IEA DHC | CHP

DHC Annex TS1:

Low Temperature District Heating for Future Energy Systems

DRAFT: Annex Working Program

Operating Agent

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Working Programme

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1. Introduction

The present document contains a brief description of the tasks (as it is stated in the DHC Annex TS1 text), as well as a detailed description of the working items that build up the task itself. The Annex TS1 provides a framework for the ex-change of research results from international initiatives and national research projects and allows, in a novel way, the gathering, compiling and presenting of information concerning low temperature district heating. The Annex TS1 aims at comprehensively covering the field of low temperature district heating.

To meet the stated objectives and overcome the challenges all research activities presented by participants within Annex TS1 are structured, as follows, into subtasks:

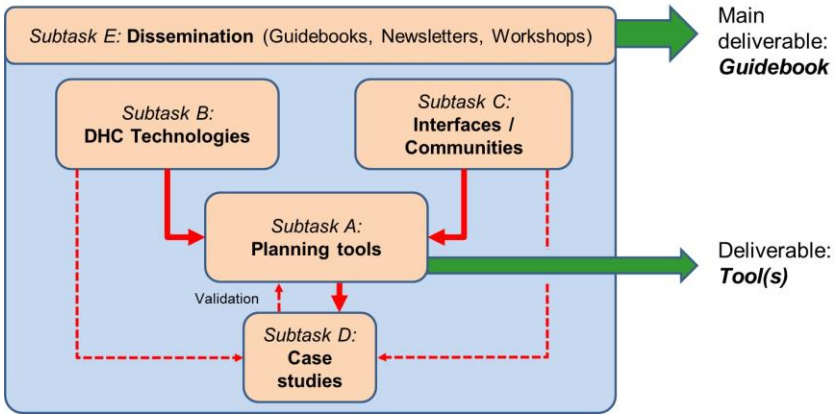

Figure 1: Structure of the IEA-DHC Annex TS1, connection of the subtasks and expected output

For each of the subtasks a table is enclosed, showing a detailed description of the milestones from which the whole subtask is composed, as well as its corresponding deliverables and the “status” that this output or publication may have.

The symbols shown in the legend below are used to specify possible functions of the participants within each of the tasks as well as the “status” that each of the deliverables may have.

Legend:

© -	**Subtask Leader**
XX –	**Report Manager**
MM -	Man month
IWR –	Internal Working Report
EWR –	External Working Report
CP –	Conference Paper
JP –	Journal Paper
TOOL	Software tool

2. Means and Structure

2.1. Deliverables from the Annex TS1

The primary deliverable of the annex is an easy to understand and practical, applicable ***future low temperature district heating design guidebook*** for key people in communities. It is to contain an executive summary for decision makers.

The guidebook is focussed at low temperature district heating from a communal, decision makers' point of view. This will cover issues on how to implement advanced low temperature district heating technology at a community level and how to optimise supply structures to ensure reduced costs for the system solution, while providing a high standard of comfort to the occupants of the buildings.

This brochure will be published preferably both as a book via a publisher, and as an electronic publication.

More detailed results, which will be published as appendices or separate reports via the project homepage are intended to cover topics such as:

- Analysis concept and design guidelines with regard to the overall performance. This could include a possible classification of technologies in terms of performance, improvement potential and innovation prospects.
- Analysis framework and open-platform software and tools for community energy system design and performance assessment.
- A collection of best-practice examples and technologies.
- Dissemination of information on demonstration projects.
- Guidelines on how to achieve innovative low temperature systems design, based on analysis and optimisation methods, and derived from scientific studies.

The dissemination of documents and other information is to be focussed at transferring the research results to practitioners.

To reach the objectives and to produce the stated deliverables the activities within the Annex TS1 have been divided in five subtasks (see figure 1), which are described in detail in following:

- Subtask A: Methods and Planning Tools
- Subtask B: District Heating and Cooling Technologies
- Subtask C: Communities, Interfaces and
- Subtask D: Case Studies
- Subtask E: Knowledge transfer and dissemination

2.2. Subtask A: Methods and Planning Tools

Subtask leader: Country (nn)

Objective
The objective of Subtask A is the identification and adaptation of a methodology for assessing and analysing procedures in order to optimise local energy systems. Furthermore, the aim is to develop simplified and advanced tools for design and performance analysis of energy systems within communities, which are based on district heating.

