP	Environmental/low-grade heat converted to DH and cooling using low-emission electricity.	• Current 2026 portfolio asset • also received NextGenerationEU funding.
Third-party data-centre heat	Turns an external cooling load into a heat source and creates an open commercial interface to the DH network.	• Telia waste heat has entered DH since early 2023 • Helen offers both utility-invests and producer-invests/heat-purchase models.
Hanasaari electric boilers + storage	Fast e-heat plus thermal decoupling of electricity purchase from heat delivery.	• Under construction:4x 50 MW boilers and a 1 GWh thermal store • targeted for 2026/27 heating season.

4.2.3 Governance & Decision structure

Helen Ltd is fully owned by the City of Helsinki, and it operates under Finnish company law. [38] [53] The decision architecture separates political ownership from corporate and operational decision: [38] [54]

- the city provides ownership steering and shareholder governance
- the annual General Meeting elects the Board
- the board approves strategy, operating and financial plans, sustainability issues, organisation and Group financing

4.2.4 Financials & stakeholders

Helen's transition is financed through a combination of corporate cash flow/capital expenditure, debt and targeted public/EU support rather than a single grant mechanism. In 2025 Helen reported EUR 1.373 billion net sales, EUR 322 million operating cash flow and EUR 424 million gross capital expenditure. [37]

Table 15: Financing and delivery mechanisms [33] [25] [26]

Mechanism	Announcements	Transfer lesson
EIB project loan	• 2024 EIB announced a EUR 150 million loan for two Helen renewable-DH projects within total investment of EUR 209 million • 90 MW heat pump and conversion of an existing coal boiler to pellets.	A creditworthy utility can bundle technically distinct assets into transition and use long-term public-bank debt alongside its own balance sheet.
EU recovery support	• Helen states that the Eiranranta heat-pump plant received NextGenerationEU funding.	Targeted grant support can de-risk new heat-pump infrastructure without becoming the sole financing model.
Waste-heat commercial models	• For data centres, Helen offers two structures: Helen can invest in recovery and receive the heat, or the data centre can invest and Helen purchases qualifying heat.	The commercial interface can be separated from ownership of recovery equipment; this is directly relevant to Riga's third-party/residual-heat development.
Customer economics	• Helen reports that lower production costs and emissions-trading costs enabled two district-heat price reductions in 2025 while the coal transition advanced.	Affordability should be monitored as an outcome variable in the transition business case, not treated as automatically improving with decarbonisation.

The EIB environmental and social review describes the 90 MW heat-pump project as using recovered purified wastewater/cooling-return heat with an average (annual) COP (coefficient of performance) of about 2.6 and 100% renewable electricity by design (which heat output is equal to the 2.6-fold of the electrical input).
Helsinki's stakeholder model is strongly implementation-oriented: [37] [38] [54]

- the city acts as owner
- Helen as developer/operator
- wastewater and data-centre partners as heat-source counterparties
- customers as heat users
- public authorities through finance and permitting.

For EIB-financed works, environmental and social review notes that consultation is organised by competent authorities when required by permitting, while Helen maintains in-house environmental/social capacity and ISO 14001/45001 management systems. [55]
Data-centre heat recovery provides a particularly transferable engagement mechanism because Helen publishes alternative asset-ownership models rather than requiring every external heat provider to become a utility. Either Helen invests in heat recovery, or the provider invests and sells qualifying heat. [37]

4.2.5 Challenges & lessons learned

Table 12: Challenges [33] [37] [34] [55]

Latvian context	Helsinki lesson	Transfer condition
Riga — 49 MW electrode boiler	• Develop e-boilers as part of a dispatch/storage strategy, not as stand-alone capacity • Helsinki has 100 MW operating capacity and a 200 MW announced	Fit to Riga's load and grid connection. Economics depend on electricity prices, tariffs, network constraints and storage. Define KPIs (€/MWh, peak displacement tCO2/MWh..)
Riga — wastewater and residual-heat pilots	• Use large-HP engineering plus explicit external-heat commercial models • Helsinki combines wastewater heat with data-centre heat purchase/recovery structures.	Latvian projects need source-temperature/availability profiles, connection hydraulics, contract allocation and local electricity/network studies before investment.
Riga — daily heat market / 52% purchased heat	• Treat independent heat as a dispatchable commercial interface and optimise it together with utility generation.	Market rules must preserve reliability, transparent metering and the utility's ability to meet peak/security obligations.
Riga — 12.49% network loss and major rehabilitation	• Couple new heat sources with network data, pipe renewal and digital optimisation so low-carbon generation is not undermined by avoidable distribution loss	Generation and network capex should be sequenced in one investment plan; Helsinki's plant sizes are not directly transferable.
Riga — biomass-heavy own generation	• Use biomass as one portfolio element while progressively adding non-combustion heat and flexibility; Helsinki's longer trajectory targets combustion phase-out by 2040.	Latvia's local biomass economics differ; sustainability and security values need explicit local modelling rather than assuming Helsinki's fuel hierarchy.

Latvian context	Helsinki lesson	Transfer condition
Salaspils — solar + biomass + 8,000 m³ storage	Next learning: heat pumps, waste heat and optimisation layered onto an already mature renewable-storage base.	Scale assets to a ~35 MW system and retain the operational value of the existing accumulator.
Smaller Latvian municipalities	Transfer the sequence—load/network data → low-grade heat mapping → heat-pumps-heat feasibility → storage/control → finance—rather than Helsinki's MW scale.	Small systems need lower transaction cost, simple governance and modular procurement; site-specific heat demand and electricity capacity are gating inputs.

Helsinki's central lesson for Latvia is the managed conversion of a large legacy heat system from fuel-centric production toward a flexible heat platform: [37] [34] [38] [53] [54] [55]

- low-grade heat recovery
- electrification
- storage
- third-party heat
- digital optimisation
- clear owner–Board–management

The strongest direct match is Riga, whose current program already contains the corresponding building blocks:

- electric boiler
- wastewater/residual-heat development
- independent heat procurement
- network rehabilitation
- 4GDH planning

but at an earlier integration stage. [24] [25] [26] [32]
Salaspils represents the complementary smaller-city application. Its solar–biomass–storage base is already mature, so Helsinki is useful primarily for the next step toward heat pumps, external waste heat and higher-value system optimisation. [27]

5. Comparative Assessment

The transfer aim is to understand the implementation sequence and allocation of risk, not the copy-paste of the plant size. [1] [3] [25] [26] [31] [33] [55]

- Szeged is most relevant to Bucharest for modular geothermal integration and the public-off-taker/ private-source interface.
- Helsinki is most relevant to Riga for coordinated electrification, waste heat, storage, digital control and network investment.
- Bucharest's task is front-end de-risking. This means proof of the resource at a suitable node and establish the source-to-utility contract before scaling.
- Riga's task is system integration: combine assets already planned or under construction into one network.

