Interreg Alpine Space

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ALPHA

Output 1.1

Joint planning and decision-making framework for an accelerated transalpine roll-out and adoption of up-to-date H&C/5GDHC networks in ALPHA territories and beyond

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Introduction

The ALPHA project brings together nine partners from five EU Alpine countries: Austria, France, Germany, Italy, and Slovenia. Its overarching objective is to accelerate the decarbonisation of heating and cooling (H&C) systems by promoting the development and implementation of modern district heating and cooling (DHC) networks. As a model of transnational cooperation, ALPHA aims to address key territorial disparities and fragmentation across the Alpine region, fostering a unified and adaptable approach to modern H&C planning.

The project advances this goal by establishing an Alpine-wide coordination and planning framework that supports stakeholders in implementing integrated H&C decarbonization pathways. Through collaborative research, capacity-building activities, and methodological innovation, the project develops strategic resources and planning tools to assist local authorities, SMEs, and infrastructure developers in aligning with both EU policy priorities and the unique geographical, administrative, and socioeconomic conditions of Alpine territories.

This Output, **O.1.1 – Joint planning and decision-making framework for an accelerated transalpine roll-out and adoption of up-to-date H&C/5GDHC networks in ALPHA territories and beyond**, forms part of Work package 1. The framework (encapsulating WP1 know-how, tools & resources) will function as an instrument for improving decision-making for up-to-date H&C /5GDHC networks roll-out, through the specification of planning requirements, practical steps and transnational resource optimisation synergies. As such, it serves as a prerequisite and resource for the planning and implementation of the pilot actions (WP2, especially Activities 2.1 and 2.2), thus paving the way for up-to-date H&C network configuration. The present output thus acts as a modular framework and prerequisite for future work, enabling users such as local authorities, municipalities, SMES, and others to diagnose local barriers, access proven solutions and existing systems, assess technical feasibility, and navigate the final implementation of the improved or new network. The insights and outputs developed will therefore not only serve as a reference for ALPHA's partners and pilot actions throughout the project but will also contribute to the broader rollout of efficient and climate-resilient heating and cooling solutions across the Alpine region and beyond.

Joint planning and decision-making framework structure

WP1 establishes an Alpine-wide coordination and planning framework through transnational cooperation mechanisms and jointly customised tools and resources, to support target groups in rolling out H&C decarbonisation pathways across Alpine Space. More specifically to:

1. Reach and raise the awareness of target groups (particularly public authorities, sectoral agencies, SMEs service & providers) on Heating & Cooling (H&C) decarbonisation solutions set forth by ALPHA, to engage them directly in project activities addressing their policy, know-how and business needs.

2. Increase their knowledge regarding the use of H&C planning tools and methodologies.

3. Influence their attitude to foster their active involvement in Local Working Groups for the pilot actions.

Furthermore, the output of this WP1 is now interconnected within this framework approach to enable a faster uptake of the knowledge and methodology gained. The framework consists of five different modules, mainly supported by the output of the activities in WP1.

Module 1: Regulatory and Administrative Gap Analysis

Module 2: SME Needs Assessment and Business Model Library

Module 3: Knowledge Transfer and Best Practice Repository

Module 4: GHG Assessment and Benchmarking Tool

Module 5: Decision-Making Support Methodology

It is important to note that modules can be used differently depending on the scenario. Rather than a "one-fits-all" framework, it is more like a toolbox of modules that can be connected individually to provide the most suitable workflow or individual framework. The most important content of each module is summarised below. For detailed reports and

comprehensive information, please refer to the deliverables, which are available on the website.

How to use this Framework?

To help users understand how to use this framework, two possible simple user pathways are displayed. It is important to note that these are only possible application scenarios, which will likely vary for each user, since the modules can be applied and interconnected individually.

Scenario A: Existing DHC network wanting to decarbonize: Starting with Module 4 (GHG Assessment and Benchmarking Tool) to assess the current emissions → Module 2 (SME Needs Assessment and Business Model Library) to identify possible SME and business models to improve the network → Module 5 (Decision-Making Support Methodology) to use provided input for improvement planning.

Scenario B: Municipality planning a new 5GDHC network: Starting with Module 1(Regulatory and Administrative Gap Analysis) to understand which gaps do exist in the respective community → Module 3 (Knowledge Transfer and Best Practice Repository) to identify already existing and proved concepts and solutions → Module 5 (Decision-Making Support Methodology) to plan the next steps using the provided structure → Module 4 (GHG Assessment and Benchmarking Tool) to assess the emissions of the planned solutions

Module 1: Regulatory and Administrative Gap Analysis

This module establishes a structured framework for identifying and addressing regulatory and administrative barriers related to Heating and Cooling (H&C) policies across the territories of project partners (D.1.1.1).

