Interreg Co-funded by the European Union | ALPHA

Alpine Space

DECEMBER 2024

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Methodology regarding regulatory and administrative gaps in Alpine territories.

Executive summary

Given the fact that the heating and cooling (H&C) sector accounts for nearly half of the total energy demand in Europe and is predominantly reliant on fossil fuels, the decarbonisation of H&C systems emerges as a critical task that can significantly contribute to sustainable energy use, environmental impact reduction, and the accomplishment of climate goals. In this context, policymakers and public authorities across all scales (local, regional, national, and supranational) can play a vital role in promoting, supporting, planning, and implementing sustainable and efficient H&C solutions.

This is particularly true in the case of Alpine regions, which are characterised by high energy demand for heating during prolonged winters, increasing cooling needs due to rising temperatures, unique ecosystems, and renewable energy potential. Nevertheless, the integration of renewable energy and the implementation of low-carbon solutions, such as heat pumps, is still lagging in Alpine space due —in some part— to insufficient policy measures and frameworks.

The purpose of the present document is to provide methodological guidelines for partners to survey and identify regulatory and administrative gaps and challenges in their territories, which can act as barriers to efforts for the decarbonisation of H&C networks. Towards this end, document's Chapter 2 offers the necessary background information about key territorial policy areas involved in H&C systems' planning and deployment processes, classifying and discussing regulatory inefficiencies and inconsistencies and administrative barriers and needs that tend to inhibit the progress of these processes.

The discussion of these common gaps and challenges is followed by the presentation of exemplary case studies of H&C/5GDHC networks in EU countries, shedding light on the regulatory revisions and administrative practices that were undertaken by territorial authorities to facilitate their development. Next, the document proceeds to describe in detail the research methodology (including research guidelines, data collection targets, and timeline) underpinning the collection of territorial data during Activity A1.1 of the ALPHA project. Lastly, it introduces the tool designed for streamlining and standardising the process of documentation of territorial data; it also offers guidelines and a suggested agenda for the organisation of the upcoming online workshop that will focus on best practices from both partners' territories and the EU.

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Introduction

The aim of ALPHA project is to coordinate and accelerate the adoption of 5th Generation District Heating and Cooling (5GDHC) networks in Alpine Space, with a view to reducing greenhouse gas emissions and increasing the use of renewable energy in the heating and cooling (H&C) sector. Bringing together nine (9) partners from five (5) Alpine Space countries (namely, Italy, France, Germany, Austria, and Slovenia), ALPHA seeks to develop a unified and customisable planning approach for 5GDHC networks, enhance policy and financing frameworks, and establish scalable solutions and pathways for decarbonising Alpine H&C and building stock. The project will directly benefit policymakers, energy planners, and operators by providing innovative tools, strategies, and frameworks to drive investments and promote clean energy transitions across the Alpine region.

The project's Activity A1.1, which this document forms part of, focuses on identifying and addressing regulatory and administrative gaps regarding H&C policies across the Alpine Space. Guided by the Lombardy Foundation for the Environment (FLA), project partners will map these gaps in their respective territories,[1] while also analysing best practices from within the region and the European Union. The activity includes an online workshop where partners are going to share findings, jointly assess these best practices, and explore their adaptation to local needs. The outcomes will be synthesised into a report that facilitates knowledge transfer and helps partners understand how to overcome identified barriers, ultimately supporting the decarbonisation of H&C systems in Alpine Space.

[1] The term 'territory' refers in this context to the spatial dimension of a region, encompassing not only its physical geography but also its socio-economic, political, infrastructural, administrative, and environmental characteristics. The concept emphasises the importance of space and place in governance, planning, and development, focusing on the equitable and sustainable use of resources, services, and opportunities across different EU and Alpine Space regions.

Policy areas related to the H&C sector and associated challenges

This chapter addresses policy areas that closely relate to the planning, implementation, and operation of decarbonised H&C systems, with a view to pinpointing and classifying regulatory and administrative gaps and challenges often confronted during these processes. Before embarking on the presentation of these gaps and challenges, however, it is worth defining and clarifying what the regulatory and the administrative processes consist in, drawing distinctions and identifying the implications between these two levels. These definitions and distinctions, which are summed up on Table 1 below, can assist in identifying and coping with existing gaps and needs on both levels.

Regulatory and administrative levels: Definitions, distinctions, convergences

The **regulatory level** refers the formal rules, laws, policies, and frameworks established by governments or governing bodies (local, regional, national, or supranational) in order to guide and control actions in a particular sector. In the case of the H&C sector, it involves the creation, implementation, and enforcement of legislation, directives, and regulations that govern the planning and deployment of H&C networks. That is to say, it involves setting the rules, standards, and requirements that involved entities must comply with. It may also entail the creation of mechanisms that are meant to encourage compliance and/or penalise non-compliance.

As such, the scope of the regulatory level is usually broader than that of the administrative. Regulatory processes focus on what needs to be done and what is allowed or not allowed. Their timeframe is typically more long-term and strategic. As a rule, regulatory aspects are more stable and require formal processes in order to change. Examples of the regulatory level in the case of H&C may involve legislation that mandates carbon neutrality in H&C systems at the national level; EU directives, such as the Renewable Energy Directive, that set targets for renewables in heating and cooling; and local laws that require the use of district heating in certain zones.

The **administrative level**, on the other hand, refers to the implementation, management, and execution of policies, regulations, and projects by public authorities or organisations. It involves procedures, processes, and day-to-day operations undertaken and overseen by governing bodies. In the context of heating and cooling, the administrative level focuses on the practical aspects of executing and managing H&C projects within the established regulatory frameworks, such as project approvals and permits, effective inter-agency coordination, and the collection of data on project progress and outcomes.

As such, the scope of the administrative level is more localised and operational, concerning how regulations are implemented and enforced. It is typically more dynamic and can be adjusted within regulatory boundaries. Examples of the administrative level may involve the review of permits for

district heating systems by municipal agencies; administrative workflows for allocating public funding for heating projects; and the use of heat maps on the part of local governments in order to better prioritise infrastructure development.

