IEA DHC | CHP

DHC Annex TS8

Experimental investigations of DHC systems

Annex Text

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ABOUT THE INTERNATIONAL ENERGY AGENCY

The International Energy Agency (IEA) is an intergovernmental organisation that serves as energy policy advisor to 28 member countries in their effort to ensure reliable, affordable and clean energy for their citizens. Founded during the oil crisis of 1973-1974, the IEA was initially established to coordinate measures in times of oil supply emergencies.

As energy markets have changed, so has the IEA. Its mandate has broadened to incorporate the "Three E's" of balanced energy policy making: energy security, economic development and environmental protection. Current work focuses on climate change policies, market reform, energy technology collaboration and outreach to the rest of the world, especially major consumers and producers of energy like China, India, Russia and the OPEC countries.

With a staff of nearly 200 who are mainly energy experts and statisticians from its 28 member countries, the IEA conducts a broad program of energy research, data compilation, publications and public dissemination of the latest energy policy analysis and recommendations on good practices.

ABOUT IEA DHC

The Energy Technology Initiative on District Heating and Cooling including Combined Heat and Power was founded in 1983. It organizes and funds international research which deals with the design, performance, operation and deployment of district heating and cooling systems. The initiative is dedicated to helping to make district heating and cooling and combined heat and power effective tools for energy conservation and the reduction of environmental impacts caused by supplying heating and cooling.

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1 Description of Technical Sector and Definition

In order to meet the climate and energy policy requirements for decarbonisation, both new construction and transformation of existing thermal networks are necessary. This includes objectives such as decarbonisation, flexibilisation and digitalisation approaches for district heating and cooling (DHC) supply. Furthermore, the transformation of supply infrastructures through the integration of renewable energies and waste heat sources, taking into account sector coupling potentials, needs to be considered. However, new operational strategies are required, especially for the multivalent and volatile use of heat sources.

2 Scope and Objectives

2.1 Scope

To prove new DHC supply strategies, laboratory investigations and field experiments in conjunction with software-based and digitalized applications (e.g., digital twins) can enhance and improve the performance of DHC systems and support the necessary expansion of DHC supply. With the help of experimental investigations, more flexible investigations are possible. Experimental investigations often represent the physical behaviour better than simulations, as boundary conditions and dynamic device behaviour can be captured much more realistically. Experimental investigations also allow for testing new approaches also in critical system states and help to gain new knowledge without adversely affecting users or other stakeholders during ongoing operations. Next to this, the comparison of simulation and experimental findings can help to improve simulation models. A validation of simulation results helps to make the findings even more reliable. But in turn only correct data lead to correct modelling and to correct results that are of major importance to facilitate the expansion of DHC successfully. Accordingly, minimizing data-related risks for fast and successful deployment of DHC networks is indispensable.

2.2 Objectives and Challenges

The cooperation project aims to advance and demonstrate experimental research for district heating expansion by identifying appropriate digital technologies, robust data bases, and linking experimental facilities.

To achieve this goal, a number of sub-goals are being pursued, which are also reflected in the sub-tasks (see chapter 3). A detailed description of the sub-goals, the work required to achieve them, and the expected results can be found in the working plans.

One of the first key steps is to assess and to identify the requirements for flexible experimental studies for future DHC supply in general. Here, for example, already existing knowledge from other Annexes (see chapter 5) will be built upon. A comprehensive survey will also be conducted, which will be answered by representatives from research and industry.

To implement further investigations the collection and compilation of design and control methods based on digital approaches are targeted. To achieve reliable results, the identification and consolidation of available data bases for software-based and experimental investigation is aimed. For example, a kind of general overview could be created here. Beside available Data and Software, there are already some experimental facilities in operation. But as they are quite often designed for specific investigation tasks (e.g. component testing, pipe testing, or systemic testing), the identification of potentials for linking the available experiential facilities is required. In order to have an overview of which test facilities (laboratory and field test) are available, a literature review is carried out.

2.3 Target groups and benefits

Different stakeholders benefit in different ways from the results of the Annex activities:

- **Technology suppliers, Component manufacturers, Pipeline manufacturer:** Carrying out customer-specific component tests for validation, measurement and optimisation.
- **Heat suppliers and DHC network operators (as knowledge receptors, owners and investors of demo cases):** Development and validation of new control system and control concepts for new operation management strategies. Use of software and simulation in conjunction with experimental investigations to optimise system operation and for the purpose of analysing components and pipe-soil interactions.
- **Planners, decision makers and service providers of the DHC sector:** Development of necessary adaptations of planning guidelines and technical regulations
- **Researchers:** Collection of comprehensive information on existing experimental facilities for DHC, their capabilities and limitations. References for operators of experimental facilities on best practice solutions concerning the facility setup and operation, conduction of experiments, as well as on cutting-edge research topics. Collection of relevant topics in the context of DHC with significant need for investigation.

As part of the collaborative project, representatives of the target group will be actively involved in the work. In addition, workshops and conference presentations will be organised to ensure knowledge transfer to the international district heating research and industry communities.

2.4 Research Issues

Against the background of the objectives of the DHC Annex TS8, a number of research questions have been developed which are to be answered in the course of the Annex, but which also provide the general guidelines for the work.

