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REHEATEAST

Methodology and models for DHC optimisation and cooperation

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The document includes input from partners

Pannon European Grouping Of Territorial Cooperation

NFFKÜ International Fund Development and Coordination Agency

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Local Energy Agency Pomurje

European Grouping of Territorial Cooperation Via Carpatia

Standing Conference of Towns and Municipalities

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ABE Renewable

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Abbreviations and acronyms

BiH	Bosnia and Herzegovina
BG	Bulgaria
DC	District cooling
DH	District heating
DHC	District heating and cooling
DHS	District heating system
EU	European Union
HR	Croatia
HU	Hungary
LL	Living Lab
PP	Project partner
RES	Renewable energy sources
RO	Romania
SK	Slovakia
SLO	Slovenia
SO	Specific Objective
SRB	Serbia

Executive summary

This deliverable presents the joint methodology and developed models for district heating and cooling (hereafter: DHC) optimisation and cooperation within the REHEATEAST project.

The methodology is built on a harmonised framework that integrates both optimisation and cooperation, recognising their interdependence in real-world DHC modernisation. The models are designed as practical solutions to make them adaptable, replicable, and easy to transfer across different regional contexts.

Seven models were developed through collaborative contributions from all partners: the Referent model, Simplified model, Incremental model, Municipal energy retrofit model, Living Lab cooperative model, Energy mapping and planning model, and Cooperation-oriented model. Each model follows a phased approach: preparation, implementation, and analytics/reporting.

The models provide a structured pathway for translating strategic concepts into concrete pilot actions. They incorporate considerations such as regulatory compliance, stakeholder engagement, and operational testing, while ensuring scalability and adaptability. Partners have been assigned responsibilities for piloting specific models, which will form the basis for further refinement and implementation.

By offering replicable blueprints, the deliverable ensures that lessons learned will extend beyond individual pilots, contributing to regional and transnational strategies for sustainable DHC improvements.

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1. Introduction

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

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

The first two deliverables within Activity A.2.1 focus on developing cooperation and optimisation models of DHC systems. These models aim to provide replicable solutions, emphasising stakeholder interaction as an important driver for technical and operational improvements. They form the foundation for pilot actions in the subsequent project steps.

This report presents a set of DHC cooperation and optimisation models, focusing on their development, adaptation, and potential future applications. It serves as a consolidated synopsis of deliverables D.2.1.1 *Joint methodology for DHC optimisation models* and D.2.1.2 *Developing DHC optimisation models*, which have been merged into this single comprehensive document. Namely, after careful consideration, it was concluded that preparing the two deliverables separately would have resulted in frequent cross-referencing and repetition. Therefore, they have been combined into one report to provide a clearer and more coherent presentation.

The report begins with an overview of the background and context of DHC systems. This is followed by the joint methodology for the models. It provides background and context and establishes the approach taken for developing the models. The main part of the report presents the developed DHC models, while the concluding section identifies further considerations to be observed within the pilots.

2. Joint methodology for DHC models

DHC systems are essential for improving energy efficiency and decarbonization, yet many regions face ongoing barriers to their modernisation. Reports from SO1 of this project highlighted the challenges faced by REHEATEAST regions in the development of DHC systems. Addressing these issues requires a proactive and structured approach.

In the context of REHEATEAST, the models presented in the subsequent chapters of this report represent a first step in developing practical pilot projects. More broadly, there is a general need for models such as those outlined in this deliverable. Given the challenges that DHC systems face, there is a pressing demand for accessible examples that are easy to replicate, scalable, and efficient. This is why the idea of these models is to provide a structured framework of solutions that can be applied to improve DHC systems, both within and outside of the REHEATEAST region.

The overall goal of this deliverable is to **develop transnationally relevant, multi-stakeholder cooperation and optimisation models** aimed at facilitating energy and cost-efficient refurbishments of DHC systems. The graphic below illustrates how the various activities within SO2 are interconnected with these models. It provides a visual representation of the process, evolving from the most generalised models to detailed, specific pilot actions within REHEATEAST.

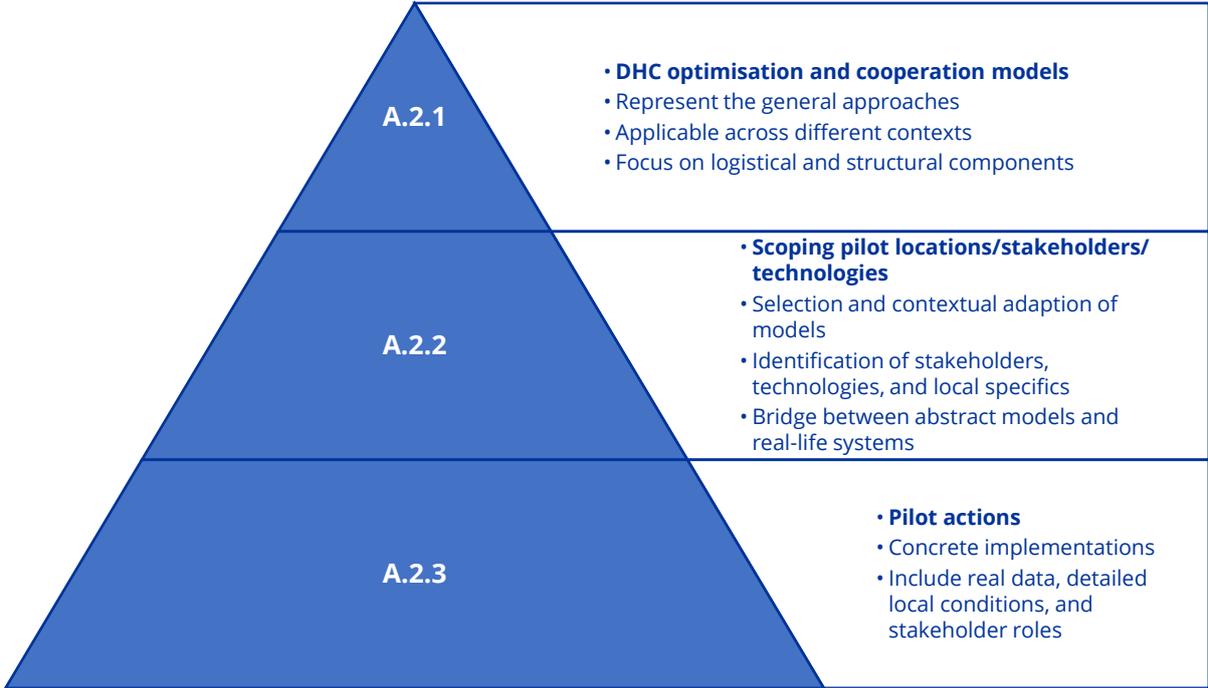


Figure 1 From concept to implementation: translating DHC models into pilot actions

To elaborate further, the models presented in this report are developed under Activity A.2.1 and are closely linked to Activities A.2.2 and A.2.3. **The goal is that these models serve as a first step and provide a clear and actionable blueprint that can be tested in the upcoming phases of the project.** Concretely, within Activity A.2.2, the **consortium identifies the most suitable cases**

for these models based on the specific characteristics of each region. During that phase, partners collect detailed information on DHC system features to help define pilot locations, involved stakeholders, and relevant technologies. This approach ensures that the **models are effectively translated into tangible pilot actions tailored to each REHEATEAST country** as part of Activity A.2.3. Therefore, this report, along with other SO2 deliverables, forms the basis for pilot actions in the REHEATEAST region.

In summary, the models **serve as a pathway that culminates in practical applications within the pilot actions themselves.** They **establish a standardised approach, ensuring their adaptability to diverse regional conditions.** The **models presented in this analysis are designed to be flexible, allowing for generalisation and easy adaptation by any stakeholder** engaging with this report. While stakeholders benefit from the structured guidance offered by these models, they must also consider specific variables, such as their local conditions, regulatory frameworks, priority areas requiring immediate action for future growth, the willingness of various parties to engage in discussions and implementations, and other local-specific contexts.

The models were developed with a holistic perspective. This report provides a **total of seven models.** The models are built on two key pillars: **optimisation** and **cooperation.** They all incorporate both those elements, reflecting the reality that these aspects are interconnected in real-world applications and, therefore, naturally integrated into the models.