Main work items:

- Procedures, models and software tools for design and performance analysis.
    - Development of simplified and easy to understand assessment tools for local energy systems based on low temperature district heating technologies.
    - Development of advanced and dynamic assessment tools for local energy systems based on low temperature district heating technologies.
- System optimisation strategies based on energy, exergy, emission and cost indicators.
- Based on the developments, promising and innovative research areas may be identified, e.g. within low temperature production of domestic hot water,

Subtask A provides the necessary framework for more detailed analyses of district heating networks in combination with the different heat production facilities and with the heat supply at a community or neighbourhood level. Based on the conducted analyses, generalised guidelines for future design or retrofit of DHC grids, for example, can be derived, thus making clear under which conditions low temperature district heating can become a low-exergy supply system.

Table 1 shows a detailed description of the milestones from which the whole subtask is composed, as well as its corresponding deliverables, and the “status” that the publication may have.

Table 1: Subtask A - Methods and Planning Tools

Milestones/Tasks		Deliverables			Partici-pants	MM	Scheduled/ Ready
A1	Procedures and definitons for design and performance analysis	A1.1	Report of procedures for detailed design and performance analysis of DHC networks: **Simplified: Excel-based**	**IWR**			
		A1.2	Report of procedures for detailed design and performance analysis of DHC networks: **Dynamic analysis**	**IWR**			

A2	Models for design and performance analysis	A2.1	Report/Compendium of the mathematical models for design and performance analysis of DHC networks: **Simplified: Excel-based**	**IWR**			
		A2.2	Report/Compendium of the mathematical models for design and performance analysis of DHC networks: **Dynamic analysis**	**IWR**			
A3	**Methods** for design and performance analysis	A3.1	Methods Network Simulation	**TOOL**			ready
		A3.2	Demand side management / Load shifting	**TOOL**			
		A3.3	From house to house DH network	**TOOL**	VTT (FI)		
		A3.4	Ring DH networks	**TOOL**	VTT (FI)		
		A3.5	Virtual Heat Plant Concept Advisor	**TOOL**			ready
		A3.6	Imaging tool	**TOOL**	BRE+UCL (GB)		II/2015
		A3.7	Heat loss for pipes calculation tool	**TOOL**	DTU (DK)		ready
A4	**Simulations Tools** for design and performance analysis	A4.1	Template for describtion of tools => report of tools	**IWR**			
		A4.2	Micro energy networks	**TOOL**	KIER (SKR)		Basic simulation ready / I/2015
		A4.3	SpHeat / INSEL	**TOOL**	HFT (GE)		II/2013
		A4.4	DHEMOS	**TOOL**	Noda (SE) / karlshamn Energi		ready
		A4.5	Thermis	**TOOL**	70Tech (DK) /DTU		ready
		A4.6	HACNET	**TOOL**	Tsinghua (CHN)		II/2013 (english)
		A4.7	Communal systems analysis tools (Exergy-based)	**TOOL**	IBP (GE)		III/2015
		A4.8	Exergy analyis of urban energy systems	**TOOL**			III/2015
		A4.9	Smart city simulation platform	**TOOL**			III/2015
		A4.10	Medium / Low Temp. / HP comparison	**TOOL**	DTU (DK)		Steady state available / dynamic by III/2013
		A4.11	Exergy analyses of DHW preparation by usage of low temp. DH	**TOOL**	IBP (GE)		III/2016

A5	Analyses of an improved implementation of **renewable energy sources** and **local storages**	A5.1	Renewable energy potentials - potentially adaptable to cross-technology comparison (PolyCity)	**TOOL**	HFT (GE)		I/2013
		A5.2	Matlab Thermal Storage Simulation	**TOOL**	Tsinghua (CHN)		ready
A6	Based on (A3, A4, A5): Identification of promising and innovative research areas	A6.1	Cross technology comparison	**IWT**			
A7	Pre-normative proposals	A7.1					

