KeepWarm
Renewing district heating

Improving the performance of District Heating Systems in Central and Eastern Europe

Pilot projects

Report on replication models

Horizon 2020 (H2020-EE-2017-PPI)
Project N°784966

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List of Abbreviations

AT	Austria
CEE	Central and Eastern Europe
CoM	Covenant of Mayors for Climate and Energy
CZ	Czech Republic
DisComEx	Dissemination, Communication and Exploitation
DG	Directorate-General of the European Commission
DHS	District Heating System
EU	European Union
GHG	Greenhouse Gas
HR	Croatia
KPI	Key Performance Indicator
KPV	Komunalno podjetje Velenje (Communal company Velenje)
LV	Latvia
MZI	Ministry of Infrastructure (Slovenia)
NGO	Non-Governmental Organisation
RES	Renewable Energy Source(s)
SI	Slovenia
SRB	Serbia
UKR	Ukraine
SECAP	Sustainable Energy and Climate Action Plan
WP	Work Package

Summary of the project

The project “KeepWarm - Improving the performance of district heating systems in Eastern Europe” is funded under the EU Horizon 2020 programme. Its objective is to accelerate cost-effective investments in the modernisation of District Heating Systems (DHS) in Central and Eastern Europe (CEE). KeepWarm is most active in seven countries: Austria (AT), Croatia (HR), Czech Republic (CZ), Latvia (LV), Serbia (SRB), Slovenia (SI) and Ukraine (UKR). The project focuses on this region, and these particular countries, because in most cases DHSs are frequently still inefficient and for the most part overly reliant on fossil fuels (especially gas, coal or oil).

The aim of this initiative, launched in April 2018, is to modernise DHSs around the whole region in a more sustainable manner. By improving system operations and promoting a switch to less-polluting sources, like renewable energy sources (RES), KeepWarm will contribute to reducing greenhouse gas (GHG) emissions. The eleven project partners strive to ensure that best practices for environmentally friendlier heating and cooling will be taken up across Europe, replicating KeepWarm’s approach in other countries and regions, even beyond the end of the project in September 2020.

Project objectives

KeepWarm’s specific objectives are:

- At least 450 relevant stakeholders with increased capacities on technical, organisational, financial and managerial aspects – includes 150 DHS operators;
- At least 95 **DHS operators** are able to **develop business plans** and to identify the most suitable **financial model** for modernisation of their own DHS;
- At least 23 **business plans for the modernisation** of DHSs have been developed and **sources for investment** have been identified;
- DHS network **retrofitting** is addressed in at least 10 local **energy plans** and 7 regional or **national strategies** or plans;
- At least 23,300 **relevant stakeholders** (directly) and 125,000 (indirectly) **reached** across Europe in order to **replicate the project outputs** in primary and secondary target regions and ensure the project’s impact;
- **Support EU policies and initiatives**, such as the Covenant of Mayors for Climate and Energy (CoM) and DecarbHeat, by exploiting key lessons from KeepWarm activities and pilots to disseminate best practices across Europe.

KeepWarm consortium partners

LOGO	PARTNER NAME	SHORT	COUNTRY
	Deutsche Gesellschaft für internationale Zusammenarbeit (GIZ) GmbH	GIZ	Germany
	University of Zagreb Faculty of Mechanical Engineering and Naval Architecture	UNIZAG FSB	Croatia
	Landeskammer für Land- und Fortwirtschaft in Steiermark	LWK	Austria
	Regionalna Energetska Agencija Sjeverozapadne Hrvatske	REGEA	Croatia
	Jožef Stefan Institute Energy Efficiency Centre	JSI	Slovenia
	ICLEI European Secretariat GmbH	ICLEI Europe	Germany
	Teplarenske Sdruzeni Ceske Republiky	TSCR	Czech Republic
	Biedriba Zemgales Regionala Energetikas Agentura	ZREA	Latvia
	Zavod Energetska Agencija za Savinjsko Salesko in Korosko	KSSENA	Slovenia
	LLC KT-Energy Consulting	KT-Energy	Ukraine
	Institut za Nuklearne Nauke Vinca	VINCA	Serbia