Table 1: Regulatory and administrative levels in H&C and beyond

	Regulatory Level	Administrative Level
Function	Creates the rules and standards	Implements and enforces those rules
Scope of Authority	Broad, often national or regional	Specific, localised, and operational
Primary Objective	Establishing binding obligations and policies	Practical execution and facilitation of projects
Key Actors	Legislators, policymakers, regulatory agencies	Local governments, agencies, public authorities
Timeframe	Long-term and strategic	Immediate to medium-term, project-specific
Impact	Sets the “what” (targets and constraints)	Determines the “how” (execution and oversight)

Despite the two levels having different functions, scopes, and impacts, there are strong implications and resonances between them. As a result, many of the inefficiencies and gaps that will be discussed below co-operate between the two levels, often feeding off each other. One of the main reasons for this is the interdependence between the two levels: regulatory frameworks often define the actions that administrative bodies must carry out. That way, administrative challenges often stem directly from regulatory gaps. For example, a regulatory gap of "unclear standards for waste heat integration" can lead to administrative challenges in "processing permits for waste heat projects"; or in a similar vein, a law requiring renewable energy integration in heating systems may fail to consider how municipalities will fund and permit projects, creating challenges at the administrative level.

And conversely, difficulties and gaps in administrative capacity or implementation feedback may reveal flaws in the regulatory framework. By extension, practical challenges in administration can lead to regulatory reforms. The interdependence between the regulatory and the administrative procedures can also manifest at the level of governance: multi-level governance and the ensuing fragmentation across governance structures can induce and amplify both regulatory and administrative inefficiencies.

In the case of heating and cooling, there are certain structural parallels between the two levels, given that both deal with similar core aspects and challenges presented by H&C networks. Issues such as the complexity and innovativeness of modern systems line 5GDHC, which require new regulations

and new administrative tools; capacity constraints and resource shortages; the interests of various stakeholders that need to be accounted for and negotiated; they all pertain to both levels and produce feedback loops between them.

These similarities and overlaps have significant implications when it comes to addressing regulatory and administrative challenges. First, they require that policy recommendations are as holistic as possible. In his sense, addressing existing gaps requires coordinated reforms at both levels. On the regulatory level, reforms should seek to simplify, update, and harmonise laws to support modern systems; at the same time, on the administrative they should build capacity, streamline workflows, and improve tools for implementation.

Moreover, policy recommendations should opt for the formalisation of feedback loops, as the establishment of mechanisms for administrators to provide input to regulators can help align strategies and address overlaps. Finally, recommendations should focus on the local needs and constraints to which administrative processes must adapt, while taking into account the broader scope within which regulations operate.

Regulatory and administrative gaps and barriers

This section outlines the main policy areas involved in processes of H&C solutions' planning and deployment and discusses common gaps and barriers that can impede or discourage efforts for the decarbonisation of the H&C sector. The analysis focuses on the Alpine Space and the EU more generally, while the identified inefficiencies, inconsistencies, barriers and needs pertain both to the regulatory and the administrative level. Some purely regulatory gaps are addressed at the end of the section.

1. Fragmented governance structures and policy frameworks

Multi-level governance structures and fragmented policy frameworks can significantly impact the planning and implementation of H&C systems, creating a range of challenges at both the regulatory and the administrative level.

Inconsistent and conflicting policies and directives

Divergent regulations across local, regional, and national authorities often lead to inconsistencies in standards and policies for H&C systems. This lack of cohesion typically complicates compliance for developers and operators, and discourages the adoption of innovative technologies, as navigating conflicting requirements becomes resource-intensive and uncertain.[2] Additionally, regulatory responsibilities shared among various agencies can result in overlapping and/or conflicting

[2] Cejudo, G.M., and Michel, C.L. 2017. Addressing fragmented government action: coordination, coherence, and integration. *Policy Sci* 50: 745–767.
https://doi.org/10.1007/s11077-017-9281-5

directives, leading to confusion and delays. For example, energy and environmental departments may both claim jurisdiction over certain aspects of H&C projects, creating bottlenecks due to inefficiencies in decision-making and coordination.

Mismatch between resources and public authorities' responsibilities

On the administrative side, fragmented governance structures require significant coordination between multiple administrative bodies. This coordination can be hindered by the absence of clear communication channels, resulting in delays and inefficiencies in H&C project implementation.[3] Resource allocation also becomes problematic in the context of disjointed policy frameworks. Misaligned priorities among different levels of governance can prevent local authorities from accessing or effectively utilising the resources required for H&C projects. This mismatch of resources and responsibilities can stall project progress, especially for innovative systems like low-temperature district heating or integrated renewable solutions.

The Alpine Space is characterised by a complex governance landscape involving multiple administrative levels — local, regional, national, and transnational. The *GoApply* Alpine Space project[4] has highlighted that Alpine countries face challenges related to multi-level governance in implementing national adaptation strategies; it has emphasised the need for improved coordination among different sectors to effectively address climate-related challenges, including the implementation of sustainable energy systems. In this context, the harmonisation of policies involved in the H&C sector across governance levels and the establishment of coordinated administrative procedures could help eliminate redundancies and foster collaboration in planning and executing decarbonisation H&C projects.

2. Inadequate renewable energy integration

Renewable energy is crucial for the modernisation of H&C systems, as it reduces greenhouse gas emissions, enhances energy security, and supports the decarbonisation of buildings, industries, and district networks. Technologies such as solar thermal energy, geothermal energy, and biomass offer localised, low-carbon solutions, while renewable electricity can power heat pumps to deliver efficient heating and cooling.[5] Despite these benefits, the integration of renewables remains insufficient both in the Alpine Space and the EU more generally, with persistent regulatory and

[3] Heidingsfelder, J., and Beckmann, M. (2020). A governance puzzle to be solved? A systematic literature review of fragmented sustainability governance. *Manag Rev Q* 70: 355–390. https://doi.org/10.1007/s11301-019-00170-9

[4] www.alpine-space.eu/wp-content/uploads/2022/06/37-1-goapply-Climate%20Adaptation%20Governance%20in%20the%20Alpine%20Space%20Transnational%20Synthesis%20Report-output.pdf

[5] International Renewable Energy Agency (IRENA). 2020. *Renewable Energy Policies in a Time of Transition: Heating and Cooling*. https://www.irena.org/publications/2020/Nov/Renewable-Energy-Policies-in-a-Time-of-Transition-Heating-and-Cooling

administrative challenges undercutting its full potential. Recent data estimate that 75% of the energy used for heating and colling in Europe is still coming from fossil fuels.[6]

Lack of explicit mandates or targets for the use of renewable energy in H&C

At the regulatory level, although the EU Renewable Energy Directive sets overarching goals for renewable integration, some regions may still lack explicit mandates, binding targets or enforceable strategies for the use of renewable energy in H&C networks. This absence of clear direction undermines the prioritisation of renewables and results in a continued reliance on fossil fuels. Furthermore, financial support mechanisms often disproportionately favor conventional energy systems, limiting the economic viability of renewable alternatives. Without robust regulatory incentives, utilities and developers face reduced motivation to incorporate renewable energy into their systems.