2.3. Subtask B: District Heating and Cooling Technologies

Subtask leader: Denmark (Svend Svendsen)

Objective

Collection and identification of promising technologies to meet the goals of future re-newable based community energy systems. The question on how and with which kind of components these systems can be realised shall be answered. The projects will take into consideration the framework derived from Subtask A and provide concepts for dis-tribution, generation and storage of thermal energy that meet the demands of community members with a minimum input of primary energy.

Main work items:

- Innovative technologies for energy supply structures at low temperature levels.
- Innovative technologies for the local utilisation of renewable and ambient resources, e.g. heat pumps.
- Advanced system concepts and solutions for the distribution, local generation and storage of thermal energy at a low temperature.
- Improved integration of all subsystems and optimised operation.

Energy systems consist of a number of components and subsystems. These are to be identified and analysed within Subtask B. The focus here is on innovative solutions to meet the goals of a future renewable based energy supply for communities. At the component level, some topics are to be addressed, such as low temperature DH-substations, installation of domestic hot water preparation using low temperature heat supply, piping and transport concepts, heat generation facilities, such as advanced combined heat and power systems.

Table 2 shows a detailed description of the milestones from which the whole subtask is composed, as well as its corresponding deliverables, and the "status" that the publication may have.

Table 2: Subtask B - District Heating and Cooling Technologies

Milestones/Tasks		Deliverables			Partici-pants	MM	Scheduled/ Ready
B1	**Innovative technologies:** Energy supply structures at different temperature and exergy levels	B1.1	Report on: **Pipe design- low temp. design DH pipes**	**JP/CP IWR**	DTU (DK)		ready
		B1.2	Report on: **Pipe design: High efficient pipes**	**IWR**	SP (SE) Karlshamn Energi		IV/2012 + IV/2013
		B1.3	Report on: **Network design (e.g. triple pipe systems)**	**JP/CP IWR**	DTU (DK)		III/2013
		B1.4	Report on: **Space heating system for low temp. (Blind Spot) overview**	**JP/CP IWR**			-
		B1.5	Report on: **High comfort Bathroom (bypass solution)**	**JP/CP IWR**	DTU (DK)		ready
		B1.6	Consequence analysis of renovation schemes (Strategy advisor)	**JP/CP IWR**	DTU (DK)		I/2013
B2	**Innovative technologies**: Local utilisation of renewable/ ambient resources	B2.1	Report on: **Domestic hot water (legionella reduction)**	**JP/CP IWR**	DTU (DK); HFT? (GE); IBP (GE); SDHA (SE)		I/2014; ?; I/2014; I/2015; No. of reports available, new I/2014
		B2.2	Report on: **Heat pumps for low temperature design and DH**	**JP/CP IWR**			
		B2.3	Report on: **Micro heat pump for domestic hot water**	**IWR**	Danfoss (DK)		III/2013
B3	**Advanced system concepts and solutions:** distribution, local generation and storage of energy	B3.1	Report on: **Absorption heat pumps for CHP plant recovery**	**JP/CP IWR**	Tsinghua (CHN)		Ready + I/2014
		B3.2	Report on: **Total heat recovery for large gas biolers**	**JP/CP IWR**	Tsinghua (CHN)		III/ 2013
B4	**Improved integration** of all subsystems and optimised operation	B4.1	Report on: **Substation design & active consumer**	**JP/CP IWR**	DTU (DK); Danfoss (IS); HFT (GE)		III/2013; I/2013 IV/2013
		B4.2	Report on: **Adapted control and operation technology for low temperature DH nets**	**JP/CP IWR**			

2.4. Subtask C: *Interfaces, Communities and Economics*

Subtask leader: Sweden (Bo Johansson)

Objective

This subtask is focused on the interfaces between an advanced generation and supply of thermal energy on one hand, and, on the other hand, the optimised demand management within the community. The holistic systematic approach is the key issue within the subtask to prevent the introduction sub-optimal systems.