5.1 Romania

Szeged demonstrates how geothermal energy can be integrated incrementally into an existing natural gas-based district-heating system. Instead of constructing one central geothermal plant for the entire city, the municipality implemented a series of modular geothermal systems serving individual heating circuits. By January 2026, nine systems were operating, geothermal energy supplied approximately 40% of district heat, and annual natural-gas consumption had fallen by around 10 million m³. Natural gas-fired capacity remains available for peak demand and backup. A particularly relevant lesson is the division of responsibilities. The municipally owned SZETÁV retains responsibility for the district-heating network, heating plants and customers, while specialised private companies developed and operate geothermal production and reinjection assets. Geothermal heat is purchased by the municipal utility under contractual arrangements. Investment was divided between EU-supported projects, private source-side investment and utility-financed plant modernisation.

Bucharest is considerably larger and institutionally more complex. Heat production, distribution and investment responsibilities are divided among Termoenergetica, ELCEN and other producers. Geothermal projects remain at feasibility or development stage rather than supplying proven operating heat. [1] [3]

The transferable lesson is therefore the implementation sequence rather than Szeged's technology scale. Bucharest should first:

- verify the geothermal resource and select a network node with stable baseload
- establish source ownership, heat-purchase conditions, dispatch priority and geological-risk allocation
- wells, reinjection, heat exchangers, plant conversion and associated network should be prepared as one functional package.
- replication should follow only after a demonstrator has completed at least one heating season.

Table 19: Comparative assessment Bucharest – Szeged [1] [3]

Issue	Szeged	Transfer to Bucharest
Starting point	Szeged converted a natural gas-based, multi-circuit DH system through nine geothermal systems. By Jan. 2026 geothermal supplied about 40% of DH heat and reduced annual natural gas use by about 10 million m³.	Bucharest is roughly twenty times larger by connected users (~530,000): Its geothermal initiatives remain at feasibility/development stage, not operating performance.
Technical model	Szeged replicated modular well groups across selected heat circuits, transferring heat through exchangers and retaining natural gas for peaks and backup. Reinjection and plant-side retrofit were integral to the solution.	Bucharest should begin with verified resource data and one suitable network/ production node, then test reservoir performance, reinjection, exchanger integration, network temperature and peak-duty requirements before city-wide scaling.
Governance / market	The municipality owns SZETÁV, while specialised private partners developed source-side assets and sold geothermal heat into the municipal system contracts joined the reservoir and customer sides.	Because Termoenergetica distributes/ supplies heat and ELCEN plus other entities produce it, Bucharest must define source ownership, off-take, dispatch priority, price setting and geological/performance risk before investment.
Finance / delivery	EU cohesion support, private geothermal investment and SZETÁV-funded plant modernisation were implemented in modules rather than as one city-wide package.	Bucharest should stage finance by risk: exploration and demonstration first; source/ network-node integration second; replication only after measured seasonal performance. Funding should align geothermal works with the ongoing network-modernisation program

5.2 Latvia

Helsinki demonstrates the transition from fuel-centred heat production towards a flexible, multi-source district-heating platform. Following the elimination of coal, Helen reported: [33] [55]

- 56% reduction in district-heating production emissions
- reliability above 99.9%
- lower customer heat prices during the first full coal-free year

The transition combines: [33] [55]

- wastewater and environmental heat pumps
- electric boilers
- third-party data-centre heat
- thermal storage
- digital network optimisation.

The main lesson is that these technologies are planned and operated as parts of one system. Electric boilers respond to electricity-market conditions, heat pumps upgrade low-temperature environmental and waste heat, thermal storage separates the timing of electricity consumption from heat delivery, and the digital twin supports dispatch and network optimisation. Helen also offers different commercial arrangements for external heat suppliers. Either Helen invests in the recovery equipment, or the external company invests and sells qualifying heat to the district-heating system. [33]

Riga already possesses several building blocks for a similar transition. These include a 49 MW electrode boiler, wastewater and data-centre residual-heat initiatives, independent heat producers and a major network-modernisation program. [25] [26] [31]

Riga therefore should integrate its planned investments through one fourth-generation district-heating network. Priorities are to develop dispatch and storage rules for the electrode boiler, conclude bankable residual-heat contracts, connect new heat sources to network data and digital control, and coordinate source investments with pipe rehabilitation and temperature optimisation. Helsinki's plant sizes should not be copied directly. The transferable elements are its portfolio logic, contractual interfaces, financing approach and system-wide operational coordination. [25] [26] [32] [33] [55]

Table 20: Comparative assessment Riga – Helsinki [25] [26] [32] [33] [55]

Issue	Helsinki	Transfer to Riga
Starting point	After ending coal use, Helen reported a 56% fall in DH-production emissions, reliability above 99.9% and lower heat prices in the first full coal-free year.	Riga already has a biomass-heavy transition base, a 49 MW electrode boiler and major network renewal own production still uses ~30% natural gas and system losses were 12.49% in FY2024/25.
Technical model	Helsinki combines wastewater/ environmental heat pumps, electric boilers, third-party data-centre heat, thermal storage and a digital twin across one dispatchable heat platform.	Riga should connect its electrode boiler, wastewater/residual-heat projects, storage options and network data in one dispatch model; the boiler should be treated as a flexibility asset, not isolated capacity.
Governance / market	City ownership provides direction while Helen's Board and management execute investments and contract with external heat providers through defined recovery-investment or heat-purchase models.	Rīgas Siltums already purchases a large share of network heat and operates in a multi-owner setting. Its next need is a single 4GDH delivery plan with standard technical/ commercial rules for residual-heat suppliers.
Finance / delivery	Helen combined corporate capital expenditure with an EIB loan of EUR 150 million for a EUR 209 million renewable-DH package and targeted EU support.	The EIB has signed EUR 47 million toward Riga's approximately EUR 135 million DH rehabilitation/extension. Future source, storage, digital and network investments should be bundled around operational outcomes, not prepared as disconnected projects.