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Executive summary

Switching from a fossil fuel and inefficient DHS (district heating system) to clean and renewable alternatives with low level of losses is challenging. In parallel, other competitive heating solutions intensify the competition on the heating market for customers, research funds, infrastructural expansion and political attention and make it difficult for other heating alternatives, such as district heating (DH) to compete. Besides, DHSs are often unable to provide appropriate value of their services from technical, environmental, societal as well as economic perspective. In other words, DHSs are in a difficult position and need to strengthen their market position in order to compete. Yet, they often lack of ambitious plans and miss out on relevant activities such as development of feasibility studies, complicated public procurement procedures, evaluation of RES potential, successful negotiations with both existing and future end-consumers, identification and application to both local/regional/national and EU funds (lack of investment strategy). Moreover, DHS require work force and capacity to achieve ambitious plans due to lack of financial funds or know-how. To support the modernisation of DHSs, the KeepWarm project focuses on modernisation of pilot DH systems in seven partner countries (Austria, Croatia, Czech Republic, Latvia, Slovenia, Serbia and Ukraine) and will use the lessons learnt from the modernisation processes as models all other European systems.

The following report points out eleven models developed within the project which can be used as good practice examples and showcase for successful modernisation of various DHSs. These models represent a continuous work and highlight main parts of the KeepWarm tailor-made approach. Continuous work includes activities such as feasibility studies, business plans, selection of pilot DHSs for creating investment opportunities during and beyond the lifetime of the project. Project partners committed to provide support to DHS representatives throughout an interdisciplinary approach with the aim of achieving investments. After identification of current state and barriers which hinder successful investments, the KeepWarm consortium organised local working groups in each country aiming to provide tailor-made assistance, to remove barriers and achieve investments.

Parallelly, a systematic overview of current legislation and legislative proposals focused on promotion of DH sector has been created focussing on the political strengths and weaknesses of DH in the heating sector. Moreover, each pilot DH project participated at a Twinning Programme, Study Visits and Inspire Events. Those activities were organised (mostly virtually), yet KeepWarm results could be shared and discussed with a multitude of different stakeholders also via online formats to share knowledge and experience.

Replication models have been created with the aim of presenting applicable retrofits of other DHSs in KeepWarm included countries (and beyond). Throughout a short overview of applied KeepWarm approach, each model presents a different way of modernisation of certain aspects within DH sector such as implementation of new heat source, pipeline renovation projects, DH network expansion, small scale improvements, step-by-step approach and continuous investments in different measures which have been identified and created within KeepWarm project.

Each model consists of short overview of performed activities in each five pillars of KeepWarm, summarizing main points and generated benefits, as well as given potential for replication. Project partners analysed included pilot projects based on geographical characteristics, available resources, and country-specific information.

Therefore, these models represent various ways of achieving decarbonisation in DH sector based on different technologies, financial and legislative constraints.

The following table presents eleven replication models developed and chosen by the KeepWarm project consortium.

Country	DHS Name	Highlight	KeepWarm Partner
Austria	Eibiswald	Engagement of local DHS	LWK
Croatia	Zaprešić	Solar energy	REGEA
Czech Republic	Brno	Large scale pipeline renovation (and biomass integration)	TSCR
Latvia	Lielauce	Small-scale modernisation	ZREA
Latvia	Bene	New small biomass boiler house (container type)	ZREA
Serbia	Priboj	Step-by-step biomass integration	VINČA
Slovenia	Ptuj	Fossil fuel phase-out	KSSENA
Slovenia	Velenje	Continuous renovation of pipeline	KSSENA
Ukraine	Bila Tserkva	Step-by-step modernisation	KT-Energy
Ukraine	Zhytomyr	Organic Rankine Process in CHP plant	KT-Energy
Latvia	Jekabpils	Diversification of fuel and automation of boiler house	ZREA

Table 1 KeepWarm Replication Models

Introduction

Based on input throughout the project, district heating systems (DHS)s have proven to be dependent on individual local boundary conditions such as availability of technology, current legislation for DH sector and financial opportunities. The aim of this brochure is to present potential good practice examples from KeepWarm Countries as a result of KeepWarm project activities. Presented examples include influence of national conditions, and cover numerous improvement measures (optimisation, retrofitting, renovation, RES integration) in five focused areas: technical, financial, organisational, managerial and legal.

