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Content

Abbreviations and acronyms

BiH	Bosnia and Herzegovina
BG	Bulgaria
CHP	Combined heat and power
DC	District cooling
DH	District heating
DHC	District heating and cooling
DHS	District heating system
EED	Energy Efficiency Directive
EU	European Union
EWRC	Energy and Water Regulatory Commission
GHG	Greenhouse gas
HR	Croatia
HU	Hungary
NECP	National Energy and Climate Plan
PEST	Political, economic, social and technological analysis
PP	Project partner
RES	Renewable energy sources
RO	Romania
SK	Slovakia
SLO	Slovenia
SO	Specific Objective
SRB	Serbia
SWOT	Strengths, weaknesses, opportunities and threats analysis

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Executive summary

This deliverable identifies gaps and barriers to the sustainable development of district heating and cooling (hereafter: DHC) systems in the REHEATEAST region. Drawing on prior project analyses and stakeholder surveys, the report provides both country-specific findings and cross-country insights.

While modernisation efforts are underway, many systems remain characterised by outdated infrastructure, heavy reliance on fossil fuels, fragmented ownership structures, insufficient financial incentives, limited consumer engagement, etc. Data transparency and planning deficiencies further constrain effective policy implementation and hinder alignment with European Union (hereafter: EU) energy and climate objectives.

Despite these challenges, stakeholder motivation is strong. Drivers such as reducing greenhouse gas (hereafter: GHG) emissions, improving energy security, modernising infrastructure, and alleviating energy poverty create fertile ground for DHC. These initiatives are seen as opportunities to demonstrate benefits and support regulatory and financial alignment.

This gap analysis highlights both the urgency and potential of coordinated action. By identifying weaknesses and opportunities across the region, the deliverable lays the groundwork for pilot actions that provide replicable solutions adaptable to diverse national contexts.

1. Introduction

The REHEATEAST project aims to reduce fossil energy demand in DHC systems by minimising energy waste in buildings and networks while integrating renewable energy. It encourages multi-stakeholder, cross-sectoral, public-private cooperation and develops, tests, promotes and disseminates practical, technical, and nature-based solutions that support large-scale rehabilitation programs and climate adaptation measures.

Specific Objective (hereinafter: SO) 1 concentrated on identifying common challenges and good practices within DHC systems, and SO2 transitions into practical applications. SO2 encourages multi-stakeholder cooperation to address key challenges in DHC systems across the REHEATEAST region. Activities under this objective aim to identify the most effective use cases through pilot actions. The insights and lessons learned will inform broader regional and transnational practices.

DHC systems in the REHEATEAST countries are facing substantial discrepancies between goals and current practices. This report examines these gaps and finds they are often rooted in outdated infrastructure, fragmented regulatory frameworks, and insufficient stakeholder cooperation despite strong motivations to transition towards more sustainable and efficient energy solutions.

This report expands on the data collected in the earlier phases of the REHEATEAST project. It specifically draws insights from the DHC stakeholder survey conducted in Deliverable D.1.1.5, as well as from the in-depth analysis of existing challenges, gaps, and best practices within the DHC sector outlined in Deliverable D.1.2.1, and from the comparative analysis of the institutional, legal, and financial status quo of DHC in Deliverable D.1.2.2. By analysing and synthesising these findings, the report aims to provide a clear understanding of the current landscape.

2. Discrepancies between targeted goals and current DHC practices

Across the region, DHC improvement efforts emphasise enhanced energy efficiency, integration of renewable energy sources (hereafter: RES), reduced operational costs, and improved stakeholder involvement. However, current practices often fall short due to various systemic issues, as described in the following country-specific subchapters.

2.1. Bosnia and Herzegovina

Bosnia and Herzegovina's district heating (hereafter: DH) systems primarily rely on coal and natural gas as their primary energy sources. While some promising pilot projects have utilised biomass, such as in Gračanica, the overall energy landscape remains heavily dependent on fossil fuels. Additionally, many DH networks were over-dimensioned during the 1990s, resulting in significant inefficiencies in heating provision and energy consumption. These oversized networks lead to heat losses and increased operational costs, making it challenging to optimise energy usage. However, there is a focus on improving energy efficiency and meeting heating demands effectively.