5.3 Transferability matrix

The matrix classifies the transfer pathway by municipal cluster and stage. "Immediate" means that preparation or operational optimisation can start with existing assets; "pilot" requires site-specific feasibility and a demonstrator. "Long term" requires major network or market restructuring. [1] [3] [24] [25] [20] [37]

Table 23: Consolidated cluster transferability matrix [1] [3] [24] [25] [20] [37]

Target cluster	Transfer pathway	Stage	Conditions and principal barrier
Romania A – Oradea/Beiuș	Lower return temperatures; heat-pump boosting; reinjection and dispatch optimisation	Immediate / pilot	• Measured hydraulics and reservoir response • barrier: reinjection and water chemistry
Romania B – Bucharest/ Timișoara	One modular geothermal node with a municipal off-taker and specialist source developer	Pilot	• Verified resource, stable base load, heat-purchase and risk allocation • barrier: fragmented governance and exploration risk
Romania C – fossil transition	Heat balance, network renewal, source screening and staged replacement	Immediate	• demand and integrated investment plan; barrier: fossil lock-in and limited capacity
Romania D – re-establishment	Demand aggregation and service-model feasibility before source selection	long term	• Active project owner and heat-density case; • barrier: no verified operating SACET
Latvia A – Salaspils	Predictive storage control followed by a right-sized heat-pump or residual-heat pilot	Immediate / pilot	• Source profile, grid study and use of existing accumulator • barrier: weak incentive to diversify from biomass
Latvia B – Riga	Integrated dispatch of electrode boiler, purchased heat, residual heat, storage and renewed network	Immediate / pilot	• Common data model and commercial rules for external heat; barrier: portfolio and stakeholder coordination
Latvia C/D – smaller or resource-led systems	Modular heat-source and low-temperature feasibility sequence	Screening / pilot	• Local demand, electricity capacity and bankable source evidence • barrier: transaction cost and resource uncertainty

The comparison therefore supports two different priorities: front-end risk reduction in Romania and integrated system operation in Latvia. Szeged's plant sizes and Helsinki's asset portfolio should not be copied. Their transferable value lies in sequencing, interfaces, measurement and accountable decision rights.

6. Task 4 – Practical Recommendations

Decision rule:

1. optimise and measure first
2. prepare source, network and building-side measures as one functional package
3. scale only after at least one heating season of demonstrates satisfactory performance against the agreed criteria

This section converts the findings of Tasks 1–3 into actions for municipalities at different transition stages, as required by the ToR. It covers the five requested dimensions explicitly: renewable integration pathways, strategic planning, governance, financing opportunities and stakeholder engagement. For municipalities above 45,000 inhabitants, the recommended municipal transition plan should also serve as the local heating and cooling plan required by Article 25(6) of the recast Energy Efficiency Directive. The plan must map efficiency, low-temperature readiness, renewable and waste-heat potential; involve infrastructure operators and the public; assess energy communities and vulnerable households; identify finance; and define an implementation trajectory. [56]

6.1 Strategic planning: six municipal decision gates for DH operators

Tasks 1–3 point to a clear sequence: measure demand and losses, optimise existing operations, compare complete source–network–building options, agree contracts and finance, then test a pilot before scaling. Szeged shows why geothermal wells need plant conversion and workable heat-purchase terms. Helsinki shows why heat pumps, electric boilers, recovered heat and storage need coordinated dispatch. The municipality sets service and affordability goals, while the DH operator leads system data and pilot integration. Bucharest must first resolve resource, reinjection and off-take risks. Riga must coordinate its heat sources with network renewal. Where no DH system operates, verify demand and an operator model before applying the six gates.

1. Name a **data owner**. Establish an hourly or daily **heat balance** covering produced and purchased heat, delivered heat, fuel, electricity, temperatures, flows, outages and normalised demand.
2. Correct metering, control valves, bypasses, pump set-points, hydraulic imbalance, visible leaks and damaged insulation before sizing new production. Publish a first-heating-season **KPI baseline**.
3. **Map** geothermal **resources**, wastewater, data centres, industry, surface/ground sources and available electricity capacity. Separate theoretical, technical, economic and contractible potential; open-data screening is not an investment decision. [3] [4] [57]
4. Compare **whole-system packages**, not stand-alone technologies. Each package combines source, network temperatures, storage, building/substation measures, backup, electricity-grid effects, emissions, customer price and lifecycle cost. Test the trajectory against the evolving efficient-DHC criteria in Article 26. [56]
5. **Fix ownership**, heat-purchase or service contract, dispatch priority, metering, performance guarantees, termination rights, permitting, environmental risk and finance **before procurement.** [19] [58]
6. **Operate the pilot through a complete heating season**, verify seasonal efficiency, availability, losses, price and comfort, and replicate only the elements that meet the pre-agreed thresholds.

6.2 Renewable integration pathways

The tables below make the cluster (not technology) unit of recommendation. “Immediate” means that preparation or operational work can start with existing authority and assets; “pilot” requires site-specific feasibility and a demonstrator; “scale” requires measured performance and a bankable delivery model.

Table 14: Renewable integration pathway for Romania [1] [3] [4] [19] [56]

Table 15: Renewable integration pathway for Latvia [26] [27] [30] [31] [56] [59] [60] [58] [61]

Cluster / municipalities	0–12 months	1–10 year pathway	Gate and KPI
A. **Advanced geothermal Oradea/Sânmartin; Beiuș**	Immediate: combine network heat balance with well-production, reinjection, pressure, temperature and water-chemistry monitoring; rank high-return substations and optimise geothermal dispatch.	Pilot/scale: heat-pump boosting where temperature lift is justified; modular source expansion; lower-temperature zones and targeted pipe renewal; retain natural gas only for defined peak/security duty during transition.	Go only if reservoir response, reinjection route, scaling/corrosion control and off-take remain acceptable over a full season. Track geothermal share, return temperature, pumping energy and reservoir indicators.
B. **Large DH modernisation Bucharest; Timișoara**	Immediate: choose one or two hydraulically bounded zones with stable baseload; create a joint owner–producer–network data room; screen geothermal and urban excess heat together with necessary network works.	Pilot/scale: procure one functional source–plant–network package. Bucharest should define source ownership, a municipal heat off-taker, dispatch priority and exploration-risk allocation before drilling, then replicate proven modules.	Stop if the resource, reinjection, node duty, heat-purchase terms or institutional decision rights remain unresolved. Szeged is transferable mainly as a staged split-asset/off-take model, not as a size template.
C. **Active fossil-DH transition Craiova; Râmnicu Vâlcea; wider screening**	Immediate: verify retained demand, losses and plant efficiency; prepare a renewal ranking by failure risk × loss × customers affected; screen geothermal, large heat pumps and contractible waste heat before replacing fossil capacity.	Pilot/scale: phase source replacement with pipe/substation renewal and building renovation. Avoid a new long-lived fossil baseload commitment that would crowd out later renewable heat.	Investment decision requires an integrated least-cost plan, consumer-retention scenario and credible operator capacity. Track fossil heat, network losses, outages, connections and heat price.
D. **Just transition / DH re-establishment Petroșani; Rovinari; Turceni**	Immediate: do not start with technology selection. Establish a project owner, heat-density map, anchor customers, connection commitments, affordability boundary and alternative service models.	Pilot/scale: only after demand is demonstrated, test a compact shared system around public/industrial anchors—potentially waste heat, a local low-temperature loop, heat pumps or geothermal where bankable resource evidence exists.	Proceed only with a viable service territory, customer commitment, operator model and source evidence. Otherwise prioritise building-level solutions outside a DH investment.