Eleven good practice examples have been selected within the project to highlight outcomes of KeepWarm's tailor-made approach and support identified in previous activities. The different applied support given for each KeepWarm country and involved DHS is explained in the Report on Support given to DHSs. Besides promotion and support activities, this document highlights a replication methodology which can be applied throughout DH sector in Europe, including:

- General info about DHS;
- KeepWarm tailor-made approach;
- Highlight of activities;
- Results and lessons learnt;
- Replication potential;
- Contact.

The social, economic, and financial impacts of the Covid-19 pandemic had a huge influence on KeepWarm since the outbreak and worldwide spreading in the first months of 2020. Most importantly, access to finance and investments were severely impacted by the socio-economic situation and the lasting insecurity. Therefore, investments to DHS changed, were delayed, or completely stopped due to (1) social restrictions and therefore the possibility for physical meetings, (2) slowed procedures in terms of public procurements and obtaining permits, and, in general – (3) due to a change of policies within each national/regional framework in terms of priorities for development of the energy sector in comparison to the recovery of the economic situation.

Therefore, this report highlights development of pilot DHSs projects with different stages of implementation (finished investments, in progress, planned investments that are outstanding and planned beyond the duration of the project) and presents the outcomes of KeepWarm's tailor-made approach in all countries.

KeepWarm approach [1]

The KeepWarm approach includes several targeted areas and activities to reach EU goals in DH sector by promoting a switch from fossil fuels to renewables. The first step (knowledge sharing and capacity building[2]) provided 746 hours of tailor-made training to address specific objectives and capacities, clustered in five groups, for target stakeholders.

In a second step, support has been given to pilot systems to develop **business plans and attract investment** promoting benefits of renewable energy, excess heat and energy efficiency increase. In total, 29 pilot systems performed necessary assessments to maximise their benefits.

Figure 1 KeepWarm Approach

Local working groups have been created to support KeepWarm pilot DHSs, to discuss best options with different stakeholders and further possible adaptations of business models (reports are available on KeepWarm website[3]). On the other hand, a **Twinning and Ambassador Programme** has been organised and set up to facilitate replication of the entire KeepWarm approach and share knowledge between paired DHS stakeholders.

In the next step KeepWarm partners conducted **Inspire Events** where participating DHS owners/operators, DH associations and agencies to reach out to relevant stakeholders, local, regional, and national authorities to attract interest for the project's results and stimulate motivation for policy improvements.

To support the individual national strategies, the project partners created **Action Plans** for the retrofitting of the DH sectors, pointing out areas which aren´t sufficiently addressed in these strategies. These action plans[4] aim to contribute to the improvement of a legal framework for systematic decarbonisation of DH networks, the introduction of incentives for heat production from RES and to increase the energy efficiency of these systems.

[1] Sustainable Adoption Roadmap
[2] Learning Centre
[3] KeepWarm's results
[4] Multi-level Policy Plans

General overview of replication methodology

Before presenting KeepWarm's good practice examples which directly derive from the KeepWarm project and should be successfully implemented in post-project period if not already during the project period, this chapter gives an overview of all aspects that need to be included if potential DHS would like to achieve modernisation of their production and distribution units to build up a future-oriented, sustainable and decarbonized system attractive both for existing and new end-users.

This replication methodology represents a comprehensive set of activities for DHS modernisation which can be followed in order to achieve the same or similar outcomes, to raise interest among relevant stakeholders, as well as to maximise the impact, especially focusing on KeepWarm countries (and the European area). Also, fostering cooperation and exchanges between DHSs is anticipated, especially between KeepWarm pilot DHS projects and DHSs which would like to undergo the same process by applying the KeepWarm approach.