To maintain alignment across consortium partners and to ensure that the models are transnationally relevant and replicable, the model development process adhered to a set of predefined guidelines. They place strong emphasis on cooperation between stakeholders, the strategic decision-making process, and systemic thinking. They are presented in a **flowchart format to ensure comparability and ease of use.** This approach allows the **models to serve as practical tools that can be easily adapted, transferred, and implemented across different national and local frameworks.** Each partner adhered to a standardised format, ensuring consistency in visual presentation and structural coherence.

The initial idea was to develop individual country-specific models. However, through discussions within the partnership, it became clear that many of the inputs shared common elements and themes. Consequently, the models were structured to reflect the mentioned seven models, providing a broader, more integrated perspective. The collaboration among partners facilitated a harmonised approach, integrating diverse regional perspectives into a cohesive framework.

The models presented in this report are structured into three phases, as shown in the figure below.

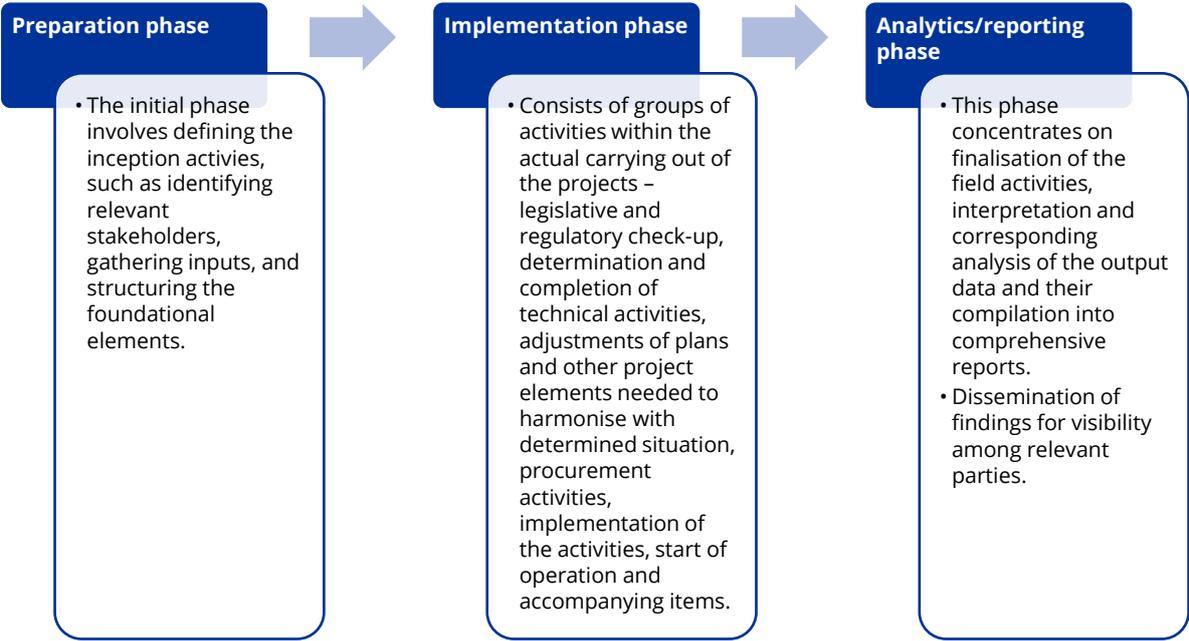


Figure 2 Phases within models

The development of the DHC models within REHEATEAST partnership followed a structured, phased approach, which can be summarised in the following key phases:

1. Development of a model template: an initial template was prepared to guide data collection and structuring. This template was validated within the partnership to ensure it provided a common, relevant starting point for all regions.
2. Building the models with partner inputs: partners provided the necessary data and information for creating the models.
3. Standardisation and model grouping: during the process, similarities in inputs and data structures were observed. Models were therefore grouped according to common characteristics rather than presented in separate country-based chapters, enhancing comparability and broader applicability.

The flowchart of the aforementioned activities is depicted in the following figure.

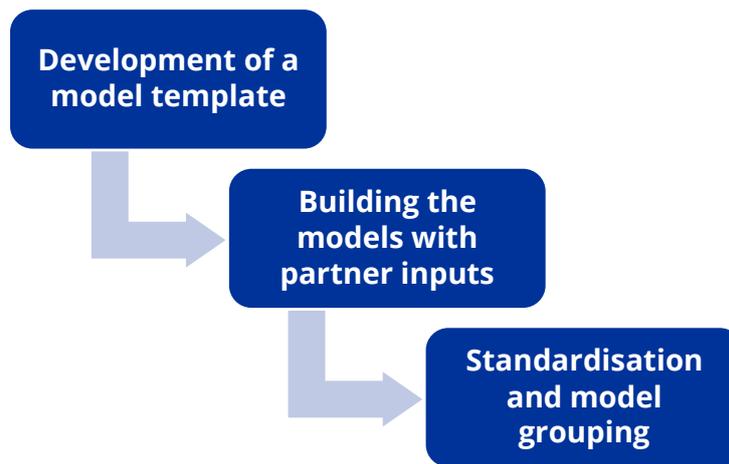


Figure 3 Approach to making the models

To conclude, the joint methodology for DHC models presented in this chapter establishes a comprehensive, flexible framework designed to support the modernisation of DHC systems across diverse contexts. By combining optimisation and cooperation elements within practical, easy-to-adapt flowchart models, this approach addresses the common challenges faced by REHEATEAST regions and beyond. The harmonised development process ensures that the models are both replicable and regionally relevant. Serving as a foundational step for subsequent pilot projects in REHEATEAST, these models guide strategic decision-making and foster stakeholder engagement, ultimately facilitating tailored, transnational solutions for sustainable DHC refurbishment and growth.

3. DHC optimisation and cooperation models

This chapter presents the developed models, based on the methodology outlined in Chapter 2. All project partners contributed to the development of the DHC models, and the final selection includes the following **seven models** that ensure a **generalised and replicable framework** for the refinement of DHC systems.

3.1. Referent model

In the following, the referent optimisation model for the development of the DHC pilot projects is set as a base model, including all necessary steps. It is further regarded as a template for variants for adjusted models in the Chapters 3.2 - 3.4. The paragraphs below Figure 4 offer a description of the processes within each phase of its development.