Cluster / municipalities	0–12 months	1–10 year pathway	Gate and KPI
A. **Advanced renewable/flexible DH** **Salaspils**	Immediate: optimise accumulator charging, biomass cycling, return temperature and customer substations with forecast data; screen flue-gas condensation and low-grade heat sources.	Pilot/scale: add a right-sized heat pump or contractible residual-heat source; use storage to shift electricity demand and reduce marginal biomass/natural gas operation; evaluate heat–cooling synergies where there is an anchor cooling load.	Go if the source profile, temperature lift, grid capacity and storage interaction improve whole-system cost and emissions. Use seasonal COP, biomass input/MWh, return temperature and peak-fuel hours.
B. **Large hybrid 4GDH transition** **Riga**	Immediate: create one dispatch baseline for the electrode boiler, purchased heat, own production, storage and network constraints; standardise the intake screen and term sheet for wastewater/data-centre/ industrial heat.	Pilot/scale: integrate electric boiler, large heat pumps, residual heat, storage and pipe renewal through common forecasting, dispatch and investment governance. Couple source projects to the EIB-supported network programme.	Do not add major electric capacity without a grid, price, storage, peak-security and emissions assessment; do not buy excess heat without temperature, volume, outage, metering and termination clauses. [62]
C. **Biomass-led smaller systems** **Municipalities to validate**	Immediate: improve combustion and load control, O₂/CO monitoring, buffer use, return temperature, network densification and customer service; report sustainable feedstock and fuel quality.	Pilot/scale: diversify with small power-to-heat plus storage, a source-matched heat pump, solar heat or recovered heat. Where conditions suit, absorption-assisted flue-gas condensation can be screened before building new combustion capacity.	The AbSolut study reports site-dependent 20–30% fuel-utilisation gains and 15–25% fuel-cost savings for absorption heat-pump flue-gas recovery; treat these as screening ranges, not guarantees.
D. **Local resource opportunity** **Nīca / south-west Latvia**	Immediate: update heat demand and temperature requirements; verify modern subsurface evidence, well concept, brine/reinjection management, environmental permitting and anchor loads.	Pilot/scale: advance only a modular demonstrator with explicit exploration stage gates and a fallback service concept; coordinate any new low-temperature loop with building readiness.	No construction decision without bankable resource, brine-management, demand and ownership evidence. If these fail, stop the DH concept rather than forcing an unsuitable technology.

6.3 Quick shots for the first season

Quick wins should be reversible, measurable within one heating season and useful even if the long-term source changes. They are not promises of universal payback. The utility should approve the baseline and measurement method before implementation. [63]
Most measures in the following table apply to operating DH systems (Romanian A–C and Latvian A–C). For Romanian Cluster D, and Latvian resource-screening locations without a confirmed viable network, the first-season actions are demand preparation and building efficiency, not network tuning.

Table 16: Quick shot list [58] [57]

Measure	What is done	Accountable lead	12-month evidence
Heat balance and KPI baseline	Meter production/purchases, deliveries, fuel, electricity, temperatures, flows and outages; normalise demand for weather.	Utility data owner	Unallocated heat < agreed data tolerance; monthly loss, fossil-share and outage dashboard.
Return-temperature campaign	Rank high-volume/high-return substations; correct sensors, control valves, bypasses, hydraulic balance and domestic-hot-water settings.	Network + building owners	Lower flow/return temperature without comfort or hygiene failure; pumping kWh/MWh decreases.
Pump, valve and dispatch tuning	Review differential-pressure set-points, variable-speed drives, storage limits, boiler cycling and renewable dispatch priority.	Operations manager	Fuel and pump electricity fall at comparable weather/load; peak/backup availability retained.
Leak and insulation sprint	Repair visible leaks, wet/damaged insulation and priority valve chambers; align the renewal list with failure and customer-impact data.	Asset manager	Water make-up, emergency work and affected-customer minutes decline.
Contract lock-in review	Identify take-or-pay, minimum natural gas purchase, under-consumption penalties and purchased-heat rules that can displace lower-carbon heat.	CFO + legal + dispatcher	Revised contract/dispatch rule or documented mitigation before new source commissioning.
Excess-heat source atlas	Record location, temperature, flow, operating hours, distance, reliability and ownership; validate shortlisted sources locally.	Municipality + utility	At least one source reaches a signed data-sharing agreement and pre-feasibility screen.
Customer retention and feedback	Train building managers; publish outage, complaint and connection data; offer a substation correction pathway and clear contact point.	Municipality + customer service	Complaint closure time and avoidable disconnections improve; vulnerable customers are included.

Qiuck wins without operating DH: For Petroșani, Rovinari and Turceni, the municipality should appoint one coordinator and use existing public-building energy bills to map anchor demand and current heating equipment.

- speak with building owners about connection interest
- record interest separately from binding commitments

Municipal facilities teams can correct heating schedules, faulty thermostats, hydraulic imbalance, exposed pipe insulation and basic maintenance in occupied buildings, while documenting weather-adjusted energy use and comfort. Obtain grid-connection information and compare a shared heat-pump scheme with building-level renovation and heat pumps before commissioning detailed design. These are proposed actions, not claims that such programmes already operate.
For Nīca or other Latvian resource-screening locations, first confirm the existing heat-service baseline, anchor buildings and source-data access. Use the same building-level checks where applicable; do not describe exploration drilling or construction of a new network as a low-cost quick win. The output should be a short demand-and-service options brief with an accountable owner, affordability criteria and a stop/go decision.

6.4 Long-term system packages

Network and temperature:

Renew pipes by lifecycle priority rather than age alone. Coordinate excavation with source and building works. Specify factory-made pre-insulated twin pipes as an option for suitable new branches and medium-diameter replacement sections, but compare them with separate pipes at the actual diameter, route, soil, repair strategy and lifecycle cost. Lower network temperatures by zones, after checking emitters, domestic hot water and the worst-performing buildings. Twin-pipe examples can reduce losses relative to single pipes, but route-specific design remains decisive. [56] [64]

Sources, storage and electricity:

Treat heat pumps, electric boilers and thermal storage as a portfolio. Size heat pumps from measured source temperature/availability and required lift. Size electric boilers against grid capacity, market access, storage and peak-security duty. Thermal storage separates the time of electricity purchase from heat delivery and can reduce cycling, but its value must be demonstrated in the dispatch model. [59] [63] [65]

Geothermal risk sequence:

For Romania, use independent gates for data access, resource model, exploration drilling, production test, reinjection test, chemistry/material selection and full-season operation. Package wells, heat exchangers, heat-pump boosting, network connection and backup as one functional system. Agree who funds exploration and bears unsuccessful-well risk before seeking construction debt; a public risk-sharing instrument may be explored where one is actually available. [4]

Controls and digital twin: Use a four-layer hierarchy:

1. reliable meters and asset data
2. safe rule-based weather/pressure/storage control
3. demand/price/source forecasting and model-predictive control
4. thermo-hydraulic digital twin.