Yet, replication also raises the question, if the same (KeepWarm) approach can achieve the same outcomes since social, economic, political and other conditions might differ from the proposed models. In other words, DHSs which will intent to replicate the KeepWarm approach will "walk" the same path of the KeepWarm consortium, following the presented methodology and considering specific local/regional/national conditions, as well as other aspects as explained below. The eleven models presented in the following chapters can serve as examples highlighting each one special feature at the core of the modernisation. Before explaining the methodology, it has to be emphasised that for a successful replication, original creators (KeepWarm consortium) should be included in the process in order to more carefully mirror the methods and procedures used within the project.

Within the KeepWarm project, the partners have developed a reliable and transferable methodology to boost the replication of exploitable results, namely modernisation of DHSs and integration of renewable energy sources (RES). The methodology starts by assessing the current state via questionnaires and direct contact with DHS, identifying the best approach through feasibility studies, process analysis and development of business plans. Then, the implementation can start establishing clear and effective training plans addressing the needs of DHS, getting in contact and collaborating with relevant stakeholders (and other DHSs) and finally, review of existing and proposals for future legislation regarding DH sector. The better each step is performed, the better the possible result for achieving investments – thus, DHS who decide to use the KeepWarm approach should take into consideration all aspects presented in figure 2.

In order to visualise the decision-making process of the replication methodology, the following figure presents a graphical overview of necessary, desirable and possible steps and aspects in order to successfully use and exploit the KeepWarm approach for your proper DHS modernisation.