1. For which topics and aspects are experimental investigations reasonable and beneficial? Are there experimental facilities available that are tailored to these aspects?
2. What knowledge is available for the experimental investigations? How can experimental investigations contribute to e.g. reducing costs and emissions and increasing the efficiency of the systems?
3. What data basis is actually needed for the experimental studies?
4. What are the experimental facilities in the other countries? What tests are required for district heating?

5. Are results transferable in principle? How are they transferable? How are the results from experiments applied in real systems? How district heating suppliers benefit from the results?
6. What are the requirements for the technical monitoring of tests? How should a possible software-hardware interface be designed?
7. Can the coupling of geographically separated laboratories with complementary equipment provide a cost-effective and scalable approach for experimental studies of future DHC applications (especially in view of sector coupling)?
8. Which standardization of tests methods and boundary conditions are required for experimental facilities and field experiments?
9. How can economical and impact analysis contribute to improve experimental facilities and field experiments?

The research questions developed will be specifically addressed in the individual subtasks to achieve the objective of the Annex and to harmonise the results of the internal processing as part of the subtasks (see Table 1).

Table 1: Assignment of the research questions to the individual subtasks

RQ \ ST	A	B	C	D	E	F
1	X	X	X	X	X	X
2	X	X		X		
3		X		X		
4	X		X		X	
5	X	X		X	X	X
6	X	X	X			
7			X	X		
8		X		X	X	
9	X		X	X		X

3 Means

As IEA DHC Annex TS8 is a task-shared annex, there will be no individual, separate research projects started within the Annex. The International Energy Agency's (IEA) DHC Annex TS 8 provides a framework for the exchange of research results from international initiatives and national research projects and allows the gathering, compiling and presenting of information concerning the experimental investigation of district heating and cooling systems.

To meet the objectives and overcome the challenges described in the previous chapters, all research activities presented by participants within Annex TS 8 are structured, as follows, into subtasks (see).

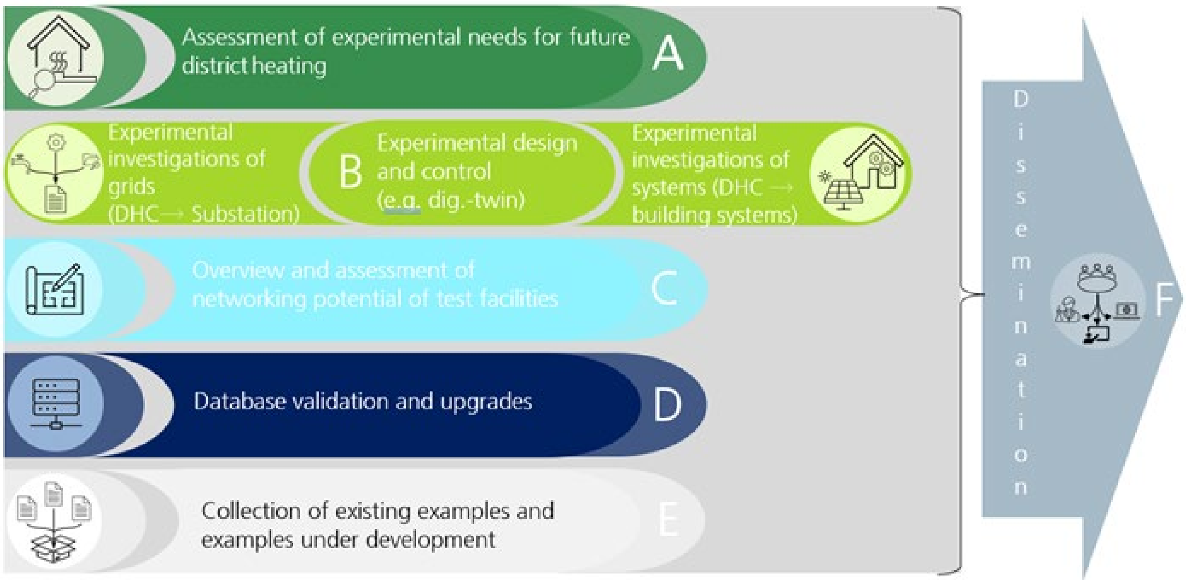

Figure 1: Structure of the IEA-DHC Annex TS8

3.1 Subtask A: Assessment of experimental needs to promote future district heating

Subtask A deals with the identification and the assessment of experimental needs for future district heating and thus forms a foundation for the Annex project. Therefore, sub-task A gives input for the ongoing Annex, but also for the final report.