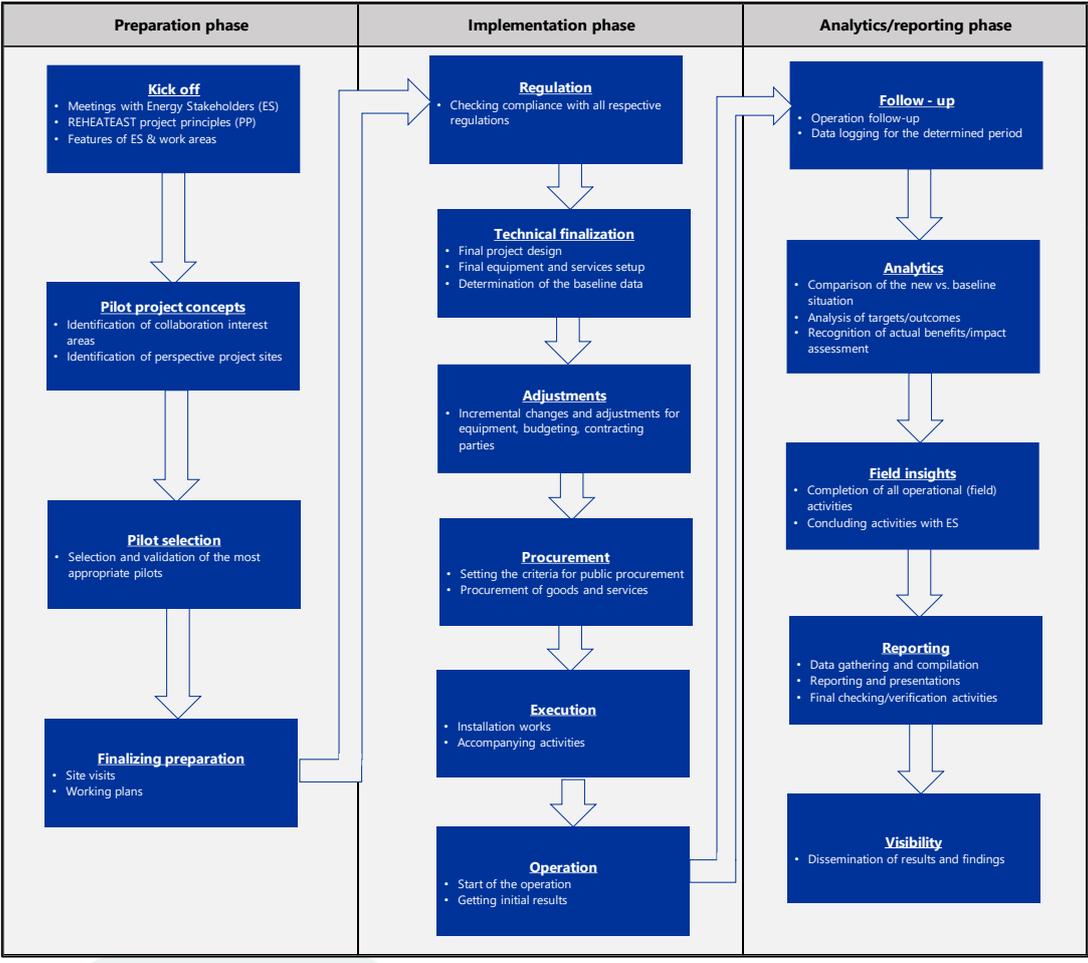


Figure 4 Referent model

The preparation phase

The preparation phase involves a comprehensive reconnaissance of the stakeholders, which comprises the determination of the institutions and entities that are of significant importance for the DHC-related issues. It includes the relevant potential users, development supporters, or other stakeholders influential in the setup and optimisation of DHC models. Establishing effective communication and ensuring a transparent exchange of operative information with them is essential. It includes holding initial kick-off meetings to explain the project in a way that enables practical understanding. During this phase, brainstorming sessions should be conducted to identify and develop prospective project ideas and key areas of interest.

The common findings of the kick-off phase serve as the foundation for further collaboration, and viable project concepts are selected and identified for further refinement. These concepts are then assessed based on their technical feasibility, efficiency-benefit, economic viability and organisational practicality. From this evaluation, the most suitable concepts are selected, typically ranging from one to three.

The preparation phase concludes with recommended site visits to potential implementation locations and discussions on working (action) plans with corresponding partners. These discussions should involve all relevant collaborating parties and the definition of roles and responsibilities, to ensure a well-coordinated approach and set a robust foundation for implementation.

The implementation phase

The implementation of the selected pilot projects starts with a thorough review of the regulatory framework and identifying all legal requirements the project must comply with. A legal expert or experienced professional should support this process by defining the necessary steps for compliance, with necessary adjustments incorporated into the action plans.

In the technical area of implementation, the project design must be drafted - if not already prepared - and finalised. The required equipment and services should be identified and listed, along with the cost estimates, financing options and economic considerations. It is important to establish baseline data in the referent period to compare it to the output data and check the efficiency improvements upon project completion. This data could include parameters such as energy consumption, operating hours, etc., whatever is relevant for the project.

The project design and action plans should be adjusted in the next stage to account for actual implementation conditions, including pricing, budget constraints, organisational issues, etc.

If any procurement activities are required, procurement procedures must be determined, along with the relevant criteria. Once this is established, the purchasing of required goods and services can proceed.

When these steps are completed, the pilot project can be implemented. The partner with the funds has the primary responsibility for ensuring proper execution. Any accompanying activities should be identified and carried out as required.

Finally, the pilot project enters the operation stage, with the initial results recorded. Data collection methodology and timelines are determined, along with test periods of operation (if needed) and the relevant timeframe for monitoring operations.

The analytics/reporting phase

The analytics and reporting phase starts with diligent follow-up activities, primarily focusing on operational data collection within the predetermined timeframe. Additional follow-up activities can be identified and carried out at this stage.

An analytical comparison between baseline and new performance data quantifies the actual benefits and the overall performance of the pilot project. Based on these findings, a detailed evaluation of the targets, outcomes, and other relevant aspects is conducted to assess the effectiveness and any positive or negative impacts accurately.

The following step is finalising all activities related to the pilot part of the project, including finalising technical, organisational, fiscal, and other relations with project partner(s), transferring equipment, and addressing any issues necessary for project closure.

The reporting step is a key project activity. It involves organising, validating, and compiling data into structured documents. The optimal reporting and presenting formats are determined, resulting in structured documentation and supporting materials such as presentation slides, videos, etc. A final proof check and verification of key findings is recommended to ensure the integrity of the reporting documents.

The phase concludes with designing and executing visibility and dissemination strategies. They define the target audience and the most effective methods for presenting the pilot project outcomes to relevant stakeholders.

3.2. Simplified model

The next model is focused on a simplified procedure, which could cover a larger scope.

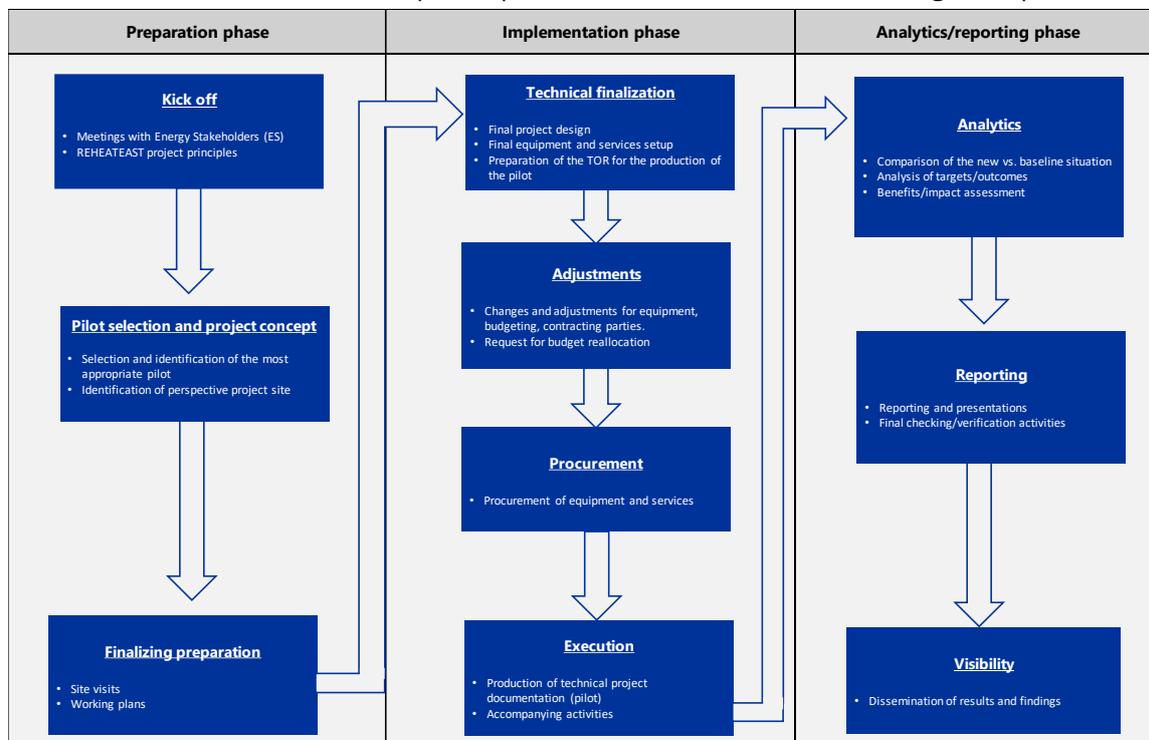


Figure 5 Simplified model

The preparation phase

To ensure a synchronised approach, it is essential to involve all relevant stakeholders in this phase. The relevant stakeholders are all institutions and entities that are of importance for the long-term sustainability of the pilot. This includes potential future owners/users and other stakeholders who could contribute to the setup and optimisation of the DHC model. Establishing effective communication with these stakeholders and ensuring the communication and exchange of necessary information are essential for the successful implementation of the pilot. This phase includes initial meetings with all relevant stakeholders for discussions and consequent agreement on the location and scope of the pilot.

The findings of this phase serve as the foundation for the next steps in the implementation of the selected pilot concept. The concept is then assessed and selected based on its technical, efficiency-benefit, economic-financial, and organisational viability.

The outcome of the preparation phase is the identified implementation locations and scope of the pilot, including the agreement on the action/implementation plan with all relevant stakeholders.

The implementation phase

The implementation phase of the selected pilot projects starts with work on finalising the project design, finalisation of the equipment and services setup and the preparation of the Terms of Reference (hereinafter: ToR) for the pilot.