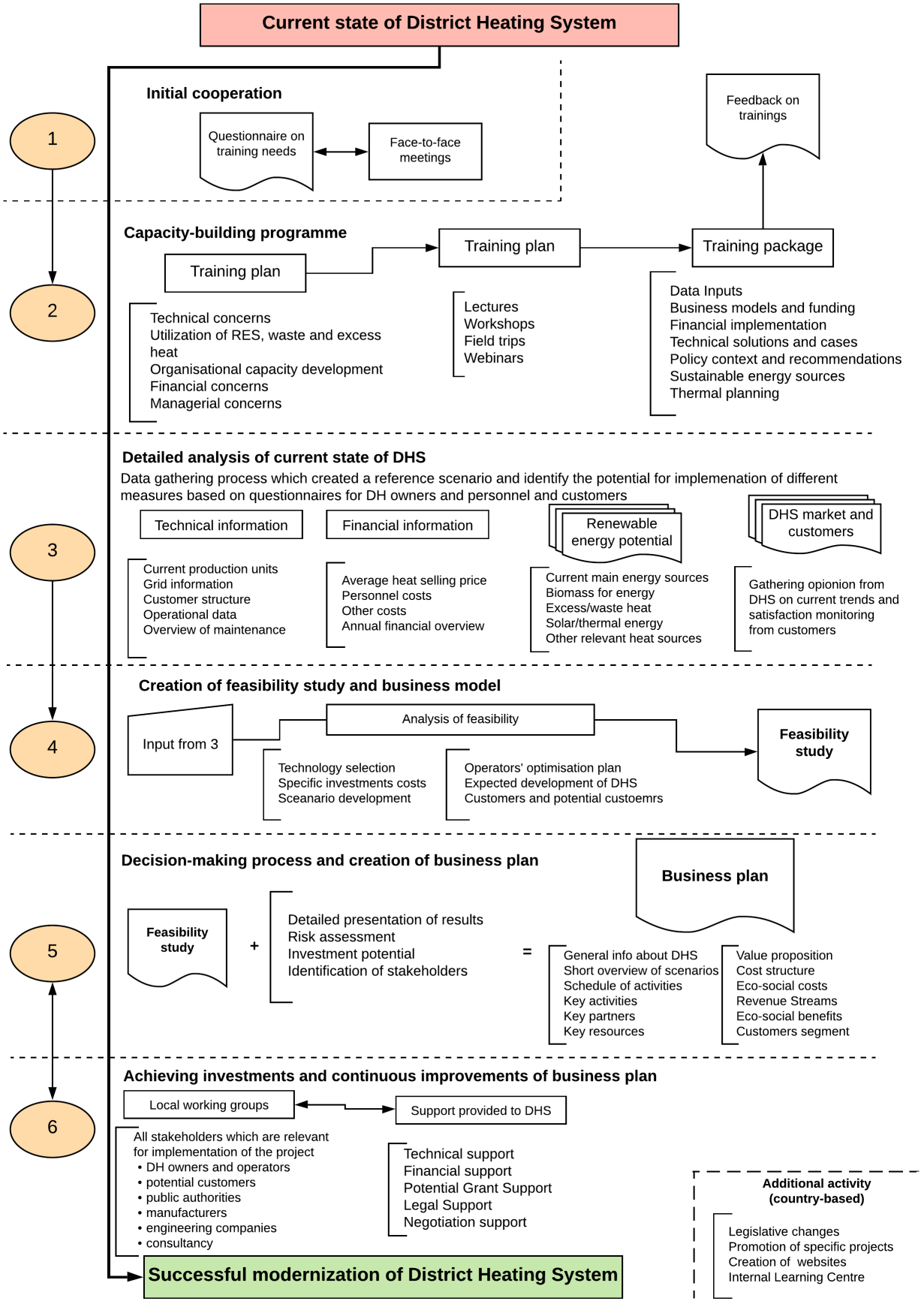

Figure 2 Replication methodology

Replication Models

As a result of created business plans and provided support to pilot DHS systems, replication models have been created with the aim of presenting applicable retrofits of other DHSs in KeepWarm included countries (and beyond). Throughout the project, 29 pilot projects have been engaged with KeepWarm approach and achieved numerous improvements within their scope of work. However, eleven pilot projects have been selected from the pool to highlight benefits of the approach through capacity buildings, solutions for modernization, identification of available funds and legislative support. Project partners analysed included pilot projects based on geographical characteristics, available resources, and presence of at least one model per country Therefore, these models present various ways of achieving decarbonisation in DH sector based on different technologies, financial and legislative constraints.

Apart from presenting applicable retrofits, this document focuses on raising awareness and promotion potential of pilot projects and activities performed throughout the project. These activities (KeepWarm approach) results in achieving certain investments in energy efficiency and renewable energy resources, as well as built capacity and influence on certain legislative documentation.

Given table presents selected examples of pilot DHSs projects within the KeepWarm project.

Country	DHS Name	Highlight	Partner
Austria	Eibiswald	Engagement of local DHS	LWK
Croatia	Zaprešić	Solar energy	REGEA
Czech Republic	Brno	Large scale pipeline renovation (and biomass)	TSCR
Latvia	Lielauce	Small scale modernisation	ZREA
Latvia	Bene	New small biomass boiler house (container type)	ZREA
Serbia	Priboj	Step-by-step biomass integration	VINČA
Slovenia	Ptuj	Fossil fuel phase-out	KSSENA
Slovenia	Velenje	DHS own investment in continuous renovation of pipeline	KSSENA
Ukraine	Bila Tserkva	Step-by-step modernisation	KT-Energy
Ukraine	Zhytomyr	Organic Rankine Process in CHP plant	KT-Energy
Latvia	Jekabpils	Diversification of fuel and automation of boiler house	ZREA

Table 2 Overview of KeepWarm replication models

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A case example from DHS Eibiswald, Austria

The DHS was founded in 1993. Nahwärme Eibiswald is a registered cooperative of 18 members (farmers of the region). The goal of the DHS is, that they use the wood chips of the farmers of the cooperative and therefore to generate more income for the members.

For the DHS Eibiswald, the use of renewable energies is the primary option - DHS is currently mainly using wood chips as fuel which are also the most available fuel in the region of the DHS Eibiswald - more than 60% of the area in Styria are forests.

Figure 3 DHS Eibiswald (Source: Nahwärme Eibiswald eGen)

Throughout the project duration, project partners have created the KeepWarm approach to DH modernisation[5] based on which tailor-made support has been given.

Training and capacity-building

Based on training needs assessment[6], specific topics have been identified which resulted with 15 capacity building sessions (130 hours) and 166 individuals in total. The KeepWarm training approach proved to be flexible and enabled the partners to adapt the training to their national context. The lecturers were employees of LWK Steiermark, various advanced DHSs, research facilities, and other companies involved in DH such as consulting companies, equipment producers etc.