Methodology & analysis of regulatory and administrative gaps in Alpine territories

Within the conducted survey of the respective activity in the project, several common transalpine challenges and gaps hindering the decarbonisation of heating and cooling (H&C) systems, despite regional differences, have been identified. The main outputs are described in the following.

High-impact gaps and necessary actions:

No binding renewable H&C targets - establish clear national/regional targets, pair them with stable financial incentives, and prioritise network-based solutions over individual systems.

Weak support for critical infrastructure - fund smart grids, thermal storage, low-temperature networks and digital management systems; create subsidy programs and supportive regulations.

Spatial planning disconnected from energy needs - require energy infrastructure to be integrated into zoning and spatial plans so district heating expansion avoids land-use conflicts.

Incompatible or outdated building regulations - harmonise regulations across levels, align building rules with decarbonisation goals, and simplify legal barriers for retrofitting and network connections.

Complex and inadequate financing schemes - provide dedicated grants, tax incentives and low-interest loans; simplify application procedures, standardise eligibility and expand technical support for applicants.

Skills shortage in H&C sector - scale up vocational training, certification programs and partnerships with technical institutions; provide funding for upskilling and regional knowledge exchange.

Low public awareness and social acceptance - run targeted outreach and information campaigns, involve communities in planning, and allocate resources for transparency and communication.

Moderate impact gaps and proposed actions:

Fragmented governance and policy misalignment - create intergovernmental coordination mechanisms (regional energy councils/working groups) to align national, regional and local decision-making.

Resource-responsibility mismatch for authorities - increase targeted funding, technical assistance and clear mandates for local/regional bodies that implement H&C projects.

Inconsistent data collection and sharing - standardise reporting protocols, improve transparency of energy statistics and invest in digital platforms for real-time monitoring.

Under-utilised waste heat - set recovery targets, offer financial support for heat recovery infrastructure and streamline rules for integrating industrial waste heat into networks.

Slow and fragmented permitting - introduce simplified, standardised permitting procedures with clear timelines and reduced administrative redundancies.

Transferability and localisation on best, up-to-date H&C practices

Based on the knowledge transfer workshop, best practices from partners areas and the EU for the decarbonization of the H&C sector and 5GDHC network planning can be systematized as followed:

Each best practice can be evaluated in terms of its scalability and transferability. It is apparent that some strategies can be adapted easily to different contexts, while others require structural adjustments prior to implementation. Some practices are more appropriate for large-scale deployment, while others were better suited to smaller municipalities. Ultimately, the unique characteristics of each region determines which measures are suitable for, and effective in, promoting and facilitating the deployment of

5GDHC systems within the respective territories. Based on the above taxonomy, several general observations about the relative scalability and transferability of the identified practices can be made.

Highly scalable and transferable practices include:

- Binding decarbonisation targets
- EU and national funding mechanisms, which provide flexible financing solutions.
- Early cost transparency with respect to the DHC solutions

More effective in small towns:

- Cooperative ownership models
- Direct outreach strategies

Best suited for large cities:

- Public-private land use agreements
- Industrial waste heat recovery
- Market-flexible public oversight

Requires strong policy frameworks:

- Permitting and regulatory certainty for large-scale system repowering
- Stable subsidies for district heating

All detailed information regarding this module input can be found on the ALPHA project website here: https://www.alpine-space.eu/project/alpha/

Influence on the Joint planning and decision-making framework

With specific regulatory and administrative gaps being identified, this supports the overall framework by enabling a more detailed understanding of critical decisions and important aspects to address within the entire decision-making process and the planning phase of

H&C decarbonization solutions. Additionally, presented best practices help facilitate the development and expansion of 5GDHC systems and up-to-date H&C networks. Furthermore, best practices can enable sustainable investments, public-private collaboration and regulatory evolution to support low-carbon energy transition, thus supporting the joint planning and decision making for the roll-out of 5GDHC and up-to-date H&C systems.

Module 2: SME Needs Assessment and Business Model Library

This module mainly contains the results of the respective task 1.2. Within this activity, all partners mapped the technological, financial and skills-related needs of SMEs and service providers across the broader H&C sector in their territories, and documented suitable business models and collaboration opportunities to support ecosystem development. The results of the SME's needs have been clustered related to H&C, thereby accelerating their integration into H&C modernisation planning and green-growth initiatives in the Alpine Space. The main clustered output of the conducted survey can be directly used within Module 2 to provide valuable insights into potentially identical needs and business models.

The survey captured input from stakeholders across three ALPHA partner countries, with 20 submissions reported (16 from SMEs and five from individual service providers). Responses were concentrated in Italy (12), Austria (seven) and Slovenia (two). The survey showed that none of the respondents were involved in manufacturing heating and cooling (H&C) components. Instead, both SMEs and individual providers typically offer a combination of installation, maintenance, consultancy and digital services for district heating and cooling (DHC) systems. Most SMEs (93%) and a significant proportion of individual providers (80%) also provide consultancy services and develop digital control and consumption monitoring tools.