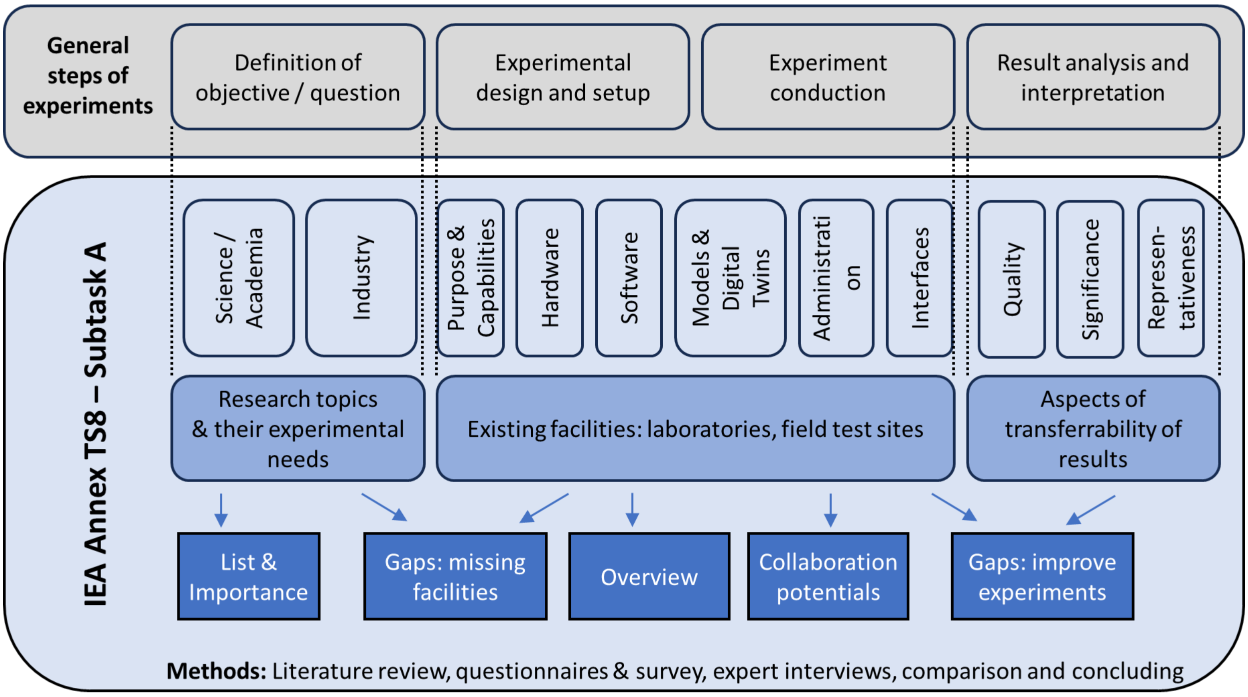

Figure 2: Scheme for the assessment of experimental needs to promote future district heating as part of the Annex TS8.

In general, before experimental investigations can be carried out meaningfully, several aspects must be clarified: what is the subject of investigation, which experimental setup is suitable to gain the intended insights, which data should be recorded and how should

it be evaluated, how transferable are the findings to the practical application outside of the experimental environment.
In the spirit of these preliminary considerations, Subtask A aims for the following objectives stated below. As experimental investigations in the context of DHC systems are conducted in laboratory environments as well as in field experiments, subtask A considers both variants. Input from other Annexes or national projects is foreseen. In addition, the participation of partners from the practical application (e.g. utilities, manufacturers, or digital service providers) is planned.

Objectives are:

- Assessment of experimental needs
  - Main trends in DHC research and development
  - "Hot topics" of the presence and future from industry and practitioner perspective
  - Collection of investigation topics and assessment of their need for experiments.
- Definition of suitable experimental setups
  - What do suitable experimental setups look like to derive new findings on the identified topics that need experimental investigations?
  - How can it be ensured that experimental setups are meaningful for the intended purpose of investigation and representative / transferrable regarding the later practical application in the field?
  - "Reality check" by experts
- Overview on existing experimental facilities (laboratory environments and field tests):
  - Type and purpose of facilities, e.g. laboratories for network investigations, laboratory environments for building-side investigations, district heating test tracks in the field, etc.
  - Available hardware setup (hardware under testing and auxiliary hardware for measurements, communication, emulation etc.)
  - Applied software toolchains (for operation, measurement, modelling & simulation, etc.)
  - Administrational and organizational operation (technical staff, research group, financing, etc.)
  - Readiness for usage by external (interfaces, "plug and play", required skills, entry barrier and learning curve, administrational barriers, schemes of collaboration etc.)
  - Capabilities and limitations of the experimental facilities, identification of synergies and collaboration possibilities
  - Best practice experiences and problems / obstacles that the facilities face
- Conclusions on requirements, opportunities, synergies, and gaps

- What are relevant topics in DHC that can be advanced through experimental investigations?
- What aspects do existing experimental facilities cover?
- How can existing experimental facilities collaborate effectively and complement each other?
- What can be learned and transferred from the operation of existing facilities?
- Where are gaps in the landscape of experimental investigations that existing facilities don't cover? Suggestions on how to change this.

Main work items:

- Identify state of the art and research needs:
  - Research on topics/aspects in the DHC domain that require experimental investigations and identification of suitable experimental setups through a review of scientific literature and questionnaires/interviews with experts from science and industry. List and prioritize the topics to be investigated, including suitable experimental setups.
  - Motivation and presentation of the need for experimental investigations in the context of district heating, also derivation of experimental requirements in the context of transforming district heating towards climate neutrality.
- Compile and processing information on existing solutions:
  - Collecting information on existing experimental facilities by designing and conducting a survey among operators and experts in the field, as well as structuring and summarizing the information. On-site research stays at the facilities might be helpful to establish contact and gain deeper insights.
  - Collecting information on existing software tools for experimental control, and also on digital twins that represent or control laboratory environments and field tests (Interface to Subtask B: Experimental design and control.)
- Assessment:
  - Evaluation of the suitability of existing facilities and tools compared to the identified need for experimental investigations. Based on this, identify gaps and recommendations to close these gaps.
  - Elaboration on collaboration opportunities between various facilities, considering both thematic and infrastructural compatibility.
  - Development of criteria and limitations for transferring experimental results to practical applications in the field, and application of these criteria to existing facilities and tools.