Lack of supportive policies for critical infrastructure

Technical and infrastructure constraints further compound the impact of inadequate policies. The lack of supportive policies often translates into insufficient investment in infrastructure critical for renewable integration, such as smart grids, energy storage systems, and district heating pipelines. The International Energy Agency (IEA) highlights that systems designed for fossil fuel-based heating may not be capable of accommodating renewable energy sources without substantial upgrades.[7] This limitation is also evident in Alpine Space, with renewable integration requiring region-specific solutions to leverage renewable forms of energy effectively. Policies that fail to mandate or incentivise such infrastructure improvements can impede the scalability of H&C networks relying on renewables.

Limited access to energy resource maps or tools

Administratively, the challenge may lie in a lack of planning and capacity to identify and harness renewable energy resources effectively. Local authorities may lack the data or capacity to map renewable energy potential and match it to local energy demands.[8] Devoid of access to detailed energy resource maps or tools that identify renewable energy potential, such as geothermal reservoirs, biomass supply chains, or solar thermal capacity, they are unable to design and implement systems that can maximise the use of available renewable resources. Insufficient or delayed renewable energy integration can also stem from limited administrative competency and expertise to assess and implement green energy technologies or limited administrative and financial resources.

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[6] European Commission (EC). 2024. *Solution Booklet: District Heating and Cooling* https://managenergy.ec.europa.eu/publications/solution-booklet-district-heating-and-cooling_en?utm_source=chatgpt.com

[7] International Energy Agency (IEA). *Renewable Energy Policies in a Time of Transition*. https://www.iea.org/reports/renewable-energy-policies-in-a-time-of-transition

[8] European Environment Agency (EEA). *Decarbonising Heating and Cooling — A Climate Imperative*. https://www.eea.europa.eu/publications/decarbonisation-heating-and-cooling

3. Spatial planning and zoning

Spatial planning is another policy area that plays a key role in the successful implementation of decarbonised H&C networks. Effective spatial planning designates specific areas for residential, commercial, industrial, and agricultural purposes. This allocation can affect the feasibility of district heating and cooling networks, as densely populated urban zones are more conducive to such systems due to higher energy demand densities. Conversely, rural or sparsely populated areas may present challenges in terms of economic viability and infrastructure development. In the Alpine region, spatial planning must also balance infrastructure development with environmental preservation. Zoning laws that protect natural landscapes and biodiversity can limit the areas available for H&C infrastructure, necessitating innovative solutions to integrate energy systems without compromising ecological integrity.

Inconsistencies in zoning laws

Regulatory and administrative challenges can undermine spatial planning's potential to support sustainable energy transitions. At the regulatory level, inconsistencies in zoning laws across jurisdictions frequently hinder the deployment of district heating and cooling systems. Certain areas may not allocate sufficient space or designate zones for H&C infrastructure, such as energy centers, thermal storage facilities, or distribution networks.

Insufficient integration between spatial planning and energy planning and policies

Additionally, spatial planning often lacks integration with climate and energy policies and planning,[9] leading to fragmented approaches that do not effectively address the complexities of H&C decarbonisation. This regulatory inertia can leave H&C systems poorly aligned with urban development priorities.

The lack of strategic integration of H&C planning within broader spatial planning processes poses significant challenges. Urban planners may overlook the importance of allocating land for centralised H&C systems or pathways for underground piping networks. Without clear land use strategies, projects risk conflicts with other infrastructure developments, such as transportation or water networks, leading to delays and increased costs. Furthermore, coordination between different agencies responsible for energy, environment, and urban development is often inadequate, resulting in fragmented approaches to infrastructure deployment.

Incompatible building regulations (e.g. rigid insulation requirements, outdated thermal performance metrics)

Building regulations are part and parcel of spatial planning and governance. The building code plays a pivotal role, as it establishes the minimum requirements for energy efficiency, safety, and

[9] Energy Cities. 2024. The state of play and what will be needed to make it a standard practice across the EU: Findings and Policy Recommendations.
https://energy-cities.eu/wp-content/uploads/2024/09/EU-analysis-Heating-and-Cooling_Update2024.pdf

performance in the built environment. Its significance extends to several key aspects of H&C systems, including:

- Energy efficiency and decarbonisation: Building codes directly influence the energy performance of H&C systems by setting standards for insulation, ventilation, and thermal performance.
- Integration of renewable energy: Modern building codes often encourage or mandate the integration of renewable energy technologies, such as solar thermal systems or geothermal heat pumps, into H&C systems.
- Uniform standards and equity: Building codes establish consistent benchmarks across jurisdictions, ensuring that all buildings adhere to minimum energy and safety standards. This uniformity helps level the playing field for developers and ensures equitable access to efficient and safe H&C solutions.

Building regulations can exhibit inefficiencies and inconsistencies, hindering the effective planning, implementation, and operation of decarbonised H&C networks. A significant issue is the outdated nature of many building codes, which fail to keep pace with advancements in H&C technologies such as heat pumps, low-temperature district heating, and waste heat recovery systems. By prioritising traditional high-temperature and fossil-fuel-based systems, they can limit the adoption of more efficient and innovative solutions.

Regional disparities further exacerbate these inefficiencies, as different jurisdictions adopt varying versions of building codes or enforce them inconsistently. Lack of uniformity can generate confusion and additional costs for developers and contractors working across multiple regions. Additionally, possible discrepancies between national and regional regulations can lead to fragmented application, forcing developers to navigate multiple, often conflicting, requirements.

4. Complex permitting processes

Permitting processes can present significant regulatory and administrative challenges in the planning and implementation of H&C networks.

Conflicting or outdated requirements

Lengthy and intricate regulatory requirements can cause delays in project timelines, increased costs, and deterred investments. The problem can be more intense in the case of innovative H&C solutions, as permitting regulations often remain outdated and fail to accommodate modern H&C technologies, such as heat pumps or district energy systems. This misalignment with contemporary solutions further complicates permitting processes and creates unnecessary obstacles.

Limited administrative capacity and technical expertise in permitting offices

From an administrative perspective, permitting offices often face severe resource constraints, operating with limited staff and outdated tools. These inefficiencies lead to prolonged review times

and backlogs, discouraging investment in H&C projects. For instance, it was recently found out that and reported that homeowners in the UK have experienced delays of up to six months in obtaining planning permission for heat pump installations, as councils struggle to process a higher volume of applications due to increased demand.[10] The rapid advancement of H&C technologies can exacerbate the problem, as permitting officials frequently lack the technical expertise required to evaluate applications for these complex systems. This knowledge gap can result in overly cautious or inconsistent decision-making, either delaying approvals unnecessarily or rejecting viable projects. These issues of limited administrative capacity and technical expertise in permitting offices have been addressed by the European Commission in their recent recommendation on speeding up permit-granting procedures for renewable energy and related infrastructure projects.[11]

5. Funding and economic incentives

Arguably, access to funding and the provision of economic incentives are critical for the feasible and successful planning and implementation of modern decarbonised H&C solutions. Financial support mechanisms, such as grants, subsidies, and tax incentives, can offset the substantial initial capital expenditures associated with these advanced technologies. Without these incentives, both public and private entities may find it economically unfeasible to invest in their implementation, resorting to continued reliance on outdated and less efficient solutions. Hence, regulatory and administrative challenges related to funding and incentives can have detrimental effects on the materialisation of decarbonisation H&C projects.