A digital twin should not precede a stable meter and asset model. Helen's 2026 report describes its network twin as under validation and partially in use, supporting supply-temperature reduction and production planning—an appropriate sequence for Riga rather than a turnkey software purchase. [66] [63] [65]

Business models:

Use a specialist source company plus municipal utility off taker for geothermal or independent recovered heat. Offer utility-financed and supplier-financed connection options and use ESCO/performance contracts for substations, controls and shared heat pumps where savings are measurable. Every heat-intake contract should allocate source availability, temperature, volume, outages, backup, ownership, metering, dispatch, change-in-demand and termination risk. Szeged and Helen show complementary forms of these interfaces. [19] [58] [67]

6.5 Governance, financing and stakeholder engagement

Governance:

Create a municipal heat-transition board chaired by the responsible elected municipal representative and managed by one program director. It should include the DH operator, heat producers, electricity DSO/TSO interface, permitting/environment authority, finance/procurement, social-housing or building representatives and major source owners. Publish a matrix for strategy, data, resource risk, assets, dispatch, tariffs, customer protection and emergency supply. Ambient/anergy networks require especially clear system boundaries because heat can flow bidirectionally and ownership is distributed. [56] [68] [69] [70]

Financing: Match finance to risk: [31] [71] [72]

1. The Modernisation Fund can support renewable generation/use, efficiency, storage, DH networks and just-transition investments in both Romania and Latvia
2. Municipalities must verify the current national call and eligibility at submission rather than treating an announcement as an open opportunity.
3. Riga's EIB project is a useful precedent for a multi-year network program.

One preparation instrument to screen is EIB–European Commission ELENA. It can cover up to 90% of eligible preparation costs and supports district-heating investment programmes; its energy-efficiency window targets programmes above EUR 30 million over three years. It is technical-assistance support, not a grant for building the heat plant or funding an unsuccessful exploration well. Smaller municipalities should assess aggregation with a regional partner. Application and approval remain necessary. (https://www.eib.org/en/products/advisory-services/elena/index)

Illustrative Bucharest pilot (Cluster B):

the municipality, heat distributor and relevant producer jointly select one node and fund a pre-feasibility package. A specialist developer carries or explicitly shares exploration risk; the municipal buyer agrees only conditional heat-purchase terms until production and reinjection tests succeed. Eligible capital support, sponsor equity and debt are then assembled for wells, plant integration and the network interface. This is a recommended financing sequence, not a confirmed funding award. For Riga (Latvian B), the immediate equivalent is to prepare one contracted waste-heat/heat-pump integration package alongside the existing network loan programme, with source availability, grid access and dispatch established before capital commitment. [3], [17], [29]

Table 17: Financing by development stage

Stage	Financing / risk allocation to seek	Decision before advancing
Resource assessment / exploration	Municipal or developer development budget; eligible technical-assistance grants; explicitly negotiated public/developer risk sharing for drilling.	Independent resource model, test programme and allocation of dry-well/reinjection failure risk.
Feasibility / project preparation	Preparation grants and sponsor equity for demand, technical, environmental, financial and procurement work. Aggregate smaller schemes where appropriate.	Costed options, credible heat buyer, permissions path, customer affordability and funding eligibility.
Pilot / demonstration	Eligible demonstration or investment grant combined with sponsor equity and, only where bankable, debt; performance guarantees allocate equipment risk.	Defined operating boundary, baseline, acceptance tests and seasonal verification.
Full investment / replication	Utility cash flow/equity and long-term loans; eligible investment grants reduce capital burden but do not replace a viable operating model.	Verified demand/resource, signed contracts, permits, debt-service capacity and an affordable tariff pathway.

Stakeholders: Use three formal engagement gates:

1. validate the problem, service boundary and affordability criteria
2. compare the short list of system packages, including disruption and tariff effects
3. agree the preferred package, customer protections and monitoring dashboard before procurement.

Publish assumptions and minutes, include tenant and vulnerable-household representation, and give waste-heat suppliers/building owners a structured route to provide data. Article 25 explicitly links local heat planning to public participation, infrastructure operators, energy communities and vulnerable households. [56]

6.6 Energy communities and household heat pumps

Energy communities can organise shared renewable electricity, storage and—where national rules and heat-market responsibilities permit—shared thermal assets. The EU framework gives renewable energy communities rights to produce, consume, store, sell and share renewable energy, but heat supply, customer protection and network operation remain subject to the relevant national and sector rules. Romania established the national energy-community register and electricity-market/storage participation rules through ANRE Orders 50/2026 and 9/2026. Latvia's Regulation No. 808 covers registration and relationships with energy suppliers, including heat-system operators. [73] [68] [74]

Pilot 1 — DH-connected apartment or public building community:

Use shared PV, one central heat pump, a hot-water buffer and smart controls. Keep DH as peak/backup during the pilot. Meter heat-pump electricity, thermal output, return temperature, comfort and cost allocation and define whether the community owns the equipment or buys heat-as-a-service.

Pilot 2 — Ambient/energy quarter:

For a new or comprehensively redeveloped area that is unsuitable for conventional high-temperature DH, evaluate a low-temperature shared loop with building-level heat pumps, seasonal ground storage and possible bidirectional heating/cooling. Proceed only after spatial mapping, seasonal source balance, public-space rights, lifecycle cost and ownership are settled. [69] [70]

Pilot 3 — Coordinated household heat pumps outside viable DH areas:

Prioritise detached or low-density areas, failed-DH territories, or defined low-temperature extensions. Do not subsidise uncoordinated apartment-by-apartment disconnection from a dense and viable DH system. It can strand network costs and weaken the remaining customer base. Every pilot needs an emitter/temperature check, grid study, domestic-hot-water concept, acoustic siting, maintenance responsibility, seasonal performance measurement, backup and a tariff that avoids double payment.