In the technical area of implementation, the ToR for the project design must be finalised. The required equipment and services will be identified, along with the cost estimates, financing options and economic considerations. In this phase of the pilot implementation, it is also important to prepare baseline data for the identified pilot project location. Upon completion of the pilot technical project documentation, the baseline data will be compared to the pilot project output data to confirm the efficiency improvements of the pilot.

The pilot project's ToR and action plans will be adjusted to account for actual implementation conditions, including pricing, budget constraints, organisational issues, etc.

In this phase, the procurement procedures will be determined, along with the relevant criteria. Once this is established, the procurement processes for goods and services can proceed.

Upon completion of these steps, the work on the pilot project will be implemented, and any accompanying activities will be identified and carried out as required.

This phase ends once the production of technical documentation is completed.

The analytics/reporting phase

The first step of this phase foresees a comparison of the new vs. baseline situation, analysis of targets/outcomes and benefits/impact assessment. If needed, additional follow-up activities can be carried out at this stage.

In order to determine the actual benefits and the overall future impact of the pilot project, the analytics starts with comparing the energy production performance planned by the prepared technical documentation with the baseline data. Based on the findings, an evaluation of the targets, outcomes, and other relevant aspects will be conducted to assess the benefits and impacts.

The reporting step foresees the compilation of all collected data and information that will be included in the final report.

In addition, besides the planned project visibility activities, the dissemination of pilot project outcomes to relevant stakeholders will be implemented.

3.3. Incremental model

The further model flowchart considers the procedures where more specific incremental steps are considered, to cover the possible transient steps which may be needed within specific project development.

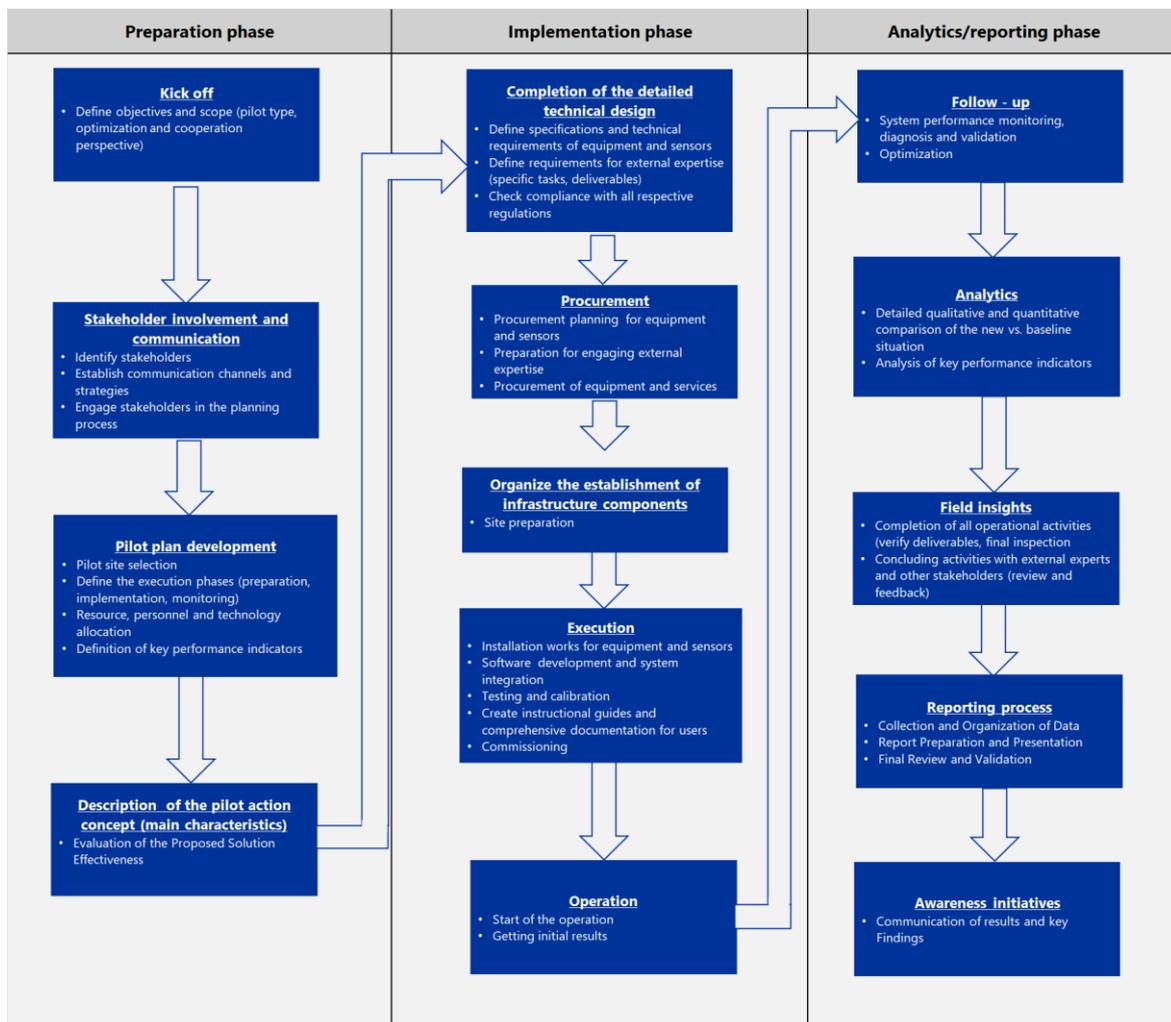


Figure 6 Incremental model

The preparation phase

The preparation phase begins by defining the scope and objectives of the pilot action, including selecting the pilot type, optimisation goals, and cooperation strategies. This step ensures that all parties are aligned with the project’s vision and understand the pilot’s purpose, expected outcomes, and collaborative approach.

Once the scope and objectives are established, the next key step is stakeholder targeting. This involves identifying the essential institutions, companies, collaborators, and end-users who will

contribute to the pilot's implementation. Stakeholders are chosen based on their expertise, resources, and ability to help set up and optimise the DHC models.

A kick-off meeting for the project will be held to introduce the project and provide stakeholders with an overview of its objectives. Additionally, brainstorming sessions will be organised to encourage collaboration among all stakeholders.

The next step is the development of the pilot plan, which includes selecting the pilot site, defining the execution phase, allocating resources, personnel, and technology, and defining performance indicators.

The preparation phase concludes with a detailed description of the pilot action concept, which includes the location, characteristics of the pilot site, and expected results. This description provides the foundation for pilot implementation.

The implementation phase

The implementation of the selected pilot project begins with the completion of the detailed technical design, ensuring that all technical aspects are well-planned and meet the required standards. This step involves several activities:

- Definition of specifications and technical requirements of equipment and sensors
- Definition of requirements for external expertise
- Ensuring compliance with regulations (ensuring that all activities comply with applicable regulations related to the pilot's technical, environmental, safety, and health aspects)

The next step involves procurement activities, which include developing a procurement plan and establishing procedures for acquiring equipment and services. Once the procurement plan is finalised, the bidding and procurement processes can proceed.

Following this, infrastructure components are organised and established to ensure the pilot project has the necessary physical and technical structures for execution.

Next comes execution, which includes installing equipment, developing software and integrating the system, performing testing and calibration, creating instructional guides and comprehensive user documentation, and commissioning the system.

Finally, the pilot project enters the operational phase, where the system begins functioning and collecting initial results.

The analytics/reporting phase

Once the pilot project is operational, the follow-up step is crucial to ensure the system continues to perform as expected. This step includes system performance monitoring, diagnosis and validation, and optimisation.

The analytics step evaluates the system's effectiveness by comparing it to the baseline and analysing key performance indicators.

The field insights stage marks the final phase of the project, ensuring all activities are completed, deliverables are checked, and the system is thoroughly inspected. It also involves gathering feedback from external experts and stakeholders to prepare the system for long-term use.

The reporting process involves systematically collecting and organising data, preparing comprehensive reports, and presenting results to stakeholders.

Awareness initiatives are essential for sharing project outcomes, raising awareness, and informing stakeholders and broader audiences about the results, including project achievements, key findings, and impact. These efforts ensure that all interested parties and the audience understand the value and potential of the implemented system or solution.

3.4. Municipal energy retrofit model

The figure below illustrates the multi-stakeholder cooperation and optimisation model, considered for the energy-efficient improvement of DHC systems, where the steps are more diverse when compared with the referent model. This is the situation where planning of the procedure needs to be adjusted to specific features of the regarded project(s).