A more detailed description of the goals, the activities, the expected results and the milestones can be found in the working plan.

3.2 Subtask B: Experimental design and control (e.g. dig.-twin)

Subtask B focuses on the planning and execution of new experiments related to new research topics in the district heating domain. The central topic is the design and control of new experimental setups, which can be performed using a physical test setup and/or using simulation tools and digital twins. These tools play a vital role in improving the overall experimental design and control processes.

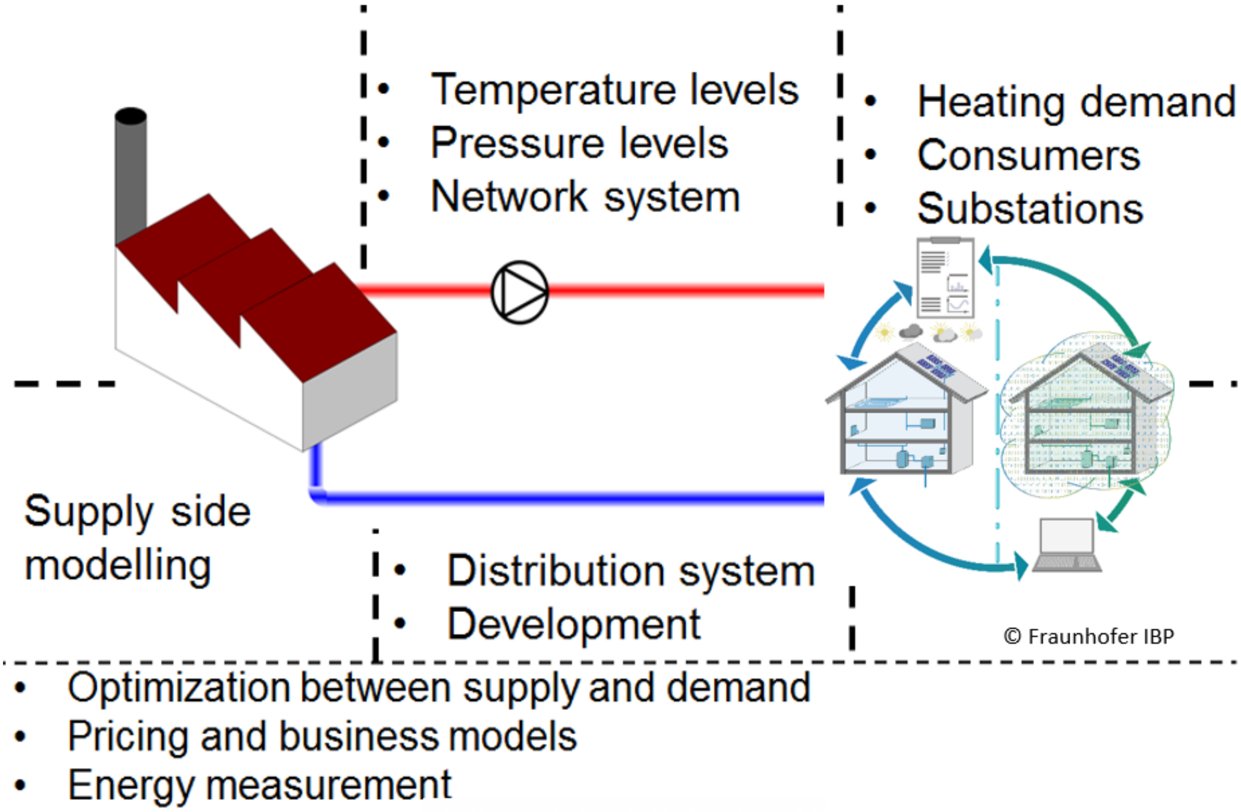

Figure 3: Overview of the various boundaries as considered in DHC Annex TS8.

The subtask is subdivided to encompass a range of examination options, including a grid-level approach and a system-level approach. The primary objective is to gather and identify potential research questions on these levels. Then the aim is to comprehensively explore and address various aspects related to experimental and design control for these new research questions.

This subtask aims to give conceptual guidelines for experimental design setups for each of the identified research questions and to draw conclusions from gathered data and identify any required open research issues.

Main work items:

Building systems:

- Investigation of return temperature limitation to increase the temperature difference between flow and return and for possible integration of renewable heat sources.
- Model predictive control (MPC) of the entire building in consideration of the weather forecast and the resulting district heating network temperatures as well as in consideration of the user consumption profile.

- Design of a suitable data analysis scheme to effectively identify poorly performing building (e.g. high return temperatures, inefficient heating systems, lack of hydraulic balancing) within the district heating network.
- Investigation into suitable generators and control concepts on the building level. Focus on identifying cost-effective solutions that can increase the temperature on the secondary side of the district heating network. Additionally, exploring the implementation of these concepts to improve the overall efficiency and effectiveness of the district heating infrastructure within buildings, ultimately enhancing the heating system's performance. Investigation of different interfaces and protocols to allow access to a multitude of components.
- Investigation of thermal buildings system configurations and operation approaches with respect to the interaction with innovative district heating (DH) grids
- Cataloguing of possible buildings side configurations and assessment of their suitability for the interaction with different thermal network types, such as decentral feed-in, prosumer behavior, low temperature networks, etc.