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8. Pictures & Tables

Figure 1: Estimated heat flow (left) and subsurface temperature at 3000m depth (right) [3]

Figure 2: District heat network (left) and heat demand density (right) in Bucharest [13] [12]

Figure 3: Gross renewable share in heating; Romania (blue), Latvia (orange) and EU27 (green) [14]

Figure 4: Szeged: geothermal energy grid [17]

Figure 5: Hanasaari electric boiler plant (left) and Eiranranta heat pump plant (right) [37]

Table 1: Strongest geothermal supplied sources [1] [2] [3] [4] [7] [8] [6]

Table 2: District heat baseline and selection criteria for an European best practice for Latvia [21] [23] [24] [25] [26] [8]

Table 3: Clustering for Latvia [21] [23] [26] [25] [24] [32] [27] [28] [29] [30]

Table 4: Overview of the district heat in Riga [24] [25] [26] [32]

Table 5: Overview of district heating in Salaspils [32] [27]

Table 6: European case screening [35] [33] [34] [36] [39] [40]

Table 7: Baseline [17] [18] [48]

Table 8: Implementation timeline [17] [18] [19] [46] [50]

Table 9: Key challenges [18] [19] [47] [17] [49] [48] [50]

Table 10: Timeline [33] [34] [37]

Table 11: Heat producing devices [34] [37]

Table 12: Challenges [33] [37] [34] [55]

Table 13: Transferability [37] [24] [26] [25] [29] [55]

Table 14: Renewable integration pathway for Romania [1] [3] [4] [19] [56]

Table 15: Renewable integration pathway for Latvia [26] [27] [30] [31] [56] [59] [60] [58] [61]

Table 17: Quick shot list [58] [57]

Table 18: Financing by development stage

9. Annex A – Romania

Typology Clusters [1] [2] [3] [4] [7] [6]

Refined cluster	Indicative municipalities	Evidence-based definition	Decision question
A. **Advanced geothermal DH**	Oradea/Sânmartin; Beiuș	Operating geothermal integration with optimisation/ scale-up questions rather than first adoption.	How to deepen geothermal share, integrate heat pumps, manage reinjection, modernise networks and retain/reconnect consumers.
B. **Large DH modernisation + renewable integration**	Bucharest; Timișoara	Large operating systems with major customer bases and modernisation needs; geothermal is emerging or under consideration rather than mature at system scale.	How to integrate a new renewable baseload source into a large legacy network while coordinating multiple institutions.
C. **Operating fossil-DH structural transition**	Craiova; Râmnicu Vâlcea; potentially Constanța for broader regional screening	Current SACET operation is confirmed by ANRE; the decarbonisation problem is replacement/modernisation rather than creation of a new heat service.	How to sequence network rehabilitation, heat-source replacement and consumer retention without locking in another long-lived fossil pathway.
D. **Just transition / DH re-establishment / geothermal opportunity**	Petroșani; Rovinari; Turceni; selected western/southern municipalities without active SACET	The three named coal-region municipalities are absent from ANRE's 2025 active-SACET list even though the profiling identifies energy-transition and geothermal leads.	First establish the service model, heat-density case, resource quality, governance and demand aggregation before applying lessons from an operating DH system.

Relevant municipalities for screening [1] [2] [4] [7] [8] [75]

Municipality / area	Evidence	Task 1 interpretation
Lovrin	ANRE reports an active SACET serving 81 dwellings in 2025; the 2019 WEBER assessment documented 75 °C geothermal water, direct use and severe mineral-deposition/scaling issues.	Small-system cautionary/replication case; useful for water chemistry, heat-exchanger and network-design lessons.
Constanța	ANRE reports an active system serving 26,424 dwellings in 2025 and records rehabilitation of primary/secondary networks and metering works during the year.	Black Sea-region modernisation case; keep geothermal as a screening question until modern subsurface evidence supports a municipal project.
Sântana / Pecica	A 2023 Bundesverband Geothermie report describes public-building geothermal initiatives in Sântana and Pecica; this is secondary project reporting rather than evidence of a mature urban DH transition.	Western small-municipality replication lead; lower priority than Oradea/Beiuș for Task 1.

10. Annex B – Szeged

Decision structure [19] [20] [45] [22] [17] [48] [18] [50] [76] [77] [51] [52]

Actor	Formal position	Decision/asset control	Task 2 interpretation
City of Szeged / General Assembly	100% municipal owner of SZETÁV.	Owner strategy, appointment/ oversight, annual business-plan control.	Sets political mandate and owner expectations; does not run wells day to day.
SZETÁV	Municipally owned DH utility and customer-facing service company.	Operates DH plants/network interface, buys geothermal heat and supplies end users.	System integrator and heat off-taker.
Geo Hőterm Kft.	Private geothermal project/investment company and heat supplier.	Production/injection installations; current well-side development and operation.	Carries geothermal-source delivery role and supplies heat into SZETÁV.
NFP / national ministry program bodies	State implementation/ funding partner in the KEHOP program.	Historic public procurement, program administration and project communication roles.	Bridged EU funding rules and local/private implementation.
MEKH + national energy ministry	National sector regulator and tariff framework.	Licensing, regulated heat-price/support framework and oversight of licensed returns.	Local decarbonisation economics remain exposed to national regulation.
University / InnoGeo / GEOSZ / contractors	Technical knowledge and delivery ecosystem.	Geology, design, drilling, research, operating know-how and advisory support.	Local competence reduced dependence on a single external adviser.
Residents / institutions	Heat users and affected communities.	No corporate control, but building retrofits and project acceptance affect achievable renewable share.	Participation is operationally relevant, not merely communications.

Decision Makers [19] [20] [45] [46] [17] [48] [76] [77] [51] [52] [78] [20] [76] [79] [80]

Person / institution	Current role	Responsibility
Dr. Balázs Kóbor - SZETÁV	Managing Director / CEO	owner-utility relations; heat-purchase model; financing and regulation.
Dr. Gábor Bozsó - SZETÁV	Technical Manager	Plant retrofit, dispatch, realised geothermal share, natural gas backup, technical constraints and next-step heat pumps.
Dr. Tamás Medgyes - SZETÁV	Operations Director / CEO's general deputy	Operating model, project-development process, contracts, procurement and internal coordination.
Tamás Péter - Geo Hőterm	Managing Director	
City of Szeged - owner side	Mayor Dr. László Botka; Dr. Tamás Kovács is Economic Deputy Mayor	Political mandate, corporate-owner decisions, business-plan approval and long-term heat strategy.
MEKH / national ministry	Regulatory and tariff-setting institutions	How heat-purchase price, consumer tariff, subsidy and natural gas obligations interact with geothermal dispatch.