There is an evident lack of comprehensive legislation regulating key areas such as tariffs, consumer relations, and the integration of RES, creating uncertainty and delaying progress.

The existing infrastructure lacks modern metering systems, resulting in inadequate monitoring and management of energy consumption. Additionally, the systems are not equipped to adjust the supply temperature effectively, further compounding inefficiencies.

Despite recommendations from various EU projects, there is a lack of a unified national DH action plan, which is essential for guiding the country's future development and the sustainability of heating practices.

2.2. Bulgaria

Bulgaria's DH system is the primary source of heating and hot water for around 30% of urban households, mainly relying on natural gas. The largest DH network in Sofia is located, representing approximately 65% of the national heat supply and catering to more than 440,000 consumers through municipal combined heat and power (hereafter: CHP) plants. A report from the World Bank in 2018 emphasises the sector as a cost-effective and environmentally friendly heating option. Overseen by the Energy and Water Regulatory Commission (EWRC), the sector guarantees equitable pricing, dependable service, and consumer safeguards.

DH companies must meet various regulatory standards, including licenses, tariff compliance, and the integration of energy efficiency and renewable energy measures, while reporting to the EWRC on national and EU compliance. Initially constructed in the 1950s and 1960s, the systems face challenges due to limited investments and maintenance, leading to operational inefficiencies and service quality concerns, particularly in cities like Gabrovo.

Despite these positive developments, Bulgaria's DH sector continues to face challenges. One of the foremost issues is efficiency, primarily attributed to deteriorating infrastructure, particularly the ageing pipes within the heating network. This inefficiency increases operational costs and undermines the heating system's overall reliability and sustainability. Moreover, the transition to RES remains slow and limits the potential for reducing GHG emissions and achieving greater energy security. There is an urgent need to accelerate the adoption of renewable technologies to meet both local and international environmental goals.

The reliance on subsidies for energy pricing places considerable financial strain on municipal budgets, limiting their capacity to invest in infrastructure upgrades and innovations. As a result, the affordability and accessibility of heating services can vary significantly among different socio-economic groups, further entrenching inequalities within the system.

2.3. Croatia

In 2022, Croatia supplied about 2 TWh of heat through DH, serving over 160,000 customers, mainly households in larger continental cities. Most DH systems use pressurised hot water above 100°C, but inefficient buildings lead to high energy losses.

The DH sector relies on a diverse fuel mix, including natural gas, renewables, and oil products. Currently, CHP systems make up 79% of the market, showcasing efficiency. However, 85% of heating energy still comes from natural gas. Increasing the use of renewable resources would enhance sustainability and reduce dependence on fossil fuels.

The National Energy and Climate Plan (hereafter: NECP) emphasises modernising district heating systems (hereafter: DH systems) as a crucial component of the country's energy strategy. However, it falls short of establishing binding targets that drive accountability and measurable progress. As there is no long-term national strategy specifically focused on district heating, this consequently delays transposing relevant EU directives, which impedes national practices' alignment with broader EU energy goals and standards.

The high operational supply temperatures within the district heating networks can largely be attributed to inadequate building insulation. It affects energy efficiency and diminishes DH's competitiveness, thus pushing consumers to seek alternative heating solutions.

There is a shortage of effective financial incentives to encourage DH projects using RES. This lack of funding opportunities hinders the transition towards sustainable heating solutions and limits investment in innovative technologies that could enhance energy efficiency.

2.4. Hungary

In Hungary, around 17% of residential buildings are connected to DH systems, while 78% rely on individual heating, mainly using natural gas, which accounts for 50% of their energy sources. In

2022, natural gas comprised nearly 70% of the DH energy mix, with renewable sources at 23.7%. This heavy reliance on imported natural gas presents economic and supply risks, especially during geopolitical tensions that can drive up prices. While the use of renewable energy is increasing, the dependency on natural gas in DH systems is projected to decrease, but will remain significant in the near future.

Despite the presence of favourable regulations designed to promote renewable energy, the actual implementation has been slow. Additionally, the challenge of transitioning from legacy systems is significant; many existing district heating networks are still gas-based, necessitating substantial and costly retrofitting to integrate sustainable renewable solutions effectively.