Main work items:

- Identification of the relations between DHC and generation on one hand, and, on the other hand, between DHC and demand.
- Innovative control concepts and strategies for a demand controlled supply.
- System concepts and solutions, including storage systems for low temperature.
- Development of possible business cases and models for communities and utility companies based on the low temperature concept.

The core issues in Subtask C are the identification of interfaces and dependencies between the different subsystems and actors along the energy supply and use chain. The management of energy use, in particular, might offer new system layout and operational strategies. This may lead to innovative and more cost efficient designs and to a higher potential for integrating fluctuating renewable energies. A closer look at economical boundaries of the projects and new possibilities for new business opportunities is to round up the activities of this subtask.

Table 3 shows a detailed description of the milestones from which the whole subtask is composed, as well as its corresponding deliverables, and the “status” that the publication may have.

Table 3: Subtask C – Communities, Interfaces and Economics

Milestones/Tasks		Deliverables			Partici-pants	MM	Scheduled/ Ready
C1	**Identification of the relations:** between DHC and **generation**	C1.1	Generation side modelling for optimisation of low temperature district heating systems				
		C1.2	Study and approach: Consumer behaviour and acceptance of low temperature district heating networks				
		C1.3	Next generation district heating (Holistic approach)		FVB (SE) / Karlshamn Energi		IV/2012
C2	**Identification of the relations:** between DHC and **demand**	C2.1	Demand side modelling for optimisation of low temperature district heating systems				

		C2.2	Study and approach: Consumer behaviour and acceptance of low temperature district heating networks				
C3	Innovative control concepts and strategies for a demand controlled supply (community level)	C3.1	General approach (philosophy) for optimising of design criteria for low temperature district heating systems				
		C3.2	Low-energy-density quarters in communities / cities		HFT (GE)		IV/2014
		C3.3	Interaction of electricity, heat and other energy distribution networks		HFT (GE) IBP (GE)		II/2014
C4	System concepts and solutions, including storage systems.						
C5	Development of possible business cases and models for the communities and utility companies	C5.1	Business logic and Business models for district heating		Profu (SE) / Karlshamn Energi		III/2014
		C5.2	Survey of worldwide but also country specific current business models for district heating				
		C5.3	Policy studies to promote district heating		Tsinghua (CHN)		II/2014
		C5.4	Economics of low temperature district heating systems		DTU (DK)		I/2013
		C5.5	Low temperature DH marketing / rebranding: new type of renewable energy				
		C5.6	Development: Pricing policies (to promote low-temp. DH, to make it compatible with energy savings (to high fixed prices))				
		C5.7	Political energy planning (How can the necessary decisions be taken so that low.-temp. can be promoted in communities and why				

2.5. Subtask D: Case Studies

Subtask leader: Finland (Kari Sipilä)

Objective

Within this subtask, already realised low temperature community energy, as well as planned or designed systems, shall be identified,
collected and visualised. Based on these experiences, design guidelines are to be set and a basis is to be formed for vali-dating the models and tools identified within subtask A with measured data from these community projects.

Main work items:

- Application of advanced system concepts and solution for the distribution, local generation and storage of low temperature heat.
- Usage of innovative control concepts and strategies for demand controlled supply.
- Collection of already existing community projects.
- Validation procedure of community design and planning tools.

The core issues in Subtask D are the identification, demonstration and collection of innovative low temperature district heating systems. Advanced technologies and the interaction between system components are to be demonstrated here. Based on the evaluation of the collected examples of low temperature DH systems, the tools and methods identified in Subtask A, and the implementation of combined dynamic analyses in Subtasks B and C, the case studies can be integrated into a larger picture of low temperature district heating.

Table 4 shows a detailed description of the milestones from which the whole subtask is composed, as well as its corresponding deliverables, and the “status” that the publication may have.