Inadequate financial support schemes/ Complex and fragmented regulations

Inconsistent or insufficient policy frameworks often result in inadequate financial support for such projects. For instance, the absence of clear mandates or targets for renewable energy integration in H&C systems can lead to a lack of dedicated funding streams. This uncertainty discourages investment and innovation.

Limited capacity and expertise within local authorities to design and implement funding and incentives programs

On the administrative side, limited capacity and expertise within local authorities can hinder the effective deployment of funding programs. Many municipalities may lack the resources to design, implement, and manage incentive programs tailored to H&C systems. This deficiency can result in under-utilisation of available funds or misalignment of incentives with project needs. Moreover,

[10] Cooke, B. November 17, 2024. Homeowners wait six months for heat-pump planning permission. *The Times*. https://www.thetimes.com/uk/environment/article/homeowners-wait-six-months-for-heat-pump-planning-permission-0x8tphwzr

[11] European Commission. May13, 2024. *Commission Recommendation (EU) 2024/1343 on speeding up permit-granting procedures for renewable energy and related infrastructure projects.* https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L_202401343&qid=1732875840744

bureaucratic inefficiencies, such as cumbersome application procedures and lengthy approval processes, can delay project timelines and increase costs.

6. Workforce skills and technical capacity

The availability of a workforce with an adequate technical capacity is another critical factor. A skilled workforce is indispensable to the planning, implementation, and operation of decarbonisation H&C networks, particularly in the case of advanced systems like 5GDHC.[12] These systems rely on new technologies such as heat pumps, low-temperature grids, thermal energy storage, and digital controls, all of which require specialised knowledge and expertise.

Absence of standardised certification and training programs

Regulatory and administrative challenges related to this area can therefore severely impede the feasibility and progress of H&C networks' planning and implementation. In many regions, there is a lack of standardised and decarbonisation-specific certification and training programs for H&C professionals. This absence leads to inconsistencies in skill levels and qualifications, making it difficult to ensure high-quality installations and maintenance. Moreover, existing regulations may not mandate continuous professional development based on new H&C technologies and applications, resulting in a workforce that is not up-to-date with the latest technologies and best practices.

Insufficient planning and investment in skills training by local authorities

As far as the administrative level is concerned, gaps in workforce development are often closely tied to the lack of planning and investment in skills training. Furthermore, the under-utilisation of existing workforce data and tools, such as skills assessments or labour market forecasts, means that regions fail to anticipate future needs and address skills shortages proactively.

7. Data collection and sharing

Data is critical for designing decarbonisation H&C systems that are both efficient and scalable, as it enables a detailed understanding of energy demand patterns, potential supply sources, and network performance. Datasets that can be operationalised towards more efficient planning and implementation processes encompass energy demand patterns (including building-specific consumption, spatial distributions, and seasonal variations), as well as energy supply data such as renewable resource availability, waste heat potential, and grid capacity. Infrastructure-related data, including the status of existing networks and technological specifications, is equally critical, alongside environmental data like climate conditions, geospatial maps, and impact assessments.

[12] Energy Cities. 2024. The state of play and what will be needed to make it a standard practice across the EU: Findings and Policy Recommendations.

Economic and financial data, covering investment costs, energy pricing, and cost-benefit analyses, intersect with regulatory and policy data on compliance requirements, incentive programs, and access rules. Social and behavioral insights, such as consumer habits, affordability metrics, and community feedback, complement operational and monitoring data derived from performance metrics and maintenance records. Taken together, these datasets can form the backbone of data-driven decision-making for efficient, sustainable H&C systems.

Although effective data collection and sharing processes are crucial for the planning and implementation of such systems, both regulatory and administrative challenges often undermine its availability and utilisation.[13]

Absence of standardised protocols for data collection

On the regulatory side, the absence of standardised protocols for data collection results in inconsistencies in the quality and comparability of data across jurisdictions. This lack of uniformity complicates the assessment of energy needs and the design of H&C networks.

Proprietary data practices restricting access to information

Additionally, the absence of relevant robust regulatory frameworks can also result in siloed or proprietary data practices, where stakeholders such as utilities, municipalities, and private developers are unwilling or unable to share information.[14] This limits opportunities for integrated energy planning, whereas data from multiple sources —including building stock assessments, renewable energy availability, and existing infrastructure— could otherwise be synthesised to create more effective and sustainable heating and cooling networks.

Limited technical expertise and infrastructure within local authorities

From an administrative perspective, limited technical expertise and resources within local authorities often hinder the effective collection and management of data. Many municipalities lack the necessary infrastructure, such as advanced metering systems, to gather detailed energy consumption information.

8. Waste heat potential

Limited recognition of waste heat potential in policy frameworks can be considered a missed opportunity in the context of planning and implementing decarbonisation H&C networks. Waste heat, often generated by industrial processes, data centers, and power plants, represents a substantial and under-utilised energy resource. However, policies tend to fail to acknowledge or

[13] This applies to Alpine Space regions as well. The CERVINO project has sought to address this issue by developing a unified energy data platform for the Alpine region, facilitating the exchange and visualisation of energy data to support decision-making processes.
https://www.alpine-space.eu/project/cervino/
[14] Energy Cities. 2022. *The Role of Local Authorities in Data-Driven Energy Planning*.
https://energy-cities.eu/

support the recovery and integration of this energy. In Alpine Space regions, where industrial activities generate significant amounts of waste heat, this gap can significantly prevent the development of effective strategies for harnessing these resources, undermining the potential of green H&C solutions.

Absence of explicit policies and incentives promoting waste heat recovery

A primary issue can be the absence of explicit policies and incentives promoting waste heat recovery. Often energy regulations focus predominantly on conventional energy sources, neglecting the substantial benefits of utilising waste heat. This oversight results in a lack of financial incentives or supportive frameworks necessary to encourage industries and utilities to invest in waste heat recovery technologies. Additionally, existing energy efficiency standards often do not mandate or even consider the integration of waste heat recovery, leading to missed opportunities for enhancing system efficiency and reducing emissions.