Grid level:

- Design of relevant investigation methods for component tests like pipes, bends, junctions, valves, pumps or complete transfer stations related to aging, remaining lifetime and energetic performance based on operational conditions
- Design relevant test concept for bedding materials that have different thermal and mechanical properties.

Buildings and Grid Level**:**

- Creation of realistic test setups for district heating substations with focus on generating labelled data for fault detection and diagnosis in DH substations/building level (focus can be on smart control, DHW preparation, bidirectional substations, etc.).
- Comparison of test bench and real-world data, and the possibility of transferring what is learned from lab data to the network.

A more detailed description of the goals, the activities, the expected results and the milestones can be found in the working plan.

3.3 Subtask C: Overview and assessment of networking potential of test facilities

Adequate research infrastructure is a key requisite for the development of future DHC systems. Unfortunately, only a select few (research) institutions have the resources to adequately cover all relevant aspects in a controlled laboratory environment. A relevant example is the experimental evaluation of sector coupling applications, where DHC systems can provide flexibility as a service to other parts of the energy system. Such applications require a laboratory environment covering both the thermal domain and the electrical domain on district scale, a combination that is rare in practice.

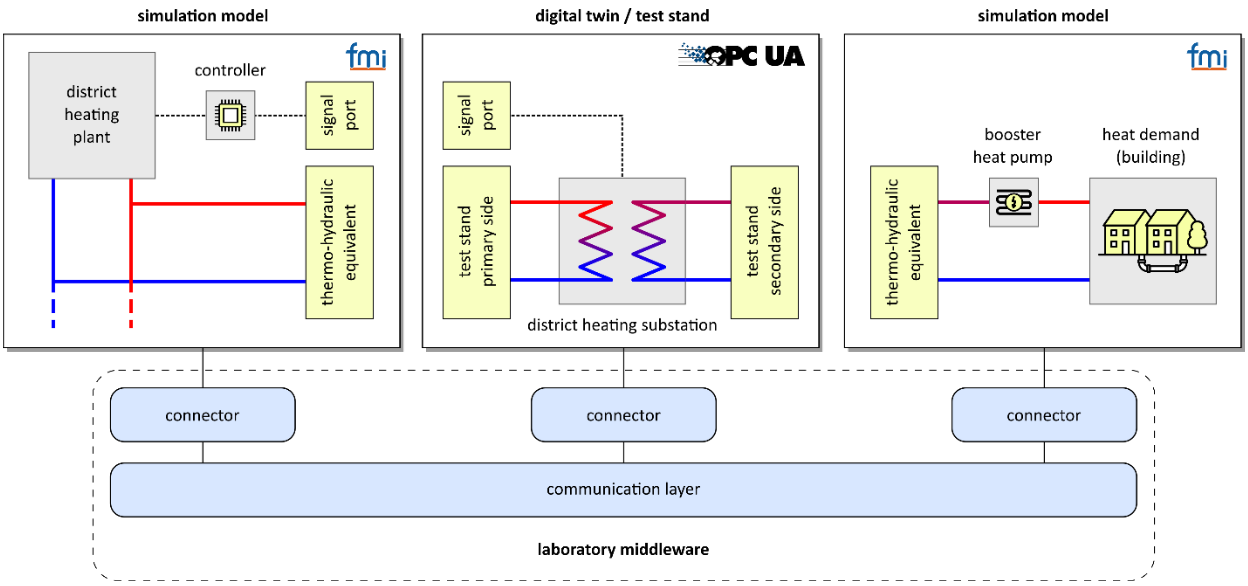

Figure 4: Example of using a laboratory middleware for connecting a laboratory test stand with real-time simulation models. The same approach can be used to connect geographically distributed laboratory setups.

In recent years, however, there have been several essential developments that can help overcome this situation in a cost-efficient way. Innovative ICT solutions can connect geographically separated lab infrastructures, relying on dedicated middleware platforms, automation tools as well as distributed and secure deployment solutions. This has so far been used almost exclusively for the electrical domain but can just as well be applied to DHC applications and hybrid networks. Subtask C's purpose is the collection of approaches and examples for this type of networking of test facilities against the background of district heating supply and sector coupling. The emphasis is on both component-by-component testing as well as system-level assessments. As previously stated, both laboratory and field experiments will be considered.

Main work items:

- Collection of examples in which experiments and/or simulations have been digitally linked, with focus on applications relevant for DHC systems
- Collection and dissemination of best practices for the technical aspects of linking laboratory infrastructure and simulation setups
- Collection of best practices for the collaborative and administrative aspects of linking laboratory infrastructure
- Overview of suitable ICT solutions for interconnecting laboratory infrastructure and simulation setups, with a focus on open-source solutions
- Collection of relevant use cases for future linking activities, demonstrating their added value
- Provide estimates regarding cost saving potentials.
- Identify and initiate a network for interested parties that would benefit from linked lab infrastructure outside of research.

- Compilation and highlighting of the needs and benefits for the European commission, especially on the background of the former soviet countries with old DH systems in need of transformation.

A more detailed description of the goals, the activities, the expected results and the milestones can be found in the working plan.