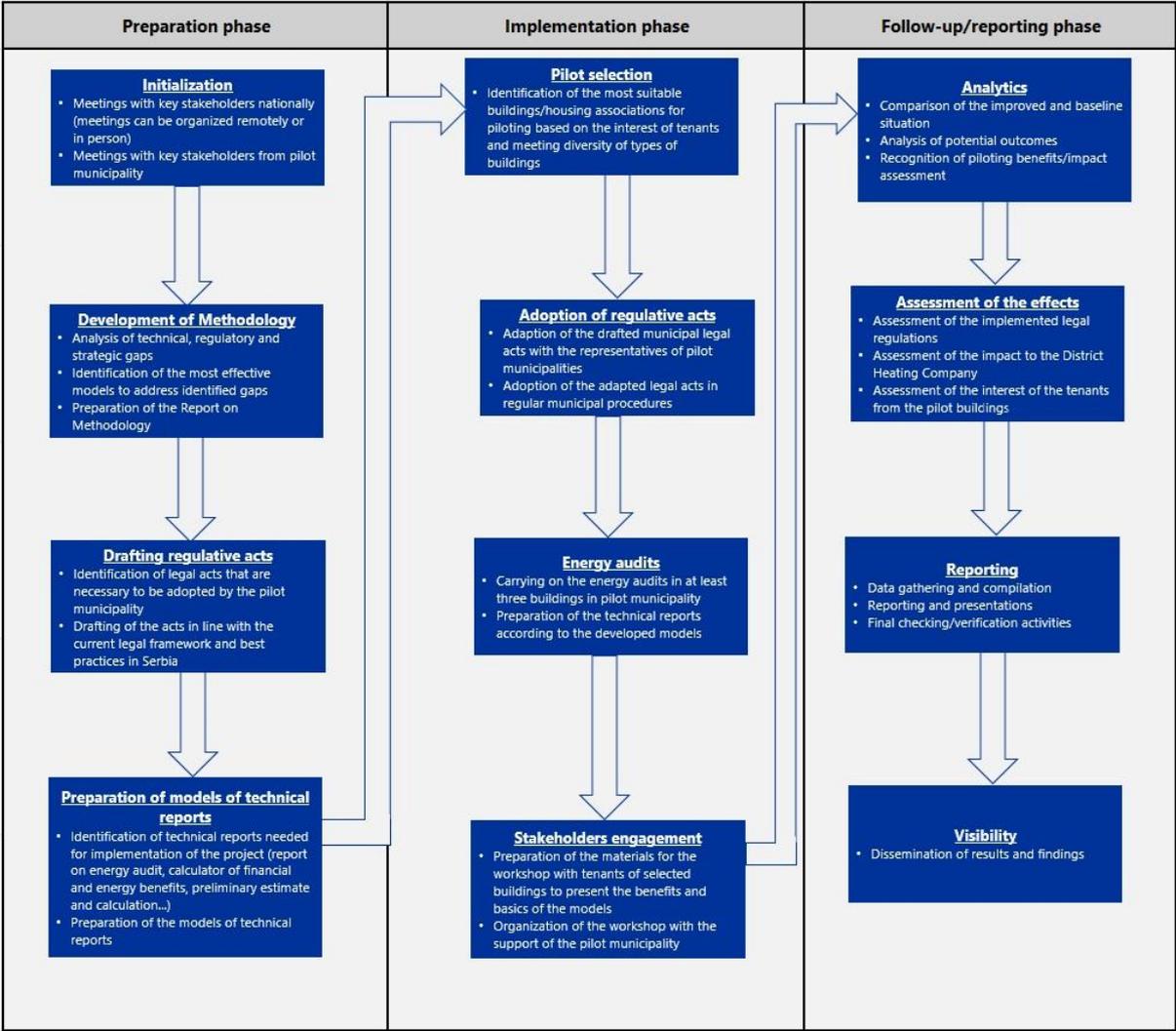


Figure 7 Specific model-tailored model

The preparation phase

The activities begin with a series of consultations to ensure alignment with key stakeholders. These meetings will be conducted both at the national level and within the selected pilot municipality. Depending on logistical considerations, discussions may take place either remotely or in person.

The goal of this phase is to establish a collaborative foundation for the methodology for energy retrofit of the housing connected to the DHC systems and gather initial insights from relevant parties.

To develop an effective approach, a comprehensive analysis will be conducted to identify technical, regulatory, and strategic gaps for the energy retrofit of housing connected to the DHC systems. This assessment will help determine the most suitable models for addressing the identified challenges. The findings will be consolidated into a Report on Methodology, which will serve as a guiding document for the next phases.

Based on the previously identified gaps and requirements, the necessary legal acts for the pilot municipality will be determined. These acts will be drafted following the existing legal framework and best practices, ensuring compliance and effectiveness in implementation.

To ensure effective implementation, a structured approach will be taken to identify and prepare essential technical reports. These reports will support feasibility assessments, cost-benefit analyses, and regulatory compliance. Key reports include an energy audit assessing consumption and efficiency, a financial and energy benefits calculator estimating savings, and a preliminary estimate outlining costs and resource requirements. Additional reports may be identified as needed.

Standardised models will be developed for each report, ensuring consistency and accuracy. These models will provide clear structures, data collection guidelines, and best practices, streamlining documentation and supporting informed decision-making.

[The implementation phase](#)

The implementation phase involves selecting pilot buildings in the designated municipality, adopting necessary legal acts, conducting energy audits, and engaging stakeholders to ensure the success of the methodological approach.

The pilot selection process will identify the most suitable buildings or housing associations based on tenant interest and the diversity of building types. This ensures a representative and scalable approach.

Following pilot selection, the drafted municipal legal acts will be refined in collaboration with pilot municipality representatives. Once adopted, these acts will be submitted to the municipality for formal adoption through standard municipal procedures.

Energy audits will be conducted in at least three selected buildings within the pilot municipality. The audits will assess energy efficiency and provide key data for decision-making. Technical reports will be prepared according to the standardised models developed in previous phases.

To ensure active participation, stakeholder engagement activities will include preparing materials for a workshop aimed at informing tenants about the benefits and fundamentals of the proposed models. With the support of the pilot municipality, this workshop will provide tenants with essential knowledge and encourage their involvement.

[The analytics/reporting phase](#)

The final phase focuses on analysing outcomes, assessing the effects of implementation, compiling reports, and ensuring broad visibility of results.

A comprehensive analytics process will compare the improved situation with baseline conditions, analysing potential outcomes and assessing the benefits of piloting. This will provide a clear understanding of the impact.

The assessment phase will evaluate the effectiveness of the implemented legal regulations, the impact on the DH company, and the level of tenant interest in the pilot buildings. These insights will help refine future policies and improve scalability.

Reporting activities will involve systematic data gathering, compilation, and structured presentation of findings. Final verification processes will ensure accuracy before results are shared.

To enhance visibility, results and key findings will be widely disseminated, ensuring stakeholder awareness and encouraging broader adoption.

3.5. Living Lab cooperative model

The figure below illustrates the Living Lab cooperative model. The following paragraphs provide a detailed description of the processes and activities within each phase of its development.