9. Public awareness and engagement

Lack of provisions for educating and involving the public

Awareness about the merits of decarbonised H&C solutions and the active engagement of citizens can be instrumental in their promotion and implementation, as communities may still remain uninformed about their benefits and operational aspects. For instance, recent studies show that a significant percentage of the public does not recognise heating as one of the top contributors to carbon emissions, which can hinder support for necessary policy changes and investments in low-carbon technologies.[15] This lack of awareness can lead to resistance against new infrastructure projects, as residents might perceive them as intrusive or unnecessary.

Limited resources and expertise to organise outreach programs

Limited resources and lack of expertise can also in this case prevent effective public engagement, thereby acting as a barrier to the adoption of decarbonised H&C solutions. Local authorities may lack the capacity to organise outreach programs or facilitate meaningful dialogues with the community. Moreover, bureaucratic inefficiencies, such as slow information dissemination and complex communication channels, can frustrate public participation efforts. This disconnection between administrative bodies and the public can further maintain lack of awareness about H&C technologies, reducing community support and potentially leading to project delays or cancellations.

[15] Smith, W., Pidgeon, N. Demski, C., and Becker, S. 2024. Mapping the Landscape of Public Attitudes Towards Low-Carbon Heating Technologies. *UK Energy Research Center* https://ukerc.ac.uk/publications/public-attitudes-low-carbon-heat-technologies/

10. Research and innovation

Lack of policy support for research and development in green H&C technologies

Given the importance of innovation for the upgrade of sustainable heating and cooling technologies, policy frameworks that fail to prioritise research and development in this sector can contribute to a lack of market-ready technologies that are both cost-effective and scalable. Such a gap can make it challenging for stakeholders to implement tailored H&C solutions, as the available technologies may not meet the specific needs or economic constraints of different regions. The integration of strong support for innovation and research into policy frameworks is therefore vital for fostering the development and adoption of advanced H&C solutions and discontinuing reliance on outdated and less efficient systems.

Case studies of H&C projects in the EU: Regulatory revisions and administrative interventions

In what follows, two exemplary cases of decarbonised H&C networks in the Netherlands and Germany are presented, focusing on the barriers they faced and/or the practices that were undertaken to facilitate their implementation and development.

The Mijnwater Project in Heerlen, Netherlands

The Mijnwater Project in Heerlen, Netherlands, stands as a pioneering example of sustainable energy innovation, which makes use of geothermal resources from abandoned coal mines. Launched in 2008, this project utilises water extracted from the Oranje Nassau III coal mine to provide heating and cooling services to buildings in the region. The system operates by pumping water from depths of approximately 700 meters, where it reaches temperatures around 28°C, and distributing it via a network of pipes to connected facilities, including residential and commercial buildings.

Initial administrative efforts included pilot studies and feasibility assessments that demonstrated how repurposing abandoned coal mines could serve as viable geothermal sources for heating and cooling, thus garnering public support for further investments. Recognising the project's potential, the municipality established Mijnwater BV in 2013, a company wholly owned by the municipality, to oversee the development and management of the heating and cooling network. The establishment of Mijnwater BV as a publicly owned development corporation further streamlined governance, allowing for better coordination among local stakeholders and facilitating investments in infrastructure necessary for the project's expansion.[16]

In the same year, the project transitioned from a fourth-generation district heating and cooling system to a fully operational fifth-generation system. This upgrade enabled the simultaneous exchange of heat and cold between various customers connected to the grid, enhancing efficiency and reducing overall energy consumption. The local government played an essential role in this transition by supporting initiatives that encouraged energy self-sufficiency within clusters of buildings connected to the grid.

The project faced several regulatory challenges during its development, primarily stemming from the need to navigate complex legal frameworks and ensure social acceptance in a region transitioning from coal mining to renewable energy. One of the significant hurdles was the lack of existing regulations specifically governing the use of mine water for geothermal heating. The introduction of new mining laws was essential, as these laws had to accommodate the unique aspects of extracting geothermal energy from abandoned coal mines, particularly concerning depth and environmental

[16] https://guidetodistrictheating.eu/heerlen/

impact. The project required permits that allowed for drilling and extraction at depths greater than 500 meters, which was a relatively uncharted territory in Dutch legislation at the time.[17]

Another challenge involved securing financial backing and managing financial risks associated with such an innovative project. Many financial institutions were initially hesitant to invest due to uncertainties surrounding the viability and potential returns of geothermal energy systems. To address this, Mijnwater BV utilized various funding schemes, including subsidies from local municipalities and European Union grants, which helped build trust and demonstrate the project's feasibility.

Social acceptance also posed a challenge. The municipality actively engaged with local communities, including former mine workers, to foster support for the project. Their involvement was crucial in identifying optimal drilling locations and ensuring that community concerns were addressed throughout the planning stages. This participatory approach helped mitigate resistance and promote a sense of ownership among residents.[18]

Additionally, the project faced difficulties in finding contractors with the necessary expertise to design and implement the geothermal grid effectively. This required a specific understanding of both the operational intricacies and energetic performance needed for a successful district heating system.[19] Operational challenges stemming from technical aspects related also to system maintenance and performance. Issues such as clogging from mineral precipitates in the mine water system necessitated ongoing monitoring and maintenance, which added complexity to project management. The need for continuous adaptation and optimisation of the system highlighted the importance of regulatory flexibility to accommodate evolving operational requirements.

In 2018, the Limburgs Energie Fonds (LEF), a €90 million fund dedicated to supporting projects in energy savings and sustainable energy production within the Dutch province of Limburg, acquired Mijnwater BV. This acquisition was a strategic move to secure financial backing for the project's expansion and to align it with regional energy transition goals. The involvement of LEF underscored the importance of administrative facilitation in securing investment for sustainable initiatives.

Overall, the Mijnwater Project exemplifies how effective regulatory revisions and administrative practices can facilitate innovative energy solutions while addressing environmental concerns and promoting regional development. The regulatory landscape evolved alongside the project, transforming initial challenges into opportunities for setting precedents in geothermal and district

[17] https://www.allesoveraardwarmte.nl/aardwarmtewinning-locatie/mijnwaterproject-heerlen/,
Nhg, Hengky. 2019. *From Third to Fourth Generation District Heating in Leeuwarden: An Exploration of Feasibility and Risks*. Master Thesis. University of Twente.
https://essay.utwente.nl/79496/1/NG_MA_BMS.pdf
[18] Renewables Networking. *Mine water for renewable energy: Heerlen (NL) gave new life to disused mines!*. Case study.
https://www.renewables-networking.eu/documents/CaseStudy-Heerlen-TheNetherlands.pdf
[19] Walls, D.B., Banks, D., Boyce, A.J., Burnside, N.M. A Review of the Performance of Minewater Heating and Cooling Systems. *Energies* 2021, 14, 6215.
https://doi.org/10.3390/en14196215

heating policies. This adaptability was key to the Mijnwater Project's success as a model for sustainable urban energy systems.