2.5. Romania

In Romania, centralised thermal energy supply is managed by local administrations in 50 locations. These systems serve 1,095,551 consumers, including 1,082,212 residential users. The total thermal capacity is 7,501 MW, with natural gas making up nearly 80% of the energy mix, significantly higher than the EU average of 30%. The network extends 4,624 kilometres, with average energy losses around 35%. Heat consumption has declined by roughly 7.7% annually over the past three years, and the number of cities using district heating has fallen from 315 to fewer than 50.

The district heating sector faces critical gaps that delay progress. Modernisation and diversification of energy sources are essential for the sustainability of Romania's district heating systems, which have high energy losses and shrinking consumer bases. Governance remains fragmented, characterised by scattered ownership, and municipalities are often underfinanced, complicating unified management and investment. Additionally, the technology in place is outdated, with design frameworks dating back to the 1950s and 1960s, which lack modern consumption control measures. This combination of governance issues and technological shortcomings poses substantial obstacles to optimising Romania's district heating systems and ensuring efficient service delivery.

2.6. Serbia

District heating systems in Serbia greatly expanded in the late 20th century, with natural gas introduced in 1963. Currently, 64 entities manage DH, with a capacity of 6.4 gigawatts (GW) and 6.7 terawatt-hours (TWh) produced in 2022.

About 25% of households (657,019) are connected to DH, covering 46.6 million square meters, mainly for residential use. The primary energy sources are natural gas (78.1%), coal (13.3%), fuel oil (6.4%), and biomass (2.2%).

The distribution network spans 2,776 kilometres and is primarily a two-pipe system, averaging 24 years old. Heat losses are around 13%. Heat is transmitted through 27,236 metered transfer stations, but only 10% of consumer heat energy is metered.

The Serbian government has enacted laws that require a minimum of 50% of the DH systems to be powered by RES by 2026. Additionally, consumption-based billing is strongly pushed to promote energy efficiency and accountability among consumers.

Despite the clear regulatory framework, only a minor part of the supply is based on consumption-based billing practices. It indicates a significant gap in compliance and the need for enhanced enforcement measures or incentives to encourage more companies to transition to this billing model.

A critical concern remains the entrenched reliance on fossil fuels, as approximately 80% of the fuel used for DH continues to be derived from fossil fuels. This enduring dependence undermines Serbia's renewable energy targets and poses environmental and sustainability challenges that must be urgently addressed.

2.7. Slovakia

DH systems in Slovakia were established in the 1960s and 1970s to support urban heating needs. Currently, over 200 systems serve about 1.8 million residents, meeting 30% of the country's heating demands, mainly in multi-family buildings and city centres.

Natural gas is the primary heat source, but coal is being phased out for cleaner alternatives in line with EU directives. Approximately 20% of the heat in DH systems comes from renewable sources like biomass, geothermal, and solar thermal energy, as part of a strategy to lower GHG emissions and boost energy efficiency.

The Slovak government and local authorities are modernising DH infrastructure to improve efficiency and increase renewable energy use, which is supported by EU funding. While progress is being made, challenges such as further modernisation and consumer affordability remain. Continued investments in renewables are essential for sustainable district heating in Slovakia, aligning with local and EU climate goals.

2.8. Slovenia

DH systems in Slovenia are primarily located in cities and larger settlements, with wood biomass systems more prevalent in smaller urban areas. Over 100 DH systems serve about one-third of municipalities, providing around 2 TWh of heat annually. Most are high-temperature, second-generation systems, which complicates the integration of RES and waste heat.

From 2017 to 2020, CHP plants supplied about 85% of primary energy for DH; however, this share fell to 72% in 2021 due to increased heat from natural gas and wood biomass. RES accounts for 15% of CHP heat production, with total RES and waste heat contributions varying between 16% and 20%. Efficient DH systems consistently produce over 80% of their heat efficiently.

There's significant potential to expand existing DH systems and develop new microsystems, as most heat demand (2.2 TWh) is in dense areas suitable for low-temperature systems, potentially adding up to 500 GWh. Smaller systems could deliver an additional 200 to 400 GWh, with total economic potential estimated at 2.8 TWh annually.

Challenges include integrating sustainable heat sources and meeting efficiency standards under the Energy Efficiency Directive (EED). NECP anticipates decreased energy consumption due to building renovations, but expanding networks could counteract this. Incorporating affordable waste heat sources may also promote further DH development.