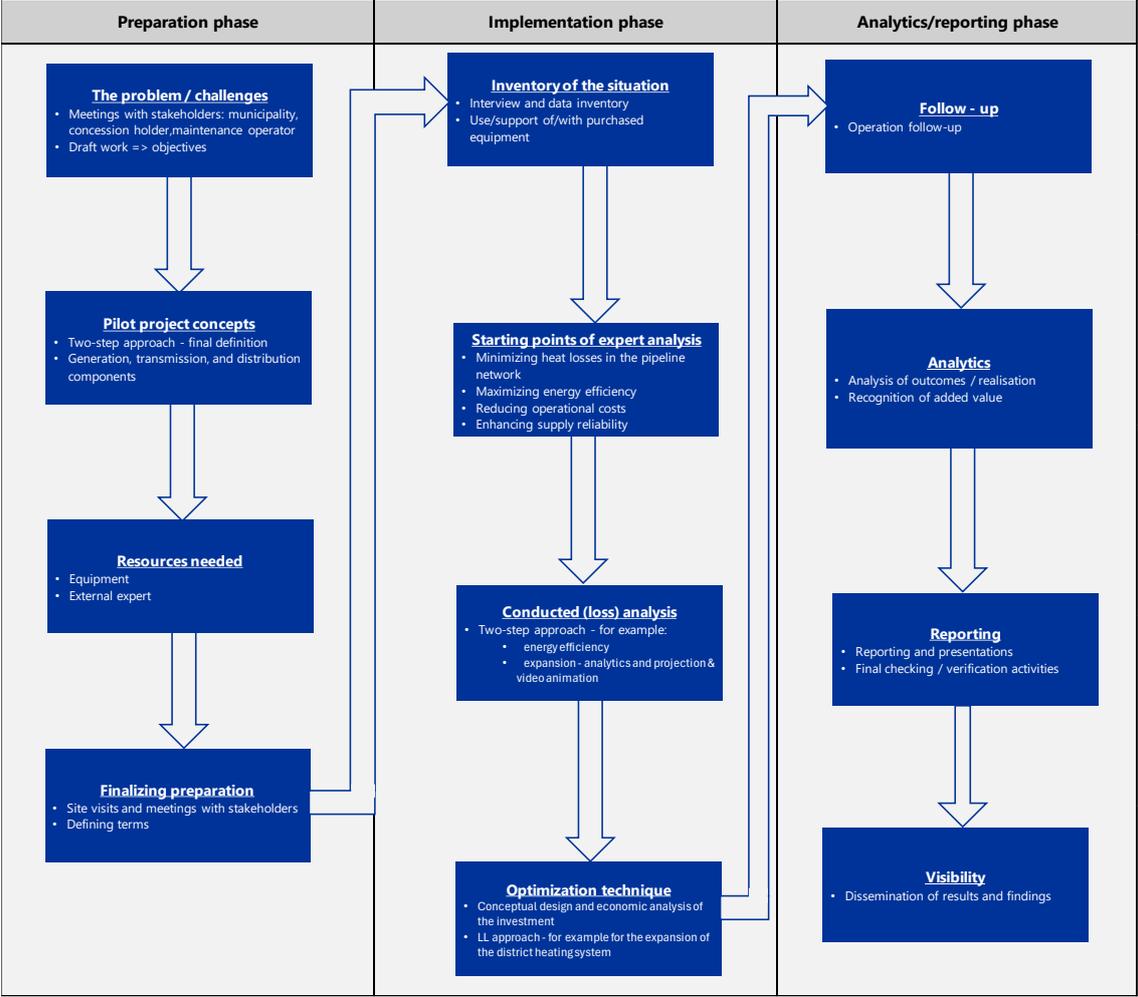


Figure 8 Living Lab cooperative model

The preparation phase

During the preparation phase, a preliminary review is conducted to assess the current issues and challenges to identify requirements related to energy efficiency, system maintenance, cost optimisation, and potential expansion to include new customers. Meetings are to be held with key stakeholders, including representatives from the municipality, the concession holder, and the maintenance operator, as relevant to the pilot project. Based on the gathered data and interviews, a draft outline of the planned activities is developed, along with the definition of expected objectives.

For this model, a two-step approach is considered. The first will focus on supply-side optimisation, while the second phase will involve modelling and optimising the potential expansion of the DH system to connect new users.

During the planning phase, specific equipment and the involvement of an external expert are crucial for the successful implementation. These resources are essential for assessing the potential of both implementation phases through the preparation of a transmission loss analysis. The equipment is necessary for identifying and monitoring transmission losses during both the pilot phase and ongoing operations. Additionally, it can be used to detect possible damage to the heating infrastructure.

The final activity in this phase involves conducting site visits and meetings, including detailed inspections of the heating route and pipeline plans.

The implementation phase

The preliminary analysis from the previous phase is expanded into a comprehensive review of the existing DH system. Data collection includes detailed and wide-ranging interviews with key stakeholders and selected consumers. A key component of the implementation phase is the use of the equipment purchased.

The key challenges addressed by the pilot - such as significant transmission losses in heat pipelines that are often difficult to quantify, the risk to energy supply reliability due to potential pipeline damage, high operational costs resulting from system losses and network expansion, and the effective engagement of new users - serve as crucial guidelines for pilot implementation and form the foundation for expert analysis.

Based on the collected data and the use of the purchased equipment, a heat loss analysis can be prepared. This analysis can, to the greatest extent possible, provide an overview of the current state of identified heat losses, along with projections and assessments for the entire existing pipeline network. It can include, for example, an evaluation of losses at customer heat exchangers (considering positioning, installation conditions, and insulation), as well as losses within the distribution system (focusing on insulation quality and other contributing factors).

The perspectives to be clarified through this analysis include the following:

- Potential primary objective: operational optimisation aimed at reducing heat losses (improving energy performance) and enhancing the utilisation of existing heat production facilities.
- Potential secondary objective: reduction of investment and operational costs, lowering of temperature levels in the supply pipeline, and consideration of system constraints such as

pipeline dimensions and heating capacity. This secondary objective can serve as a foundation for further development and potential expansion of the DH system.

This process can be carried out using a Living Lab (hereafter: LL) approach, building upon an optimal conceptual design model and an economic investment analysis. If appropriate and necessary, a video animation can also be developed to support activities within the LL framework.

The analytics/reporting phase

The first step of this phase involves follow-up activities, the most important of which is the collection and presentation of results from the implemented pilot. The results, or preferably KPIs, will be based on an analysis that will highlight the potential for optimisation and the steps that will be undertaken by the owner.

In this case, there can be, on one hand, theoretical KPIs that can be achieved with the proposed steps, and on the other hand, real KPIs that can be achieved through the implementation of the proposed measures. It is important to note that the implementation of the proposed steps is not part of the project; the project only includes the preparation of the technical aspects and ongoing animation and professional support for the implementation of the proposed steps by the project partners.

Therefore, constant monitoring of implementation has to be ensured and carried out in order to present an example of good practice, as well as an example that has great potential for expansion to other areas/other DH systems.

The added value of the project will be identified through final verification activities and results. These can provide tangible data for reporting and presentations. All such data will also be utilised for the dissemination of results and findings from the pilot. It is essential to ensure the visibility of the pilot, as it serves as a best practice for other regions, demonstrating a successful concept for the installation of district heating based on wood biomass, managed by an energy cooperative that effectively expands and enhances its DH system.

3.6. Energy mapping and planning model

The image below shows the energy mapping and planning model. The following paragraphs provide a detailed description of the processes in each phase of its development.

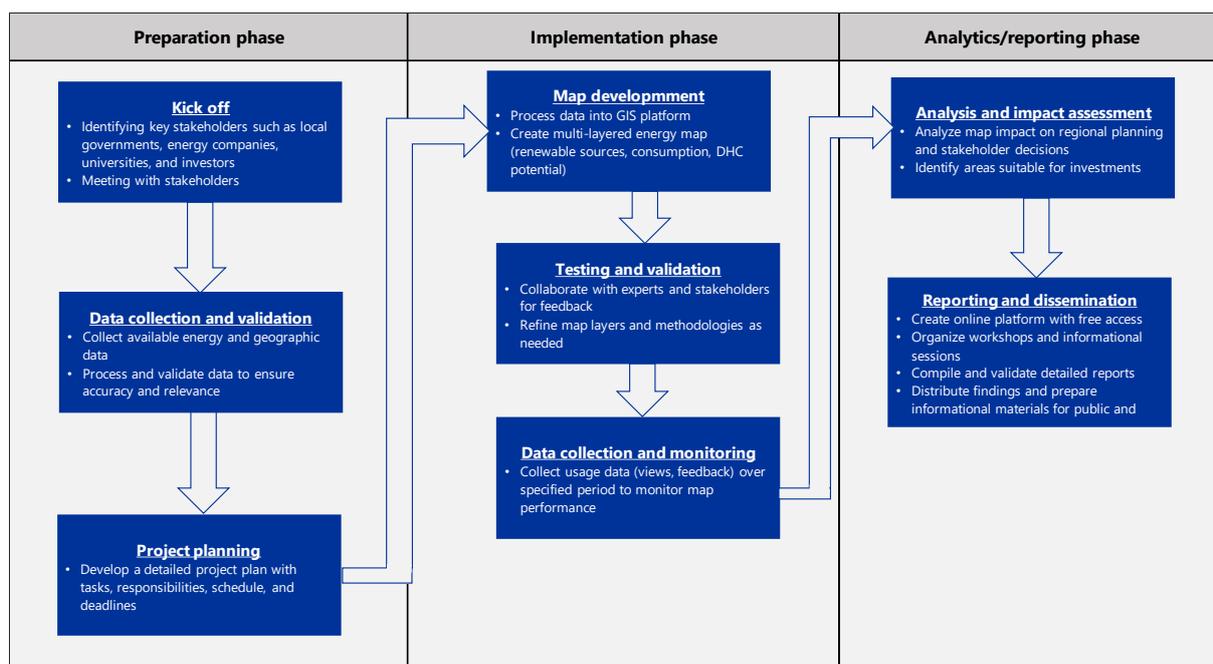


Figure 9 Energy mapping and planning model

The preparation phase

The preparation phase focuses on the initial activities necessary for the effective implementation of the mapping project. The first step is identifying and meeting with key stakeholders, including local governments, energy companies, universities, and investors. These entities play an important role in the creation and use of energy data and in planning future infrastructure investments.