The introduction of legislation that addressed and allowed for drilling and extraction at depths greater than 500 meters, the active search for and utilisation of funding schemes and opportunities, and the active engagement with local communities on the administrative level, constitute best practices that managed to tackle existing hurdles and inconsistencies. Despite being specific to the project's circumstances, these practices could be transferred and applied —or at least could inspire practices— in other contexts.

As part of its long-term vision, Mijnwater BV aims to connect approximately 110,000 homes in the Parkstad Limburg region by 2040, demonstrating an ongoing commitment to expanding this sustainable energy model across more communities.

The 5GDCH network in Neustadt am Rübenberge, Germany

The 5th Generation District Heating and Cooling network in Neustadt am Rübenberge, Germany, is another innovative project that exemplifies the shift towards sustainable urban energy solutions. It employs low-temperature renewable energy sources, particularly geothermal energy, to provide efficient heating and cooling services to the community. Commissioned in 2020, this network spans 0.92 kilometers and supplies 56 buildings in the Hüttengelände district, utilising uninsulated plastic pipes and shallow geothermal energy as its primary heat source. The system is operated by Stadtwerke Neustadt, the local municipal utility company.

The primary energy factor of the heat supply in this network is 0.45, indicating a high level of energy efficiency. The technical design of the Neustadt am Rübenberge network incorporates advanced features that enhance its efficiency and sustainability. The system is designed to facilitate bidirectional energy exchanges between buildings with varying heating and cooling demands. This means that excess heat generated in one building can be utilised by another building requiring heating, thereby optimising overall energy use within the network. Such innovative designs required careful planning and coordination among various stakeholders, including engineers and urban planners.

One of the project's preconditions was the adaptation of existing energy regulations to support low-temperature operations. Given that traditional district heating regulations in Germany were primarily focused on high-temperature systems, which did not align with the operational principles of 5GDHC, their revision and adaptation to allow for lower temperature operations, typically ranging from -5°C to 20°C, was crucial.

A significant regulatory measure that facilitated the network's development was the implementation of a mandatory connection policy for buildings within the new construction area. This policy required all new buildings in the Hüttengelände district to connect to the 5GDHC network, ensuring a

consistent demand and enhancing the project's economic viability.[20] Implementing a mandatory connection policy for buildings within the new Hüttengelände district was a certain challenge. While such mandates enhance network efficiency and economic viability, they can face political resistance and legal scrutiny. Local authorities had to justify the policy's benefits to gain public acceptance and legal approval.

Administratively, the ownership structure of the decentralised heat pumps has played a crucial role, as the municipal public utility and network operator, Stadtwerke Neustadt, owns the decentralised heat pumps installed in each building.[21] This arrangement allows for centralised monitoring and maintenance, ensuring optimal performance and adherence to energy efficiency standards. It also simplifies the billing process, as the operator can charge for the heat delivered at the condenser of the heat pump on the building side, streamlining administrative procedures and enhancing operational efficiency.

Additionally, the project had to navigate administrative hurdles related to the coordination between various stakeholders, including policymakers, industry stakeholders, and research institutions. Effective collaboration and communication were essential to overcome technical and economic challenges and to ensure the successful implementation of the network.

In summary, the successful implementation of the 5GDHC network in Neustadt am Rübenberge was facilitated by strategic regulatory policies, such as mandatory connection requirements, and effective administrative practices, including centralised ownership and management of decentralised heat pumps. Both measures are not exclusive to this case; instead, they are common to many other DHC networks, 5G or otherwise. In Neustadt am Rübenberge's case they have proven to contribute to the project's economic viability, operational efficiency, and alignment with national energy objectives, serving as a model for similar sustainable energy initiatives.

[20] nPro.energy. *5GDHC network in Neustadt am Rübenberge: Facts and figures*. https://www.npro.energy/main/en/5gdhc-networks/5gdhc-districts/neustadt-am-ruebenberge-huettengelaende

[21] nPro.energy. *5GDHC network in Neustadt am Rübenberge: Facts and figures*. https://www.npro.energy/main/en/5gdhc-networks/5gdhc-districts/neustadt-am-ruebenberge-huettengelaende

Data Collection Guidelines

Survey design and research participants

The purpose of this survey is to develop a methodology that will enable partners to collect the territorial input required for ALPHA's activity 1.1. More specifically, the survey focuses on the identification of regulatory and administrative gaps in partner's territories, which may act as barriers to the development of H&C networks that could contribute towards the decarbonisation targets that have been set in the local as well as the Alpine Space context. The focus should be on gaps and challenges related to the implementation of DHC solutions, but partners could identify and describe gaps impeding the deployment of decarbonised H&C solutions more generally.

To this end, FLA has developed a standardised approach for data collection, ensuring that all input is documented in a consistent, comparable, and clearly structured manner. The questionnaire, which is provided in Annex I, aims to guide partners and facilitate the research process. Respondents are strongly encouraged to first read the thematic background provided above, as it includes information, clarifications, and examples that will help them better pinpoint and classify challenges in their regions on both the regulatory and the administrative level.

ALPHA partners are advised to conduct thorough desk research for their territories to gather as much detailed and comprehensive evidence as possible. Additionally, they are encouraged to engage with relevant authorities and stakeholders —such as public authorities and governing bodies at different levels, policymakers, industry representatives, research institutions, and civil society actors— to gain deeper insights into existing regulatory and administrative gaps and challenges.

Identifying inefficiencies, inconsistencies and barriers in the policy areas that bear upon DCH applications, and the H&C sector more generally, can be an intricate process, requiring a strong understanding of existing practices and frameworks across various levels (transnational, national, regional, and local) as well as a good grasp of industry-specific peculiarities. The following questionnaire is designed to help partners navigate this process and systematically compile the necessary data.

The data collection tool

The questionnaire provided in Annex I consists of the following sections:

A. Participant information. In this section, respondents will provide their name, email, and organisation.

B. Current state-of-play in the H&C sector. Respondents are asked to rate the level of decarbonisation and modernisation of H&C networks in their territories, and evaluate the extent to which existing gaps and barriers in related policy areas may inhibit efforts for decarbonisation.

C. Identification of gaps and challenges on both regulatory and administrative levels. Respondents are asked to point out regulatory inconsistencies and inefficiencies and administrative weaknesses and needs that may hinder processes of planning and implementing H&C technologies. They are required to pinpoint the specific gap, assess its intensity, describe its impact, and provide information about initiatives that may have been undertaken in order to address or ameliorate the gap in question, if any.