Recent amendments to the Energy Act have established a framework that prioritises district heating systems over individual heating solutions. This strategic shift aims to enhance energy efficiency and promote sustainable heating practices across urban and rural areas.

Despite advancements, the infrastructure presents challenges, highlighting the need for upgrades and modernising heat distribution systems to enhance overall performance.

Moreover, public engagement is a significant challenge, as local communities have so far embraced renewable energy solutions only to a limited extent. Enhancing awareness and encouraging involvement in renewable energy projects are crucial for building community support and speeding up the shift towards sustainable energy practices.

3. Regional common challenges and gaps

Key barriers to DHS development across the region include heavy reliance on fossil fuels, outdated infrastructure and other technical obstacles, regulatory misalignments, socio-economic constraints, low public awareness and consumer resistance. While countries like Hungary, Slovakia, and Slovenia generally face moderate challenges, Bosnia and Herzegovina, Serbia, and Romania continue to lag due to persistent economic, financial, and technical obstacles.

Across various countries, gaps and inconsistencies persist in the practices surrounding DHC. These challenges significantly delay the effectiveness and sustainability of heat distribution systems.

3.1. Outdated infrastructure

Many existing DHC systems are burdened by ageing infrastructure, characterised by inefficient and damaged pipes and underperforming heat generation plants. This deterioration not only results in substantial heat and water losses but also contributes to inefficiencies that compromise the overall reliability and safety of the systems.

The transition to fourth-generation district heating systems, which are designed to operate at lower temperatures and integrate RESs, is progressing slowly across the region. This slow adoption is partly due to the conservative nature of existing infrastructure, which is often unsuitable for modern technologies. Many DHS still rely heavily on fossil fuels and traditional heating methods, creating obstacles to incorporating innovative solutions. Additionally, the reluctance to invest in new technologies, combined with limited training opportunities for professionals in the sector, further delays modernisation.

3.2. Dominance of fossil fuels

The reliance on fossil fuels like natural gas and coal poses a significant obstacle in decarbonisation. Despite the urgent need to shift toward cleaner and more sustainable energy alternatives, these traditional heat sources continue to dominate, delaying progress toward environmental goals. EU-aligned nations are leading the way with robust regulatory frameworks that provide clear incentives for the integration of RES. Meanwhile, some countries still rely heavily on fossil fuels, presenting opportunities for growth in transitioning towards more sustainable heating solutions.

3.3. Fragmented ownership and regulatory barriers

Most countries in the REHEATEAST region lack binding national strategies for DH that ensure a coordinated approach to modernisation and sustainability. While Slovenia and Hungary have developed more comprehensive frameworks to improve their DH sectors, many other nations operate under fragmented, non-binding regulations that do not create a consistent long-term vision. This lack of cohesive national policies can lead to inefficiencies, hinder investments, and result in uneven progress across municipalities. For instance, without mandatory action plans or guidelines, local authorities may struggle to prioritise upgrades to DHC systems, resulting in a mix of outdated practices.

The regulatory landscape for DH development offers a diverse picture across the countries being examined, highlighting varying degrees of energy policy advancements, renewable energy adoption, and financial support mechanisms.

Many nations are making progress in aligning their policies with EU energy directives. Yet, challenges such as regulatory gaps, insufficient incentives, and financial limitations hinder the transition to cleaner, more efficient DH systems.

In Bulgaria and Croatia, for example, the heat distribution landscape presents opportunities for improvement through addressing fragmented ownership structures and regulatory hurdles. These countries could develop cohesive national strategies and modernisation initiatives by overcoming these complexities. Serbia illustrates a different scenario, where local authorities control heat pricing. This system results in various rates across cities, indicating a potential area for market optimisation. On a more positive note, countries like Slovakia and Slovenia showcase well-aligned EU regulations that effectively promote the integration of RES, including biomass and geothermal energy, and waste heat technologies into DH systems. Looking at Bosnia and Herzegovina and Serbia, there is an opportunity to strengthen their regulatory frameworks to support the transition from coal and natural gas-based heating to more renewable options. Similarly, Bulgaria, Croatia, and Hungary are on a promising path toward RES integration, with evolving policies that increasingly support CHP, biomass, and geothermal energy. Romania benefits from EU funding and subsidies to modernise DH systems and incorporate renewable technologies, even as its regulatory frameworks continue to develop.