3.4 Subtask D: Database or dataset identification, validation, enhancement and interoperability

Subtask D focusses on the topic of existing labelled database or dataset identification, validation, enhancement and interoperability. Different approaches are to be compiled, which primarily serve the minimizing of data-related risks for fast and successful deployment within DHC networks. One example for the usage of wrong data sets can be the lifetime prediction for pipes and junctions in EN253 and EN 489.

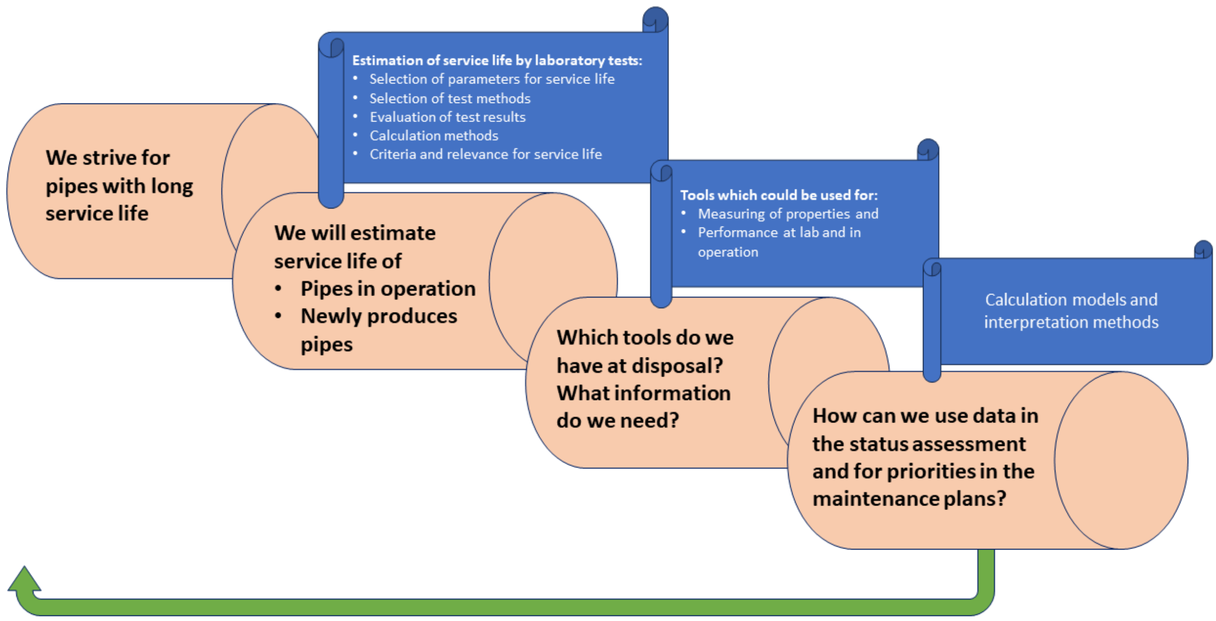

Figure 5: Explanation of data spaces and interoperability.

Data availability and data interoperability are an essential requirement for the effective digital transformation of the energy industry. In the future, testing facilities will also have to consider the validation of interoperability in data-driven applications. Subtask D will offer a perspective on advancements related to data interoperability (semantic models, dataspaces, etc.) that are relevant to the DHC sector.

Main work items:

- Collection of data and validation approaches that would need to be used for experimental investigations.
- Collection of cases where data from labs has been used to compensate pour data quality from real world measurements.
- Compilation of possible data sources and, if applicable, data sources from partners

- Assessment of typical data challenges for validation with regard to their possible advantages and disadvantages
- Overview of ongoing activities to achieve data interoperability (semantic data models, dataspaces, etc.) in the DHC sector

A more detailed description of the goals, the activities, the expected results and the milestones can be found in the working plan.

3.5 Subtask E: Collection of existing examples and examples under development

Subtask E has the objective to collect approaches of system investigations, that are part of DHC or building supply structures. The investigations distinguish between building supply infrastructures, which are connected to a thermal network, for example, and district heating systems. The consideration of laboratory and field experiment is intended.

Main work items:

- Identification and review of existing examples and examples under development
- Review of available simulation and validation approaches for the investigation of building and system dynamics.
- Classification of the collected examples (e.g.: grid-level, building level) in close cooperation with subtask A, B and D
- Description of the respective focus and purpose of the investigation facility
- Creation of fact sheets for the Collection of existing examples and examples under development

A more detailed description of the goals, the activities, the expected results and the milestones can be found in the working plan.

3.6 Subtask F: Knowledge Transfer, Dissemination, Management

The focus of this subtask is to collect and distribute information on on-going and finished work. This includes the set-up of an information platform and the organisation of seminars and workshops.

Main work items:

- Initiation of demonstration projects and development of new activity formats between research and business.
- Documentation of best practice examples.
- Information material, website and seminars/workshops.
- Harmonize vocabulary
- Guidebook.

The results of Subtasks A – E are to be provided as input to the joint activity in Subtask F. All collected information and task-related results will be published via the different channels named in Chapter 3.7. A web-based information platform, open seminars and widespread scientific publications will provide sources of disseminating information. Also, new target groups are to be identified and new means of spreading information will be implemented, where it appears to be sensible. The plan is to condense the findings of Annex TS8 activities in order to simplify public access and use of the results.

3.7 Expected results and planned activities

Against the background of the objectives of the Annex (see Chapter 2.2) and the objectives of the subtasks (see Chapter 3.1 - 3.6), the following results are expected.