Financial Numbers – not validated

At individual project level, Geo Hőterm's official KEHOP page for Rókus records HUF 1.806 billion total (~5 M€) cost and HUF 1.084 billion support (~3 M€). [50]
The municipal utility also invested directly: the January 2026 completion report states that SZETÁV spent roughly HUF 5-6 billion (~16 M€) of its own resources over eight years modernising heating plants so they could use geothermal heat efficiently. [17]
Public aggregate figures are not fully harmonised. The EU Covenant of Mayors page reports an EUR 80 million geothermal budget financed 40% by ERDF and 60% private investment, while the Commission states EUR 23 million of EU investment and individual KEHOP project pages state 60% support. These figures appear to use different project scopes and denominators, so they should not be combined into a single financing ratio without project-level reconciliation. [18] [49] [50]
The commercial interface is a heat-purchase relationship: SZETÁV's public-service rules list Geo Hőterm among its major suppliers. Geo Hőterm supplies geothermal heat in order to reduce natural gas use. [20] [45]
Urban drilling created direct local impacts. CROWDTHERMAL recorded resident complaints about noise, smell and construction mess, with many complaints addressed to SZETÁV; the project responded with measures including noise-protection walls, site tours, public hearings, interviews and a broader Green Szeged communication campaign. [19]
Responsibility for engagement was distributed: the state implementation partner NFP and specialised communications firms handled formal communication and participation in the KEHOP phase, while SZETÁV remained the visible local utility and complaint interface. [19]

11. Annex C – Helsinki

Possible interview partners [53]

Decision-maker / stakeholder	Competences
Timo Aaltonen — SVP Heating and Cooling	Portfolio dispatch; source hierarchy; network constraints; heat-pump integration; e-boiler business case; storage; reliability during coal exit.
Olli Sirkka — CEO	Transition sequencing; relationship with City owner and Board; risk appetite; how affordability/reliability were protected during coal retirement.
Timo Rajala — SVP Finance	Capital allocation; EIB role; debt/cash-flow constraints; investment thresholds for low-carbon heat and flexibility.
Atte Kaleva — Board Chair	Owner–Board boundary; approval of strategy/financing; oversight of transition risks and company objectives.
City ownership steering / Mayor Daniel Sazonov	How municipal climate objectives translate into ownership expectations without micromanaging utility operations.
HSY / Telia or another waste-heat provider	Temperature/availability guarantees; metering; ownership of recovery equipment; heat-purchase pricing; data/operational responsibilities.
Tuomas Teuri — SVP Digital Solutions	Digital twin; data governance; optimisation use cases; implementation cost; which capabilities matter most before adding multiple distributed heat sources.

Success factors [33] [37] [34] [38] [53] [54] [55]

Factor	Why it mattered
Clear owner mandate with corporate execution	City ownership long-term direction; Helen's Board and management strategy, financing and execution.
Portfolio sequencing	Coal replaced; wastewater/environmental heat pumps, e-boilers, biomass conversion and external heat, with storage added
Measured reliability and customer outcomes	Helen reports >99.9% reliability, −56% DH-production emissions and lower heat price in the first full coal-free year, allowing transition success to be judged against service outcomes.
Heat/cooling and waste-heat integration	Katri Vala, Eiranranta and data-centre models turn low-grade heat streams into useful DH and create value from cooling demand.
Digital optimisation	The digital twin supports system-level decisions as heat sources become more numerous and electricity-linked.
Bankable balance sheet + public-bank finance	Helen combined high corporate capex with a EUR 150 million EIB loan and EU support for selected assets.
Flexibility as an asset class	E-boilers and thermal storage are planned not only for decarbonisation but to shift heat production across electricity conditions.