While challenges remain, there is a clear momentum towards advancing sustainable heating solutions across the region.

3.4. Limited financial incentives

The REHEATEAST countries heavily rely on EU grants and funds to finance district heating projects. While these funds are essential for initiating improvements, the lack of a diversified funding model impedes innovation and ongoing investments. Substantial subsidies for fossil fuels overshadow the important financial mechanisms required to facilitate the adoption of RES.

The involvement of the private sector is often minimal due to perceived risks and insufficient regulatory support, which leads to stagnation in technological and infrastructure advancements. A more balanced approach encouraging private investment could attract additional resources and expertise, fostering more robust and sustainable development in the sector.

3.5. Data transparency

One of the significant challenges facing DHC systems in the REHEATEAST countries is the inconsistency in heat mapping and consumption metrics. Accurate data on energy use is essential for optimising DHS and planning future expansions. However, many municipalities lack the capacity or resources to conduct comprehensive heat mapping or implement effective monitoring systems. It creates a substantial information gap, preventing stakeholders from making informed decisions regarding energy efficiency improvements and investment priorities. Data transparency could facilitate better benchmarking, encourage stakeholder engagement, and support policy development.

3.6. Planning deficiency

A significant challenge lies in the lack of comprehensive data for effective heat planning. Many cities lack the analytical tools and data depth to devise strategic heating plans that comply with EU directives. Consequently, existing strategies often fall short in specificity and clarity, undermining their potential effectiveness.

However, municipal ownership or control of DH operators, standard in most REHEATEAST countries, provides a stable platform where technical, financial, and social objectives can be aligned more effectively. Planning tools are the backbone of coordination. Examples include mandatory DH zones in Romania, heat-supply zoning powers in Hungary and Slovakia, and DH integration in spatial plans in Bosnia and Herzegovina, Bulgaria, and Slovenia. These mechanisms support coordination, provided they are adequately enforced. Dialogue platforms can be crucial in contexts where municipal capacity is limited. National and regional DH associations and EU-funded projects offer training, stakeholder workshops, and finance matchmaking. These initiatives help transform ad-hoc engagements into structured, long-term collaboration.

Robust stakeholder coordination in DH depends on municipalities having the legal authority to plan and the practical tools to act, such as access to funding, clear mandates, and convening stakeholders, including utilities, investors, and end-users. When these levers are missing, coordination tends to fall back on isolated, project-based efforts rather than sustained, strategic collaboration. Municipal capacity is strongest when underpinned by national-level incentives, precise strategic planning requirements and continuous participation in EU-funded programmes. Key municipal tools, such as zoning powers, ownership or control of utilities, stakeholder forums, and targeted incentives, can elevate collaborative governance across all countries.

3.7. Low consumer engagement

The perception of DH as an inefficient and outdated solution compared to individual heating systems poses a substantial barrier to its acceptance and growth. Many consumers are unaware of the potential benefits of DH. Negative experiences with poorly maintained or inefficient systems often reinforce this scepticism, driving a preference for individual heating solutions. To counteract this perception, targeted public awareness campaigns highlighting modernised DH's advantages, including success stories and examples of efficiency improvements, are essential to fostering greater community support and trust in these systems. Building public awareness is critical for driving demand and securing a stable user base willing to invest in and support DH networks.

The complex ownership structures within buildings pose challenges to energy efficiency renovations, making it difficult to update systems. To fully harness the potential of DHC systems, there is a critical need for improved consumer engagement and education. It will empower residents to participate actively in and benefit from energy-saving initiatives.

These gaps and inconsistencies highlight the need for coordinated action and investment to create more resilient, efficient, and sustainable DHC systems.

4. Stakeholders' motivations and initiatives for pilot projects

Stakeholders are motivated to participate in pilot actions through EU projects and targeted dissemination activities due to a shared drive for sustainability, energy security, and modernisation. The following key motivations outline the specific drivers encouraging their active involvement and collaboration.