Firstly, existing and planned laboratory environments and field tests where experimental investigations of DHC systems are taking place will be collected, analysed and documented. The design of experimental setups and any results from laboratory and field tests will also be collected and documented as part of this process. To demonstrate the potential of experimental investigations, operational strategies, validation options and networking potential will be analysed and compared. Analyses of data collection, data roughness and data acquisition will also be carried out.

Conference presentations and journal articles will be published to disseminate the results among experts and to promote collaboration between research and industry. Industry workshops, meetings with other Annexes and Tasks, and collaboration with other research initiatives are also planned.

The main outcome of the annex is a guidebook that highlights the relevant results of the different sub-tasks, thus providing a holistic understanding of the potential for experimental research on district heating expansion by identifying appropriate digital technologies, robust databases and linking experimental facilities at an international level.

3.8 IEA DHC Annex TS8 Management

The DHC Annex TS8 is operated by an Task Manager under supervisory control of the Executive Committee (ExCo) of IEA DHC. The Task Manager reports twice a year to the ExCo in their meetings. The Subtasks A to E are managed by subtask leaders in a close collaboration with their co-leaders. Subtask F is managed by the Task Manager of TS8.

4 Task Manager of the IEA DHC Annex TS 8 and Subtask Leaders

The task manager for Annex TS8 is Anna Cadenbach and will be supported by Nermina Abdurahmanovic and Dennis Lottis.

The subtask leaders are expected to be from different countries.

Subtask A:	Thomas Licklederer (TU Munich, Germany) and Miha Bobic (Danfoss)
Subtask B:	Cosima Wörle (Fraunhofer IBP, Germany) and Jad Al Koussa (VITO, Belgium)
Subtask C:	Edmund Widl (AIT, Austria)
Subtask D:	Nazdaneh Yarahmadi (RISE, Sweden) and Söhnke Kraft (FFI, Germany)
Subtask E:	Peter Loepelmann (Fraunhofer IEE, Germany) and Anna Volkova (TalTec, Estland)
Subtask F	Anna Cadenbach, Nermina Abdurahmanovic and Dennis Lottis (Fraunhofer IEE, Germany)

5 Co-ordinated IEA Activities

The experts of DHC Annex TS8 are seeking a close cooperation to other IEA initiatives and TCPs (Technology Cooperation Programmes) as EBC (Energy in Buildings and Communities), HPT (Heat Pump Technology Programme) and others. Some specific co-operation activities are listed below:

5.1 IEA DHC Annex TS2: Implementation of Low Temperature District Heating System

The purpose of Annex TS2 is to facilitate the implementation of 4GDH. Doing so will support the attainment of the EU directive of energy performance of buildings (near to zero buildings; 2019 for the public sector and 2021 for the private sector) and provide input to the construction of future, smart cities.

For Annex TS2 a 4GDH handbook is seen as a good way of condensing the knowledge of 4GDH and transferring it from academics to practitioners. The book should be built on the results of Annex TS2, on discussions between technical component manufacturers, practitioners, municipal planners and 4GDH academia.

5.2 IEA DHC Annex TS3: Hybrid Energy Networks - District heating and cooling networks in an integrated energy system context

The aim of the international cooperation program IEA DHC Annex TS3 „hybrid energy networks“, is to promote the opportunities and to overcome the challenges for DHC networks in an integrated energy system context. The Annex provides a holistic approach for assessing, planning and operating hybrid energy networks, considering both technical (system configuration, operational strategy) and strategic aspects (business model, regulatory frame).

The primary result of the Annex is a guidebook highlighting the relevant results of the different subtasks and thus providing a holistic understanding of all aspects leading to optimal planning and operation of DHC networks within a hybrid energy system on an international level.

5.3 IEA DHC Annex TS4: Digitalisation of District Heating and Cooling

Annex TS4 is a project aiming at promoting the opportunities of the integration of digital processes into DHC schemes and to clarify the role of digitalisation for different parts within the operation and maintenance of the DHS system. Furthermore, the implementation of these technologies is going to be demonstrated. Digital technologies are believed to make the whole energy system smarter, more efficient, and reliable and to boost the efficiency and the integration of more renewables into the system. In the future, digital applications might enable district energy systems to fully optimise their plant and network operation while empowering the end consumer. On the other hand, challenges need to be tackled, such as data security and privacy as well as questions about data ownership.

5.4 IEA DHC Annex TS6: Status assessment, ageing, lifetime prediction and asset management of District Heat-ing (DH) Pipes

The Annex task shared 6 “Status assessment, ageing, lifetime prediction and asset management of District Heating (DH) Pipes” (TS 6) intends to initiate a collaborative work within the IEA Implementing Agreement on DHC aiming at an initiative to identify holistic and innovative approaches to ageing and lifetime prediction of DH pipes.

5.5 IEA EBC Annex 81: Data-Driven Smart Buildings

The EBC Annex 81 aim is to increase access to low-cost high-quality data from buildings and support the development of data-driven software ‘Applications’ and analytics, that provide real time building optimization and decision support for building facilities managers.