The gaps, inconsistencies and weaknesses identified and reported by the ALPHA partners will undergo a review process which will ensure that they comply with the criteria and guidelines laid out in this methodology. Partners' input will be fed into a policy analysis report developed by FLA, which will highlight weaknesses and gaps in partners' policy and governance frameworks and provide recommendations for the update and improvement of said frameworks, geared towards the promotion and acceleration of H&C decarbonisation solutions.

Key Performance Indicators (KPIs) and timeline

To facilitate efficient data collection within the timeline of Activity A1.1, minimum targets have been established for gathering territorial evidence by project partners. These targets are designed to track progress and ensure the acquisition of adequate information. Partners are not expected to cover all suggested policy areas. Each partner is required to identify **at least one (1) gap** for **five** out of the ten policy areas addressed in the questionnaire; that is, **a minimum of five (5) gaps** overall. These could be some of the gaps already mentioned in the questionnaire or they could relate to other challenges that are not addressed. They may also include gaps and challenges that do not necessarily fall within the ten policy areas discussed in the questionnaire and the document's thematic background.

Partners are kindly requested to submit their input within **4 weeks** after receiving this methodology. The questionnaire attached in the Annex is also accessible online via the following link:

https://form.jotform.com/243333471712047

Online completion of the questionnaire is preferred. The questionnaire is designed with a save-and-continue feature, which allows respondents to pause and continue without having to complete them in one sitting. After each save, users will receive an email with a link to access their progress up to that point, ensuring a smooth and convenient process.

Indicative sources to facilitate research

European Environment Agency (EEA) - Decarbonising heating and cooling: A climate imperative
https://www.eea.europa.eu/publications/decarbonisation-heating-and-cooling

Energy Cities: The European learning community for future-proof cities
https://energy-cities.eu/local-heating-and-cooling-plan/

CERVINO: Creating an Energy data exchange and visualisation tool for the Alps
https://www.alpine-space.eu/project/cervino/

Guidelines for the online workshop on H&C best practices

The purpose of this section is to provide the necessary information and guidelines so as to facilitate the successful organisation and implementation of the upcoming online workshop on heating and cooling best practices. The first part focuses on the preparation phase, including recommendations and actions that need to be undertaken prior to the workshop. The next part presents a comprehensive implementation plan, including an indicative agenda that is provided in Annex II, to facilitate the organisation of the workshop and the engagement between participants. Finally, the last section addresses the evaluation of the workshop as well as the follow-up actions which constitute the next steps of the project's Activity A1.1.

Preparation phase

The aim of the online workshop is to share successful examples of green H&C projects from partners' territories and the EU more generally, thereby facilitating knowledge exchange and opening opportunities for collaboration. While the workshop's focus is mainly on new generation DHC systems, it may also include decarbonised or efficient H&C solutions more generally. Partners should therefore look for regulatory or administrative revisions and updates that have facilitated, or are expected to facilitate, processes of planning and implementing such systems and solutions. If there are not any existing best practices in their territories to draw from, partners could look for best practices on the national level or even in the context of EU more generally. If no best practices can be identified whatsoever, the online session will serve as an opportunity for partners to consider opportunities for the adoption of best practices developed elsewhere in their own territorial policies.

FLA will dispatch formal letters or emails to partners and other stakeholders at least two weeks prior to the activity, highlighting the importance of their participation and providing the agenda and objectives of the event. Each partner can recommend stakeholders that could participate in and contribute to the workshop's workings, but this is not mandatory. First and foremost, the online event is meant to bring together partners and facilitate the sharing of knowledge between them. An invitation email template is provided in Annex II. Additionally, a follow-up reminder email a week before the event should be sent to confirm attendance and address any queries.

Partners are encouraged to review and familiarise themselves with the agenda and any case studies or materials sent before the event. Since each session is designed to include interactive discussions, their input will be crucial. They should therefore prepare ahead of the meeting to share their insights. If their territories offer relevant examples or questions about decarbonised H&C systems, they are encouraged to think about how to share or frame these during the discussions.

As far as the technical preparation is concerned, participants should ensure that they have a stable internet connection and access to the selected platform. They should also test audio and video equipment beforehand to avoid technical issues during the event.

Implementation plan

To develop an effective and comprehensive implementation plan for the organisation of the workshop, two key issues were considered:

- The workshop will take place virtually, which results in limited room and opportunities for participants' interaction with each other, as well as active engagement in the activities (e.g., presentations, roundtables, etc.) potentially included in the agenda.
- The duration of the workshop, which will be one day. This limited time results in practical boundaries regarding the range of topics to focus on, as well as the potential for incorporation of small group activities.

In this context of a virtual one-day workshop intended for the exchange of experience and best practices among project partners, incorporating diverse activities is essential to foster engagement, collaboration, and knowledge sharing. Suggested activities presented below ensure a well-rounded and engaging workshop experience for project partners. They aim to facilitate knowledge exchange, active participation, collaboration, and goal alignment among participants. Additionally, alternating between different activities maintains participant engagement and interest throughout the day.

- Icebreakers and Introductions: Brief introductions, and short interactive polls help set a positive tone, get participants comfortable, and create a warming atmosphere
- Presentations and Information Sharing: Scheduled presentations by project partners or experts using slides, visual aids, and demonstrations. Q&A sessions can follow each presentation for clarification and discussion.
- Collaborative Activities: Promote teamwork and individual engagement by using breakout discussions, brainstorming activities, and project-specific tasks to solve together. This fosters a sense of shared responsibility and ownership.
- Closing Remarks and Action Planning: Concluding remarks by workshop, highlighting key insights, summarising key points, specifying next steps and action items in the project's timespan.

The suggested agenda, presented in Annex II, has been developed taking into consideration the limitations and advantages of online workshops, while also aiming to cover the thematic areas that lie at the heart of the workshop's objectives.

Partners are expected to join the workshop on time and stay focused throughout. Their contributions are important to make this event a success; they are therefore encouraged to participate actively, share their experiences, challenges, and ideas during the discussions and taking an active role in breakout discussions.

Follow-up actions

Participants' feedback on the event and the discussion is critical for the project's next steps and activities. They should therefore complete the evaluation form that is again provided in Annex II. Partners are also encouraged to join any follow-up communication to stay in touch with other participants and continue the dialogue.

FLA will develop a comprehensive report analysing the results of the workshop. This report will serve as a tool to enable knowledge transfer across Alpine territories and facilitate the adaptation of best practices and insights to the specific needs of the participating territories. The report will be shared with all participants to support informed decision-making and implementation.