- Reducing GHG emissions: Stakeholders recognise that pilot projects offer a pathway to reduce CO_2 and other GHG emissions, aligning with EU climate goals.
- Improving energy security: Diversifying energy sources, especially by integrating local renewables, enhances energy security by reducing reliance on imported fossil fuels.
- Modernising ageing infrastructure: The urgent need to replace outdated and inefficient infrastructure is a significant motivator for stakeholders to invest in pilot projects and upgrades.
- Demonstrating benefits and best practices: Pilot projects showcase the tangible benefits of optimised DHC systems, including enhanced energy efficiency and lower operational costs. They promote sharing best practices and act as a model for wider replication.
- Facilitating stakeholder cooperation: Projects like REHEATEAST emphasise the crucial role of collaboration among municipal authorities, energy companies, building owners, and consumers.
- Policy alignment and funding access: Pilot projects help align national practices with EU directives and facilitate access to funding from EU programs and international financial institutions by demonstrating viable solutions.
- Addressing social and economic issues: Addressing high poverty levels, particularly energy poverty, motivates improving heating efficiency.

The flowchart of the motivations above is depicted in the following figure.

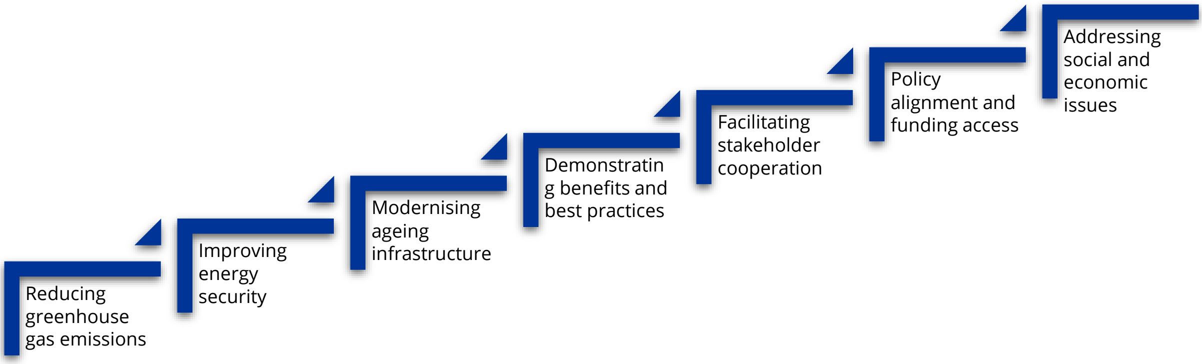

Figure 1 Stakeholders' motivations

These motivations highlight the region's proactive approach to tackling existing challenges in DHC by fostering collaboration, utilising data-driven insights, and implementing technically robust pilot initiatives.

5. Conclusion

The analysis underscores that the transformation of DHC systems in the REHEATEAST region requires more than technical upgrades. While modernising infrastructure is essential, systemic challenges, including outdated networks, high reliance on fossil fuels, fragmented regulatory frameworks, limited financial incentives, and low consumer engagement, remain significant barriers to achieving sustainability and resilience. Across the region, these gaps are compounded by varying capacities, complex ownership structures, and uneven alignment with EU directives, which limit the pace and effectiveness of DHC modernisation.

As the project's next phase, pilot actions will play an essential role in showcasing how to bridge some of these gaps. They provide concrete examples responding to local conditions and broader EU ambitions, offering opportunities to test and demonstrate various approaches. Their success will hinge on fostering active stakeholder collaboration while ensuring strong policy support.

Ultimately, the insights gained from these pilots will contribute to a more efficient and sustainable DHC sector across the REHEATEAST region. By documenting lessons learned and sharing best practices, the project aims to support the replication of successful approaches beyond the pilot areas, fostering long-term improvements in energy performance. The combination of practical implementation, evidence-based analysis, and strategic engagement provides a pathway for DHC systems to transition from fragmented, fossil-dependent networks into modern, community-oriented, low-carbon solutions.

In the following, we provide a comparative SWOT (strengths, weaknesses, opportunities and threats) and PEST (political, economic, social and technological) analyses based on this and previous REHEATEAST project reports.