Next, the collection and analysis of available energy and geographic data take place. These data are crucial for creating the map and include information on existing and potential renewable energy sources (hereafter: RES), energy consumption, and the possibilities for the development of district heating. The processing and validation of this data will ensure that the resulting map is relevant and usable for various user groups.

At the end of this phase, a detailed project plan is created, which includes a clearly defined schedule for the individual activities. This plan sets specific steps, responsibilities, and deadlines, ensuring the smooth execution of the project.

The implementation phase

The implementation phase involves the process of creating and optimising the map. In the first step, the collected energy and geographic data are processed into a GIS platform, where a multi-layered map is created containing various analytical outputs. The individual layers display existing and potential RES, current energy consumption, and possibilities for the development of district heating.

After the map is created, testing and validation are carried out in collaboration with experts and stakeholders. This process ensures the accuracy and practical use of the map in decision-making processes. If necessary, based on the feedback received, the individual layers of the map and the methodology for processing the data are adjusted.

The next focus is on gathering and organising all relevant data to ensure accuracy and completeness. The collected data will be used to create detailed reports and presentations to communicate findings to stakeholders. A thorough review and verification of all activities will be conducted to ensure everything meets the required standards. The distribution of outcomes and discoveries will ensure that all stakeholders are informed of the key findings and can take necessary actions based on the results.

Data on the usage of the map is collected, such as the number of views, user feedback, and identification of areas for improvement. Monitoring this data will allow for a better understanding of the real impact of the map and its benefits for regional planning in the energy sector.

[The analytics/reporting phase](#)

After the implementation of the map, the analysis and reporting phase follows. The aim is to assess the impact of the map on the decision-making processes of stakeholders. An important part of this phase is also identifying specific areas suitable for investments in district heating and the use of RES.

The results of the project are then processed into a detailed report, which will contain recommendations for further regional implementations. This document will serve as a reference material for local governments and investors planning similar initiatives in the future. An important part of this phase is also ensuring broad awareness of the map and its availability to all relevant users. This includes creating an online platform where the map will be freely accessible, as well as organising informational meetings and workshops for stakeholders. In the final step, informational material is prepared and distributed to the general public, municipalities, and investors. The goal is to raise awareness of the possibilities of using RES and support further initiatives in the field of sustainable development.

3.7. Cooperation-oriented model

While previous models already integrate elements of stakeholder cooperation, this particular model focuses primarily on developing and analysing a stakeholder cooperation framework in building energy efficiency, neighbourhood retrofits, considering the technical requirements of buildings and related network retrofits as well.

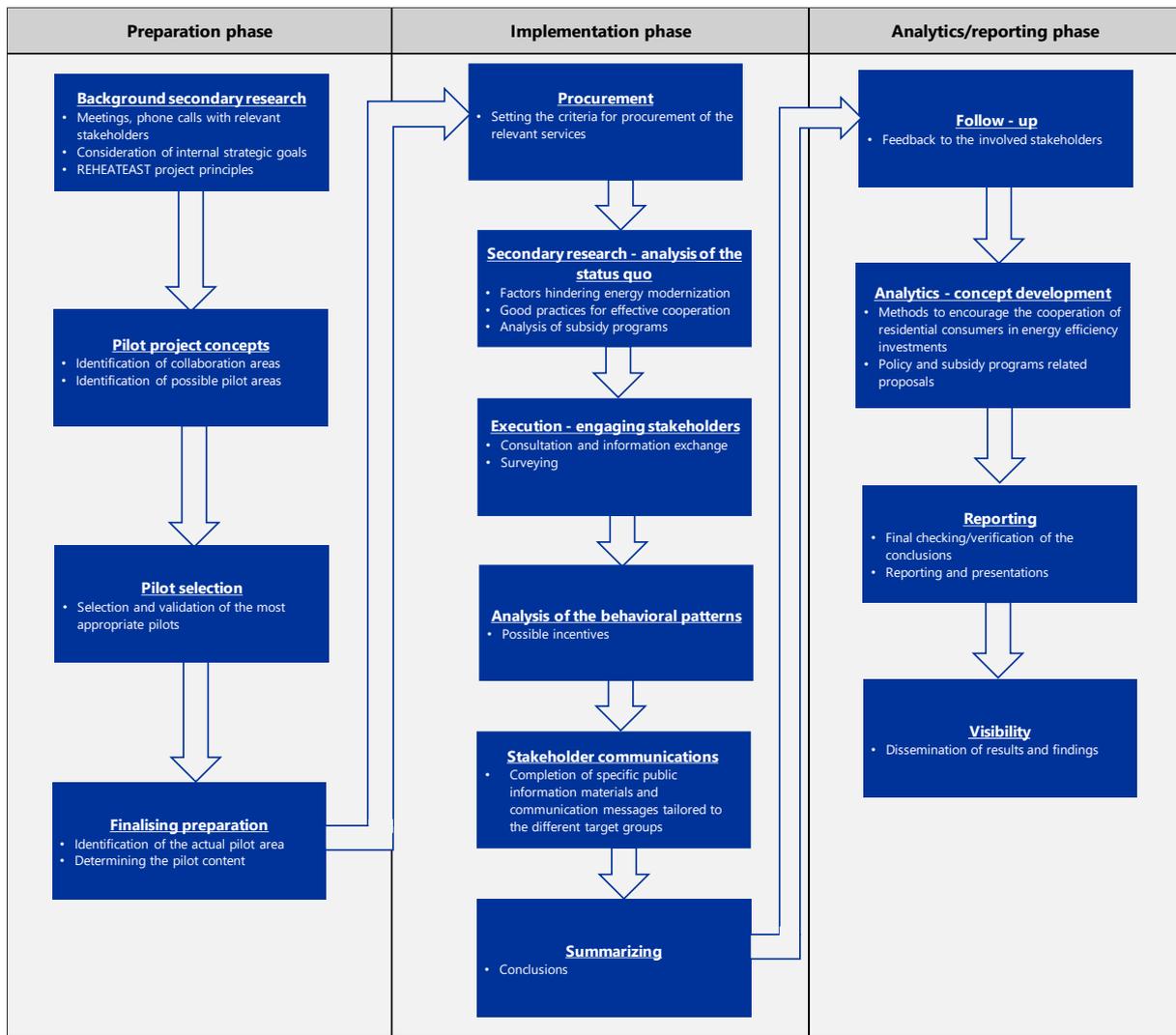


Figure 10 Cooperation-oriented model

The preparation phase

The preparation phase consists of four relevant steps described in the following.

During the background secondary research, three aspects should be considered:

- The needs of the relevant stakeholders identified through meetings and discussions,
- The internal strategic goals of the implementing organisation to provide proposals for effective state subsidy programs for energy efficiency
- And the REHEATEAST project principles.

As a result, possible pilot project concepts and pilot areas are defined.

Through brainstorming sessions, the final pilot concept selection will take place, and in the final preparation phase, the target area and pilot content should be determined.

The implementation phase

Key steps of implementation include the procurement process to find the experts to be involved in the implementation of the pilot, analysis of the status quo, engaging stakeholders, stakeholder communications and summarizing all the conclusions.