Annex I: Questionnaire for Activity 1.1

A. CONTACT INFORMATION	
Name and surname of the person filling in the questionnaire:	
Affiliation (partner organisation):	
Contact email:	
Region or Country covered:	

B. STATE-OF-PLAY IN THE H&C SECTOR	
What is the level of decarbonisation of the H&C sector in your region?	☐ High (0-30% fossil fuels) ☐ Moderate (30-60% fossil fuels) ☐ Low (above 60% fossil fuels)
How would you rate the contribution of existing gaps and barriers to hindering the decarbonisation of the H&C sector?	☐ Minor ☐ Moderate ☐ Major

C. IDENTIFICATION OF GAPS AND CHALLENGES	
Please identify and describe gaps and challenges pertaining to fragmented governance structures and policy frameworks.	
Inconsistent and conflicting policies and directives	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	

Mismatch between resources and public authorities' responsibilities	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	
Other	
If you choose 'Other', please specify	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	

Please identify and describe gaps and challenges pertaining to inadequate energy integration.	
Lack of explicit mandates or targets for the use of renewable energy in H&C	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	
Lack of supportive policies for critical infrastructure (smart grids, energy storage systems, district heating pipelines, etc.)	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate

	☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	
Limited access to energy resource maps or tools	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	
Other	
If you choose 'Other', please specify	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	

Please identify and describe gaps and challenges pertaining to spatial planning and zoning.	
Insufficient integration between spatial planning and energy planning and policies	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	
Inconsistencies in zoning laws	
Please describe the challenge in more detail.	

Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	
Incompatible building regulations (e.g. rigid insulation requirements, outdated thermal performance metrics)	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	
Other	
If you choose 'Other', please specify	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	

Please identify and describe gaps and challenges pertaining to permitting processes.	
Conflicting or outdated requirements	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	

Limited administrative capacity and technical expertise in permitting offices	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	
Other	
If you choose 'Other', please specify	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	

Please identify and describe gaps and challenges pertaining to financial support and incentives.	
Inadequate financial support schemes	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	
Complex and fragmented regulations inhibiting access to funding	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate

	☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	
Limited capacity and expertise within local authorities to design and implement funding and incentives programs	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	
Other	
If you choose 'Other', please specify	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	

Please identify and describe gaps and challenges pertaining to workforce skills and technical capacity.	
Absence of standardised certification and training programs for green H&C technologies in policy frameworks	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	
Insufficient planning and investment in skills training by local authorities	

Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	
Other	
If you choose 'Other', please specify	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	

Please identify and describe gaps and challenges pertaining to data collection and sharing.	
Absence of standardised protocols for data collection	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	
Proprietary data practices restricting access to information	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High

If relevant, describe any initiatives that have been undertaken to address this challenge.	
Limited technical expertise and infrastructure within local authorities	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	
Other	
If you choose 'Other', please specify	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	

Please identify and describe gaps and challenges pertaining to waste heat potential.	
Absence of explicit policies and incentives promoting waste heat recovery	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	
Other	
If you choose 'Other', please specify	
Please describe the challenge in more detail.	

Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	

Please identify and describe gaps and challenges pertaining to public awareness and engagement.	
Lack of provisions for educating and involving the public on decarbonisation H&C solutions	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	
Limited resources and expertise to organise outreach programs	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	
Other	
If you choose 'Other', please specify	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High

If relevant, describe any initiatives that have been undertaken to address this challenge.	

Please identify and describe gaps and challenges pertaining to research and innovation.	
Lack of policy support for research and development in green H&C technologies	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	
Other	
If you choose 'Other', please specify	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	

Please identify and describe any gap or challenge that may not fall within any of the policy areas addressed already.	
Please describe the challenge in more detail.	
Please assess the level of disruption it causes to decarbonisation efforts.	☐ Low ☐ Moderate ☐ High
If relevant, describe any initiatives that have been undertaken to address this challenge.	

Annex II: Agenda and templates for the online workshop

Invitation email template

Subject: Invitation to the upcoming online workshop on “Heating and Cooling Best Practices”

Dear [Recipient],

We are excited to invite you to the upcoming workshop on “Heating and Cooling Best Practices” organised by FLA within the framework of the ALPHA Interreg Europe project.

Details of the event:

Date: [Insert Date]

Time: [Insert Time]

Online Link: [Insert hyperlink]

Registration Link: [Insert hyperlink]

A detailed agenda and further information will be provided upon your registration to the workshop. We kindly request your confirmation of attendance by [RSVP Date].

We look forward to your participation!

Sincerely,

[Name/Affiliation/Signature]

Evaluation form template

Question	Rate (1 – 5) 1: least satisfied 5: most satisfied
Overall satisfaction with the event	
Relevance of topics discussed	
Quality of speakers and presentations	
Effectiveness of interactive sessions	
Networking opportunities	
Suggestions for future events	

☐ I consent to FLA collecting, using, disclosing, and/or processing my personal data for the purposes of the ALPHA Interreg Europe project.

Suggested Agenda

Workshop Title:
Innovative Heating and Cooling Solutions: Sharing Best Practices Across Alpine Space Territories and the EU

Duration: 3 Hours

Session 1: Introduction and Context Setting (35 minutes)

- Welcome and Opening Remarks (15 minutes)
  - Introduction by a moderator.
  - Brief overview of the workshop's objectives and brief introductions.
- Keynote: The Role of Innovative Heating and Cooling in Sustainable Energy Transition (20 minutes)
  - Presented by an expert in EU energy policies or a notable case study representative.

Session 2: Sharing Best Practices (60 minutes)

- Case Study Presentations (40 minutes)
  - *Presentation 1*: Success story from a partner territory.
  - *Presentation 2*: EU-funded project implementation (e.g., 5GDHC or other innovative systems).
  - *Presentation 3*: Local innovation by a municipality.
- Q&A Session (20 minutes)
  - Participants will engage directly with presenters.

Session 3: Collaborative Breakout Discussions (45 minutes)

- Participants will be divided into smaller groups to discuss:
  1. *Group 1*: Policy challenges and opportunities for regulatory revisions.
  2. *Group 2*: Innovative financing models for heating and cooling.
  3. *Group 3*: Community engagement and acceptance strategies.

- Questions will be provided for each group.

Session 4: Plenary and Next Steps (30 minutes)

- Group Presentations (15 minutes)
    - Each group will present key takeaways and recommendations.
- Discussion: Collaborative Opportunities (10 minutes)
    - Areas for partnership or knowledge sharing will be identified.
- Closing Remarks (5 minutes)
    - Summary of key insights and next steps by the moderator.