Table 1 SWOT analysis of DHC systems in the REHEATEAST region

Category	Strengths	Weaknesses	Opportunities	Threats
Bosnia and Herzegovina	Availability of biomass potential and EU development partnerships	Over-dimensioned, low-efficiency networks; absence of unified DH legislation; lacking metering infrastructure	Potential integration of biomass and waste heat; EU funding access for modernisation	Continued dependence on fossil fuels; weak coordination among municipalities
Bulgaria	Extensive DH coverage (30% of urban households); structured	Ageing infrastructure; slow RES adoption; heavy	CHP modernisation; national strategies	Financial strain on municipal budgets; public scepticism about DH affordability

Category	Strengths	Weaknesses	Opportunities	Threats
	regulatory authority ensuring consumer protection	reliance on subsidies	encouraging DH efficiency	
Croatia	High CHP proportion (79% of market); diverse fuel mix including RES	High operational temperatures; lack of a binding national DH strategy or incentives	Alignment with NECP goals; potential use of geothermal and biomass	Competitive pressure from individual heating; limited investor motivation [1]
Hungary	Increasing RES share (23.7% as of 2022); district energy planning tools in place	Gas-based legacy systems; high conversion costs for modernisation	Regulatory reforms promoting RES in DH; modelling-based retrofit programs	Volatile gas prices due to import dependency; slow project implementation
Romania	Established networks with a strong municipal role; high capacity (7,501 MW)	35% energy loss rate; fragmented governance and outdated technology	EU subsidies for DH renewal, waste heat recovery and biomass potential	Shrinking consumer base; insufficient local investment capacity
Serbia	Robust DH capacity (6.4 GW, 6.7 TWh); regulation targets 50% RES by 2026	Low metering rate (10%); dominant fossil fuel mix (80%)	Legal push for consumption-based billing and RES upgrades	Non-compliance risk; weak enforcement of renewable targets
Slovakia	200 networks serving 1.8 million people; integrated RES policies	High operating costs; infrastructure ageing from 1960s–70s	EU support for geothermal and biomass DH integration	Affordability concerns and local-level investment barriers
Slovenia	Legislative preference for DH over individual heating;	High-temperature second-generation systems; limited	Expansion of low-temperature microsystems; potential of	Community resistance and retrofit costs

Category	Strengths	Weaknesses	Opportunities	Threats
	emerging RES/waste heat systems	public participation	waste heat valorisation	

SWOT above summarises the main regional strengths, weaknesses, opportunities, and threats, while the following table complements this analysis with macro-contextual (PEST) insights. This enables stakeholders to view differences among the REHEATEAST countries systematically.

Table 2 PEST comparative analysis of regional DHC sectors

Factor	Bosnia & Herzegovina / Serbia / Romania	Bulgaria / Croatia / Hungary	Slovakia / Slovenia
Political	Fragmented governance, municipal autonomy limits coordination	Evolving alignment with EU directives and regulatory reform	Strong policy frameworks supporting climate-neutral DH
Economic	Heavy subsidy reliance and underfinanced municipalities	Increasing EU and private investment opportunities via NECPs	Stable EU funding and competitive pricing mechanisms
Social	Low consumer engagement and public mistrust of DH	Growing awareness due to high energy prices and energy poverty	Higher acceptance of sustainable DH; local awareness initiatives
Technological	Outdated, inefficient networks; limited digitisation	Expanding CHP and digital control systems; moderate RES integration	Transitioning toward 4^{th} generation, low-temperature networks
Environmental	High fossil dependence and GHG emissions	Transition in progress, but slow on RES share expansion	Strong decarbonisation strategies under EED and NECP alignment
Legal	Non-binding or outdated frameworks; missing tariff regulation	Some regulatory innovation; mixed enforcement	Comprehensive legal frameworks enabling energy efficiency and RES

From the analysis above, it can be observed that Bosnia and Herzegovina, Serbia and Romania face critical gaps in terms of fossil dependency, insufficient regulation, and weak financing capacities. Bulgaria, Croatia, and Hungary are in transition, supported by EU alignment but hindered by infrastructure degradation and fragmented incentives. Slovakia and Slovenia exhibit the most advanced maturity in strategic planning and policy support, though upgrades and consumer outreach remain necessary.

The combined SWOT–PEST framework presented above provides a regional comparison tool for REHEATEAST stakeholders to prioritise focus areas, investment planning, and capacity-building activities.