In order to achieve the overarching Annex aim, the Annex has a number of specific objectives relating to the subcomponents of (i) data-collection, (ii) digital characterisation of buildings, (iii) coding of knowledge into smart “Applications”, and (iv) supporting the utilisation of data-driven products and services. These additional objectives are:

- Provide the knowledge, standards, protocols and procedures for low-cost high-quality data capture, sharing and utilization in buildings.
- Develop a building emulator platform that enables testing, development and assessment of the impact of alternative building HVAC control strategies in a digital environment.
- Develop building energy efficiency (and related) software ‘Applications’ that can be used and ideally commercialized for reducing energy consumption in buildings.
- Drive adoption of Annex results through case studies, business model innovation and results dissemination.

5.6 IEA EBC Annex 84: Demand Response of Buildings in Thermal Networks

It has been proven that buildings are capable of offering flexibility to the power grid by smart control of heat pumps, EVs or white goods. Yet, in a significant share of households the heating and/or cooling demands are satisfied by district thermal grids, and if present, the thermal infrastructure and its potential for flexible and sustainable heating and cooling supply is considered as the strategic component of roadmap towards low-carbon future and gas-free neighbourhoods. The operational challenges of heating and cooling networks (DHC Nets) differ from the power grids. The DHC Nets need to address the issues like faulty operation of heating/cooling technology in buildings, incorrect use of installations by the end-users (e.g. high return temperatures from critical customers, etc.). Therefore, there is a need to investigate how the active management of thermal demands in buildings can enhance operation of thermal grids and thus reduce the need for currently fossil-fuel-based and/or costly peak production, reduce the thermal losses and enhance the capacity of existing networks. Moreover, it is the perfect time to detect transition barriers for related policy and business development, and to identify new opportunities for buildings and end-users to become an active element of the operation and control scheme of thermal networks. Accordingly, it is also the perfect time to test and demonstrate how such new approaches and technological solutions can be implemented in real life environments.

The deliverables will include technical reports, summary of best practice solutions, design guidelines and recommendations and methodologies for big-data utilisation.

5.7 IEA ES Task 43: Storage for renewables and flexibility through standardized use of building mass

Thermal building mass activation uses building masses to condition interior spaces but can also function as energy storage through targeted overheating/undercooling. This storage potential can be used for local and grid-connected renewable thermal and electrical energy (Power2Heat). The project develops new content on the construction, control and business models of such storages and disseminates it as guidelines, data and on the basis of best-practice objects that have been implemented.

5.8 IEA HPT Annex 57: Flexibility by implementation of heat pump in multi-vector energy systems and thermal networks.

This new Annex focuses on the implementation of heat pumps in DHC systems, as well as to describe possible solutions and barriers for heat pumps in these markets. The creation of the possible flexibility in the thermal network and electrical grid, is a main part of the Annex.

The possibilities to increase the share of renewable energy and excess heat as well as to reduce the CO_2 emission in the used heating systems through the use of heat pumps will be a focus area of the Annex. In addition, minimizing the system losses through the use of heat pumps will also be an objective as well as the reduction of CO_2 emissions.

6 Time Schedule

The DHC Annex TS8 is expected to be initiated in November 2022, after a preparation phase of one and a half year and will continue for a period of three (3) years. The DHC Annex TS8 will be concluded by the end of December 2027.

The following table represents the time schedule of each subtask process.

Subtask Progress	Preparation Phase			Working Phase						Repor-ting
	2023		2024		2025		2026		2027	
Subtask A										
Subtask B										
Subtask C										
Subtask D										
Subtask E										
Subtask F										
Annex Meeting	X	X	X	X	X	X	X	X	X	X

Figure 6: Time schedule of the DHC Annex TS8

7 Funding

Participation in this IEA DHC task shared Annex requires a minimum effort of 12 person-months per country. Each participant's country is required to take part in at least one of the subtasks and it is recommended that all participants take part in Subtask F. Participation may partly involve funding allocated to a national activity, which falls substantially within the scope of work to be performed under this Annex. Aside from providing the resources required for performing the work of the subtasks in which they are involved, all participants are required to provide the resources necessary for activities that are specifically collaborative in nature and are not meant to be part of a national program; for example, establishing common monitoring procedures, preparation for and participation in Annex meetings, co-ordination with subtask participants, and contribution to documentation and information dissemination.

The meetings shall be hosted in turn by the various participants. The costs of organising and hosting meetings shall be borne by the host participant. Each participant will bear his/her own travel costs to the expert meetings.

The cost of publishing the reports and summary assessments shall be borne by the Operating Agent.

8 Participants

The following organisations already send additional content or contributions to support the preparation of this TS Project:

- Technical University of Munich, Germany
- Danfoss A/S, Denmark
- AIT Austrian Institute Of Technology, Austria
- RISE, Research Institutes of Sweden, Sweden
- Vito, Flemish Institute for Technological Research, Belgium
- Fraunhofer IBP, Germany
- DTU, Technical University of Denmark, Denmark
- TalTech, Tallinn University of Technology, Estonia
- Fernwärme-Forschungsinstitut in Hannover e.V., Germany

The following organisations wants to be involved as observer of this TS Project:

- AEE - Institute for Sustainable Technologies, Austria
- HafenCity Universität Hamburg – Infrastructure Engineering, Germany
- Fraunhofer ISE, Germany
- LOGSTOR, Germany and Denmark
- DAIKIN Europe, Belgium
- E.ON Sverige AB, Sweden
- Technical University Dresden, Germany
- Sintef Energy, Norway

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