Table 4: Subtask D - Case Studies

Milestones/Tasks		**Deliverables**			**Partici-pants**	**MM**	**Scheduled/ Ready**
D1	**Application** of **advanced system concepts** and solution for the distribution, local generation and storage of energy	D1.1	Report on small heat grids		SEA (SE) / Karlshamn Energi		IV/2013
		D1.2	Report on usage of Industrial Waste district heating		Tsinghua (CHN)		II/2014
		D1.3	Report on heat recovery from CHP plants		Tsinghua (CHN)		I/2013
		D1.4	Report on low temperature operation of gas/condensing boilers in district heating nets		Tsinghua (CHN)		I/2014

D2	Usage of **innovative control concepts** and **strategies** for a **demand controlled supply**	D2.1	REC – RES cooling schemes (Greenhouses, Fishfarms)		SAgU (SE) / Karlshamn Energi		IV/2013
D3	Collection of realised community projects.	D3.1	Template for Case study documentation in Annex TS1	**IWR**	VTT (Fi)		
		D3.2	Report on results of case study **Ludwigsburg**	**IWR**	HFT (GE)		III/2014
			Report on results of case study **Wüstenrot**				III/2015
		D3.3	Report on results of case study **Lystrup**	**IWR**	DTU (DK)		I/2013
			Report on results of new case study on existing networks				
		D3.4	Report on results of case study from Annex X	**IWR**			
		D3.5	Report on results of case study from **Hvinkää**		VTT (FI)		
D4	Validation procedure of community design and planning tools			**IWR**			

2.6. Subtask E: Knowledge transfer, dissemination

Subtask leader: GERMANY (Heiko Huther /Andrej Jentsch and Dietrich Schmidt)

Objective

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.
- Website and seminars/workshops.
- Design guide.

The results of Subtasks A, B, C and D are to be provided as input to the joint activity in Subtask E. All collected information and task-related results will be published via

the different channels. 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 TS1 activities in order to simplify public access and use of the results.

Table 5 shows a detailed description of the milestones from which the whole subtask is composed, as well as its corresponding deliverables, and the "status" that the publication may have.

Table 5: Subtask E- Knowledge Transfer, Dissemination

Milestones/Tasks		**Deliverables**			**Partici-pants**	**MM**	**Scheduled/ Ready**
E1	Dissemination Activities	E 1.1	Industry workshops/other IA + Proceedings of workshops	**IWR**	All	0.5 per WS	ongoing
		E 1.2	Website	**Home page**	AGFW / IBP	1	I/2013
		E 1.3	Annex TS 1 Brochure	**EWR**	IBP / AGFW	0.5	II/2013
E2	State of the Art	E 2.1	State of the art report for Planners Planners brochure? (Semi-technical) - Check relation to ECBS Annex 51	**EWR**			Draft: I/2014 I/2015
		E 2.2	Policy recommendation (non-technical)	**EWR**			IV/2015
		E 2.4	Link collection for low temperature DH (planners tools)	**EWR**	AGFW / IBP		III/2013
		E 2.5	Brochure (description of Tools)	**EWR**			
E4	Design Guidebook	E 4.1	Design guide	**EWR**	All / AGFW-IBP	2	IV/2015
		E 4.2	Full version	**EWR**	All / AGFW-IBP	4	IV/2015
		E 4.3	Summary	**EWR**	All/ AGFW-IBP	2	IV/2015

3. Resources Committed to DHC Annex TS1

Country	Research Group	MM	Subtask A							Subtask B				Subtask C					Subtask D				Subtask E			
Activity			A1	A2	A3	A4	A5	A6	A7	B1	B2	B3	B4	C1	C2	C3	C4	C5	D1	D2	D3	D4	E1	E2	E3	E4
Denmark (DK)	DTU																									
	Danfoss																									
	70Tech																									
Finland (FI)	VTT																									
Germany (GE)	FhG-IBP																									
	AGFW																									
	HTS																									
South Korea (SKR)	KIER																									
Sweden (SE)	KE																									
	SDHA																									
	SEA																									
	SAgU																									
	Noda																									
UK	BRE																									
	UCL																									
China (CHN)	Tsinghua Uni																									
Netherlands	CHRI																									