Respondents unanimously identified the technical complexity of 5GDHC systems as the main challenge. The integration of renewables and low-temperature waste heat requires expensive, advanced equipment, such as high-efficiency heat pumps and hybrid thermal storage, as well as highly skilled technicians. However, a persistent regional skills gap and cumbersome funding procedures prevent SMEs from upgrading their services. Around two-thirds of SMEs (67%) and almost half of individual providers (40%) report difficulty accessing the limited funding available to cover the initial costs of upgrades. All respondents highlight shortages of not only specialist installers and maintenance staff, but also planners who can combine mechanical systems with IT hardware, such as sensors and remote controls.

These practical barriers are exacerbated by education and regulation. Italian stakeholders, many of whom work in maintenance, stress that local technical schools do not offer curricula that align with current sector needs, and that internships and apprenticeships are limited. They are calling for stronger collaboration between industry and education to update training and placement pathways. Stakeholders across countries request regulatory reform

to reflect 5GDHC technologies, citing tenancy, condominium and heating-cost billing rules as examples of current constraints on economically viable network operation. Financial instruments for building owners remain insufficient to cover most of the initial costs, resulting in many projects being left unfunded and decarbonisation being slowed down.

When it comes to viable business models and collaboration pathways, stakeholders favour fee-for-service and subscription approaches because of their clarity and predictability in the market. However, Italian respondents warn that variable spare-part pricing complicates subscription pricing. Energy Performance Contracts (EPCs) attract interest, especially for smaller systems, because they transfer upfront costs and technical risk away from building owners, emphasised by Austrian stakeholders. Technology partnerships (for example, between district heating and cooling (DHC) operators and IT firms) are considered highly practical for strengthening the capacity of small and medium-sized enterprises (SMEs), while symbiotic, multi-party systems are identified in Slovenia and Austria as pivotal for project delivery and value creation. Public–private partnerships can support the integration of renewables in certain contexts, though their relevance is reduced where city-owned utilities dominate or where bureaucracy places an excessive burden on SMEs. Industry–academia partnerships offer significant potential for research and development (R&D) and upskilling, but most SMEs report difficulty accessing these collaborations.

Overall, the findings point to a clear, integrated agenda. This involves simplifying and scaling up financing to reduce upfront barriers, updating vocational and higher education curricula, and expanding apprenticeships to close the skills gap. It also involves reforming regulatory frameworks to accommodate the technical realities of 5G DHC, and building structured collaboration platforms that link SMEs with technology partners, financiers, and research institutions to accelerate the modernisation of H&C.

If more and detailed information regarding this module is required, please visit the website (Activity 1.2): https://www.alpine-space.eu/project/alpha/

Module 3: Knowledge Transfer and Best Practice Repository on technical, infrastructure, administrative, and socio-economic requirements for planning 5GDHC solutions

This module is based on the most important lessons learned during the project site visit and addresses the technical, infrastructure, administrative, and socio-economic requirements for planning 5GDHC networks in respective territories.

"Which organizational forms for 5GDHC are predominating or might work best in your region/country? (expl.: Energy supply contracting, municipal utilities, cooperatives organised by the building owner, ect.)"

- Public driven networks & energy communities, including public and private organisations
- Cooperatives of private owners
- Private and Municipal Energy Service Companies
- Energy Service Companies who already run 3rd Generation heating systems
- For renovation and/or small projects: Private initiatives supported by municipalities
- For new buildings and/or big projects: Municipality initiatives, supported by Energy Supply Companies (ESCOs)

"Where is 5GDHC most promising in your region/country (compared to individual heating and classic 3G-district heating) regarding techno-economic and social factors? (For instance: settlement structure, residential buildings, social housing, public buildings, commercial buildings, etc.)"

- In an area where no district heating exists by now
- In areas of lower density of heat demand
- In buildings where nothing else is possible because of the lack of space (e.g. for Biomass storage)

- In areas with high cooling needs or where conventional air condition systems are not feasible
- Public buildings could serve as ideal starting points, because they have a single owner and can serve as lighthouse projects
- In areas where 3rd Generation heating networks exist and an investment must be done - combination 3rd Generation and 5th Generation

All detailed information regarding the output of this specific module can be found on the ALPHA project website here (Activity 1.3): https://www.alpine-space.eu/project/alpha/

Transferability for the joint planning and decision-making framework

The lessons learned will support users in forming Local Working Groups with the right expertise to assess regional needs, explore the potential of 5GDHC networks, and define suitable actions. Observations from on-site case studies also offer practical guidance on planning and implementation, helping users to set realistic priorities and anticipate potential challenges.