The first step of execution is the secondary research targeting the following goals:

- Factors hindering the energy modernization of apartment buildings in district heating (behavioural patterns, stakeholder relationships, procedures, regulation, communication, etc.)
- Domestic and international good practices on the implementation of effective cooperation and information exchange with different types of stakeholders (DH service provider, local government, population, civil association, energy service provider experienced in heat demand reduction)
- Examination of the effectiveness of state energy subsidies, focusing on what other related subsidies and incentives can make the system more efficient based on international good practices

The second step of execution will be the engagement with stakeholders:

- Implementation of consultation and information exchange with different types of stakeholders (DH service provider, local government, population, civil association, energy service provider experienced in heat demand reduction) in the pilot area,
- Surveying of the different stakeholders.

Based on the aforementioned two steps an analysis of the behavioural patterns of DH consumer groups is to be compiled. Additionally, targeted possible incentives are to be determined in the pilot area to promote DH decarbonization and building energy efficiency developments.

Understanding the pilot stakeholder groups is essential for preparing effective stakeholder communication. This includes creating tailored communication messages and information materials which will be tested during the implementation of the pilot:

- Preparation of draft content of specific public information materials, support for the presentation and description of communication messages to the target group in the pilot according to the content of the technical description
- Analysis to help encourage the cooperation of residential consumers in energy efficiency investments, and preparation of support policy proposals

Among the groups of homeowners with different characteristics, it is necessary to at least analyse the behaviour patterns and possible incentives of retirees and those who own an apartment for investment purposes (those who do not live in the apartment they own).

The analytics/reporting phase

The first step of this phase involves follow-up activities, the most important being the feedback to the involved stakeholders, considering the reactions to the identified conclusions. Additional follow-up activities can be identified and carried out at this stage.

The analytics-concept development step consists of compiling the two relevant outcomes of the pilot:

- Report on methods to encourage the cooperation of residential consumers in energy efficiency investment
- Report on proposals related to energy development policies and subsidy programs

Based on these findings, a detailed evaluation of the targets, outcomes, and other relevant aspects is conducted.

The reporting step is a key project activity. First, all collected data and information should be sorted and validated before compiling them into comprehensive reports. The optimal reporting and presenting formats are determined, resulting in structured documentation and supporting materials such as presentation slides, reports, etc. A final proof check and verification of key findings is recommended to ensure the integrity of the reporting documents.

In the final stage, project visibility and dissemination strategies are planned. They define the target audience and the most effective methods for presenting the pilot project outcomes to relevant stakeholders.

To conclude, within REHEATEAST, pilots will strive to incorporate as many of the respective model features as possible during implementation, while adapting them as pilots progress. As a result, the actions taken in the pilot phase will serve as illustrative examples of how each model can be applied.

The table below shows the key features of models, highlighting those that will be relevant for pilot implementation. It also summarises operational tools applicable across all models. Project partners will assess and incorporate additional tools if needed.

Table 1 Readiness for piloting – features and operational tools of the models

Model	Features and piloting relevance	Operational tools (applicable across all models)
Referent model	Serves as a comprehensive framework for pilot preparation and implementation; provides a reference for structuring other models	<p><u>Stakeholder mapping</u></p> <ul style="list-style-type: none"> • Determination of relevant stakeholders • Appropriate communication - features and issues • Stakeholder involvement and contribution - potentials and achievable outcomes <p><u>Assessment of existing development plans</u></p> <ul style="list-style-type: none"> • Communication with relevant stakeholders and review of such plans • Technical competence for plan review <p><u>Communication and information exchange</u></p> <ul style="list-style-type: none"> • Established communication modes among involved parties – condition for effective collaboration • Best practices to approach different groups (DH utilities, energy providers, local government, consumers, designers and service providers, etc.) <p><u>Formal agreement frameworks</u></p> <ul style="list-style-type: none"> • Drafting of appropriate cooperation agreements among regarded stakeholders/partners • Roles and mutual obligations determined and accepted
Simplified model	Supports easier replication and a wider scope of diverse procedures	
Incremental model	Supports phased testing depending on transient steps	
Municipal energy retrofit model	Appropriate for developed retrofit plans, influenced by actual municipal involvement and interaction with relevant stakeholders	
Living Lab cooperative model	Applicable for elaborated cooperation plans; needs advanced collaboration between the lead (municipality or utility) and other key stakeholders	
Energy mapping and planning model	Imagined as support for planning; impacted by the availability and quality of preliminary data	
Cooperation-oriented model	Strong focus on stakeholder collaboration; structuring complex relations among various stakeholders	

4. From models to pilots

4.1. Partner roles across models

The table below indicates which partners are associated with the further development of each model.

Table 2 Partner roles across models

Model	Designated piloting partner(s)
Referent model	EIHP, PANNON, ENEFFECT
Simplified model	AC-BiH
Incremental model	UTCLUJ
Municipal energy retrofit model	SCTM
Living Lab cooperative model	LEAPOM
Energy mapping and planning model	VIACARPATIA
Cooperation-oriented model	IDEFA

It is important to emphasise that the models are dynamic and will be adapted as the pilot actions progress. Consequently, partners may not implement every element currently represented in the models, but will adapt them as needed throughout the pilot implementation. This is why, in the end, each pilot will be elaborated through respective pilot reports, detailing actual steps and outcomes that were implemented.

4.2. Visibility planning

Regarding the pilot and project visibility activities, the methods and tools applicable to all models are planned. The following possible dissemination channels can be taken in consideration:

- Conferences – presentation of results at relevant events
- Articles – publishing of results, features and significant pilot items in magazines and other relevant media
- Online platforms
- Printed materials – newsletters and brochures

Other dissemination channels will be regarded during the project development, according to relevance and accessibility. In principle, the opportunities for public presentation of the project features and pilot results will be continuously observed and utilised.

4.3. Pilot implementation considerations

Pilot implementation will take into account several factors. Some of them have already been identified in the model development process in the previous chapter, but additional considerations are presented in the following figure.

Buildings/ systems efficiency	Heat sources	Regulatory environment	Technical/ business practices	Standardisati on and certification	Green procurement
<ul style="list-style-type: none"> Partners will strive to improve energy efficiency across buildings and networks. This includes measures like network modernisation to reduce heat losses, optimisation of supply and return temperatures, implementing monitoring and control systems, etc. Local planning contexts will guide the choice and prioritisation of interventions. 	<ul style="list-style-type: none"> The partnership will prioritise the integration of renewable and low-carbon heat sources, such as biomass, solar, waste heat recovery, etc. Selection will be tailored to each pilot's technical feasibility and economic viability. 	<ul style="list-style-type: none"> Partners will consider local and national regulations that impact district heating, and also use documented supporting reports from REHEATEAST (if relevant). Additionally, those focusing on the financial framework will examine tariff structures and incentives that promote energy efficiency and the adoption of renewable energy. 	<ul style="list-style-type: none"> The integration of technical solutions and digital tools will be explored to enhance operational efficiency. Business models promoting stakeholder engagement and sustainable investments will be highlighted in pilot approaches. 	<ul style="list-style-type: none"> Pilots will adhere to recognised standards and certifications for quality assurance. This will enhance the credibility and potential replicability. 	<ul style="list-style-type: none"> Partners involved in procuring services and equipment will prioritise the principles of green procurement whenever feasible. By doing so, the partnership will help foster an environment that promotes sustainable choices and encourages the engagement of eco-friendly suppliers.

Figure 11 Considerations during pilot implementation

In conclusion, the pilots represent the practical implementation of the models and will therefore evolve and adapt as actions progress. The factors outlined in Figure 11 do not apply to each pilot case; however, partners will take them into account wherever relevant in fulfilling their roles. In this way, we aim to deliver solutions that are both locally effective and transferable beyond the REHEATEAST regions.

5. Conclusion

This report outlines a set of DHC models, highlighting their design and adaptability. Developed through a joint methodology and contributions from all partners, they form a coherent framework that addresses both optimisation and cooperation.

The models have been designed to be practical and replicable, offering step-by-step guidance while remaining flexible enough to adapt to diverse national and local contexts. This flexibility ensures they can be adapted to varying regulatory, technical, and socio-economic environments.

With the pilot actions ahead, the models serve as a bridge between planning and practice. The application in pilots will allow further refinement, generating lessons and examples that can be replicated in other regions. The outputs, therefore, remain dynamic, responsive to local realities, and aligned with long-term goals of decarbonisation and energy efficiency.

Ultimately, the models are not an endpoint but a base for further steps. They initiate a cycle of testing, learning, and improving that will yield tangible improvements in DHC systems in the form of pilot actions. By embedding cooperation and optimisation as dual pillars, the REHEATEAST partnership sets the stage for replicable, sustainable, and climate-resilient DHC solutions.