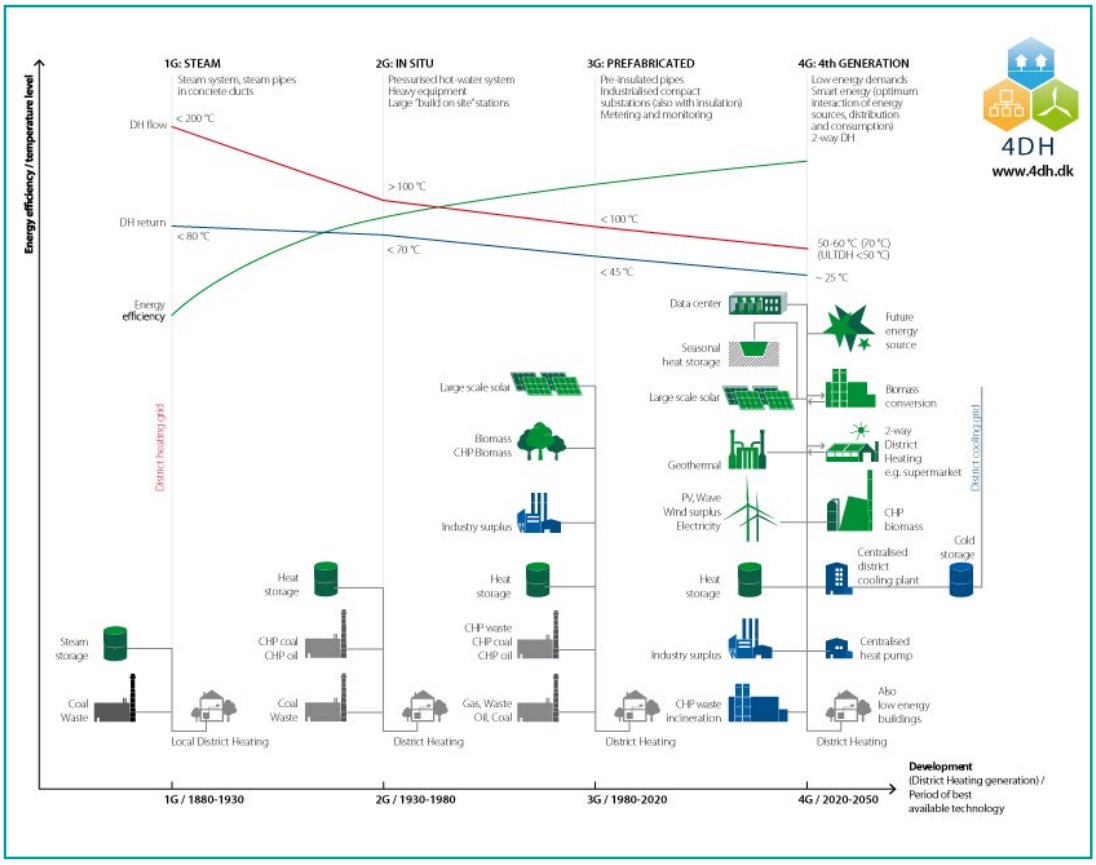
12. Annex D – Quick shot list

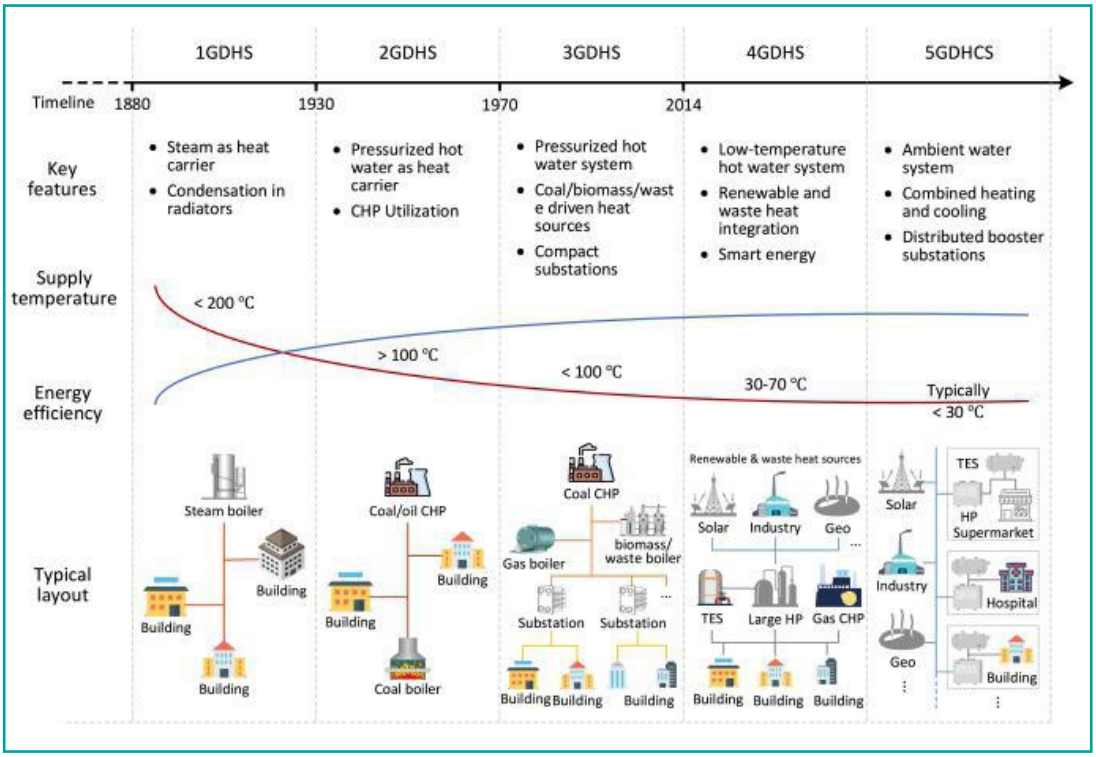
Low hanging fruits [1] [20] [24] [25] [32] [27] [66] [29]

Quick shot	What can be done easily	Romania — practical example	Latvia — practical example
1. Ninety-day heat balance	Use existing meters/SCADA to reconcile heat by source, plant, zone and substation; publish supply/return temperature, ΔT, make-up water, pump electricity and loss indicators.	Bucharest: start with one production–distribution zone and rank the ten worst loss/ΔT points before specifying capital works.	Riga: align the loss baseline used by operations with the EIB rehabilitation portfolio and the 4GDH action plan.
2. Temperature and ΔT campaign	Reset weather-compensation curves conservatively, correct high-return substations, balancing faults and unwanted bypasses; verify comfort and hot-water hygiene.	Prioritise geothermal-fed or geothermal-ready zones because lower return temperature improves usable resource heat and hydraulic capacity.	Prioritise biomass, solar-storage and future heat-pump zones use Salaspils as an operator-learning site.
3. Pump, valve and pressure tuning	Retune variable-speed pumps and differential-pressure set-points; repair oscillating/stuck valves; close proven bypasses and re-balance critical branches.	Apply first in high-flow/low-ΔT Bucharest branches and in smaller SACETs where manual settings can be corrected quickly.	Apply around Riga's renewed sections and Salaspils' storage loop, retaining minimum-flow and reliability constraints.
4. Leak and insulation sprint	Use alarms, thermal inspection and maintenance records to repair chambers, flanges, valves, damaged insulation and short high-loss sections; separate emergency repairs from full pipe replacement.	Target recurrent Bucharest loss/outage clusters first and feed results into the multi-year zonal renewal plan.	Tie verified hot spots to Riga's active rehabilitation program so new sources do not compensate for avoidable distribution loss.

Quick shot	What can be done easily	Romania — practical example	Latvia — practical example
5. Dispatch and contract reset	Create a transparent merit order including fuel, power, pumping, start-up, emissions and source constraints; review take-or-pay and under-consumption clauses.	Szeged's temporary natural gas-first dispatch under an under-consumption penalty is the warning: test natural gas contracts before geothermal commissioning.	Give Riga's 49 MW electrode boiler operating rules linked to electricity price, system need and storage—not a stand-alone utilisation target.
6. Waste-heat offer in one page	Issue a standard pre-feasibility sheet covering source temperature, profile, distance, metering, backup, ownership, minimum availability and indicative price.	Map data centres, wastewater, industry and cooling loads near stable DH demand; defer binding off-take until hydraulics and temperature are verified.	Use the sheet to accelerate Riga's wastewater and residual-heat discussions and compare utility-investment versus supplier-investment options.
7. Ten-building pilot	Select 5–10 representative buildings; automate substations, balance emitters, measure peak load, return temperature for a full season.	Pair a Bucharest pilot with a candidate low-temperature/geothermal node and housing-association engagement.	Pair a Riga pilot with a renewed branch; in Salaspils, test predictive charging/discharging against weather and heat demand.

13. Annex E – District heat generations





4. Annex F – Methodology

The review follows the planning logic of QM Holzheizwerke[1]. Because the handbook was developed for biomass heating plants, this study applies its process and quality-management principles to multi-source DH rather than treating its biomass-specific design rules as universally applicable. [63]
Each municipality and case study is assessed against six dimensions:

1. infrastructure and heat demand
2. renewable and recovered-heat potential
3. hydraulic and temperature situation
4. governance and institutional capacity
5. financing / investment readiness
6. operational performance and stakeholder acceptance

The assessment is based on the supplied municipal profiling, official statistics and regulatory material, utility and city documents, operators information (reports, homepage…), project reports and technical literature available. Public sources do not provide a harmonised hydraulic, cost and asset-condition dataset for every municipality. Recommendations are therefore screening and project-preparation guidance and do not substitute site-specific feasibility studies.

1 https://www.qmholzheizwerke.ch/home.html

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