Module 4: GHG Assessment and Benchmarking Tool

This module entails a customised tool based on two tools developed by the D2Grids project (Interreg NWE) for planning 5GDHC networks and calculating GHG emissions. The tool is specifically tailored for local authorities and public actors, district heating network operators, renewable energy solution providers, researchers and engineers, technicians and energy sector professionals. Furthermore, it was specifically designed to aid in the decision-making phase, supporting planning, mapping, feasibility checks, and the visualisation of first-impact assessments.

Thus, this tool fulfils three objectives and consists of three main sheets:

1. GHG assessment of individual systems vs. a new district heating and cooling network

The user characterises the individual systems in place by indicating the energy consumption of various consumer profiles (households, offices, industries) in terms of heating, domestic hot water and cooling. He defines the energy production equipments from an available panel, as well as their production, for each consumer profile.

The user then creates a new heating and cooling network by selecting production plant and final delivery equipments, and their projected production, with the aim of meeting the total energy consumption of the individual systems previously characterised.

Finally, the user automatically obtains GHG emissions of each case studies to compare them with graphs.

2. GHG and efficiency assessment of an existing district heating and cooling network

In the case of an existing network, the user characterises it in two steps. Firstly, he defines its production plant (equipments and production). Secondly, he characterises its branches (consumption of various consumer profiles, equipments and their consumptions, pipelines used).

The tool automatically calculates the GHG emissions of each branch and of the global network, the actual efficiency of the network and the theoretical efficiency of each branch and of the network. It provides graphs to visually represent the results.

3. Decarbonisation of an existing heating network

After calculating a network's emissions, the user can work on decarbonising it by selecting a range of actions to implement. These actions may include improving the network's energy efficiency, integrating renewable energies or recovering waste heat. Each action is characterised by its impact on the network (in %), a standard gain in energy efficiency (in %) and in avoided GHG emissions (in %), as well as an estimated implementation cost. The user also has the option of adding manually new actions to the tool.

The tool then calculates the network's future emissions, the amount and percentage of GHG emissions avoided, and the total energy efficiency gains (in %). It provides graphs to visually represent the results.

The developed tool can be found on the ALPHA project website here: https://www.alpine-space.eu/project/alpha/

Module 5: Decision-Making Support Methodology

This Module contains a detailed Decision-Making framework with the overall aim to integrate the aforementioned technical, regulatory, economic, and environmental considerations and planning steps to support the project from planning to operation. The structure of the Decision-Making Support Methodology can be described as follows:

Stage 1: Planning and Assessment

During this step, the specific area is selected, screened, and all the existing needs and demands are assessed. After that, a resource and site survey is conducted. Additionally, during this stage, a regulatory & feasibility check is conducted, and potential stakeholders are mapped and engaged. Finally, in this stage, potential ownership structures should be analysed and a possible scenario developed.

Stage 2: System Design

Within this Stage the system design is carried out. This if further divided into 5 steps. The first one being the detailed engineering and design. In the following, a comprehensive feasibility study with the preliminary results of Stage 1 is presented. Afterwards, the business model and financing plan are finalised. The last two steps include the permitting, regulatory compliance and procurement strategy.

Stage 3: Implementation and operation

The final stage involves implementing and operating the designed system. The first step is the construction and installation, then commissioning and testing, operation and monitoring. During the operation of the network, continuous maintenance and improvements, user engagement, and expansions need to take place to continually improve network operation.

All detailed information and the detailed Decision-Making Support Methodology can be found on the ALPHA project website here: https://www.alpine-space.eu/project/alpha/

Summary

Output 1.1 of WP1 of the ALPHA project delivers an individually usable, practical, and trans-Alpine planning and decision-making framework to accelerate the decarbonization of heating & cooling by enabling the roll-out of modern (5G) district heating and cooling networks across Austria, France, Germany, Italy, and Slovenia. It combines a mapped diagnosis of regulatory and administrative gaps, a survey of SME needs and viable business models, hands-on lessons from study visits, and a customised open-source benchmarking tool to estimate energy, cost, and GHG impacts of existing and new build networks, as well as the calculation of decarbonisation actions for existing networks. The work highlights key barriers and recommends targeted actions to mitigate the rollout risk and enhance the planning of new 5 GDHC networks across Alpine territories.

Based on the Decision-Making Support Methodology, clear guidelines were developed to support authorities, municipalities, planning offices, and engineers throughout the initial planning and assessment stages, as well as the detailed design and operation of the network. Additionally, the knowledge gained throughout Work Package 1 can be further utilised when applying the Methodology to aid the decision-making process.

In the next phase of the project, this very methodology will serve as a prerequisite for the activities in WP2.