The participants were mostly employees of small DHSs, but several interested external stakeholders also participated in capacity building. A broad range of relevant topics was covered through methods such as lectures, exercises, software presentations and study visits. Special attention has been given to practical approach, networking, and open discussion[7].

Stakeholder involvement:

Owner consortium, planner, municipality, financing partners

TOPIC	TRAINING HOURS	DHS EMPLOYEES	OTHER STAKEHOLDERS	TOTAL INDIVIDUALS
1. Technical topics	43	146	11	157
2. RES and EE topics	30	144	11	155
3. Organization topics	28	114	7	121
4. Financing topics	15.75	35	2	37
5. Management topics	13.25	27	3	30
Total	**130**	**155**	**11**	**166**

Table 3 Overview of trainings in Austria[7]

[5] Sustainable Adoption Roadmap
[6] KeepWarm Training Needs Assessment and Training Plan
[7] Report on Training Conducted

KeepWarm
Renewing district heating

A case example from DHS Eibiswald, Austria

Business plans

After conducting detailed training programme, national partner (LWK Steiermark) has assisted to DHS Eibiswald in creation of tailor-made business plan to support implementation of selected scenarios and assist in decision-making process. For the realisation, there are several activities during planning and construction necessary. The most crucial activities were the negotiations with the owners of Aibl, and with new customers.

Furthermore, finding suitable partners for construction was crucial. The total costs of this scenario are **around 6 million Euro**. Just smaller parts are paid via equity. Both financial institutions and subsidies were considered, also an additional amount of 8,600 m³ of wood chips are necessary per year.

The annual primary energy savings through the efficiency increase is 320 MWh. On the life span of 25 years, the total primary energy savings are 8 GWh. Furthermore, DHS Eibiswald contributes to an increased production from renewables of 8,410 MWh.

On the life span of 25 years, the total additional use of renewables will be 210.25 GWh. Additionally, such an investment would lead to annual CO2 savings of 1,764 tons. Those are mainly due to connecting new customers, which are currently using fossil fuels. On the life span of 25 years, the total CO2 savings will be 44,100 tons.

Key Partners
- ✓ Owners of the DHS
- ✓ Owners of DHS Aibl
- ✓ Municipality/Authorities
- ✓ Planning and construction companies
- ✓ Technical suppliers
- ✓ Financial institutions and funding agency

Key Activities

First planning, convincing board, first negotiations with Aibl, talk to stakeholders

Detailed planning, negotiation with potential customers, applying for permits, applying for subsidies, talking to financial institutions and customers

Construction of the boiler

Value Propositions
- ✓ Renewable heat from biomass
- ✓ CO2 savings
- ✓ NOx
- ✓ Using local fuels (30 km range)
- ✓ High comfort for customers
- ✓ High security of supply
- ✓ Moderate costs and stable prices

Customer Relationships
- ✓ Heat contracts 15 years
- ✓ Integration of customers in optimisation / construction process through stakeholder processes.
- ✓ Talking to customers of Aibl

Customer Segments

Type of customers:
- ✓ Private households
- ✓ Public buildings
- ✓ Companies

Goal: getting 110 new customers along existing and new grids in Eibiswald. 30 new customers in Aibl.

Key Resources

Financial resources:
- ✓ 6 Million Euro investment
- ✓ 1.75 Million Euro subsidy
- ✓ Rest: loan from financial institution

Physical resources
- ✓ new boiler, boiler house, grid, technical equipment, heat transfer stations, 8600 m³ additional wood chips

Channels
- ✓ Personnel conversations with customers
- ✓ Annual billing
- ✓ Stakeholder process

Eco-Social Costs
- ✓ Still using some fossil-fuels (as backup)
- ✓ Noise and dust emissions during construction phase

Eco-Social Benefits

8 GWh primary energy savings over the life span.
210.25 GWh additional use of RES over the life span.
CO2 savings of 44,100 tons over the life span
- ✓ Use of local fuels
- ✓ Substitution of fossil heating
- ✓ High security of supply
- ✓ Local added value

- ✓ Local job security

Figure 4 Summary of Business model DHS Eibiswald

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A case example from DHS Eibiswald, Austria

Attracting funds for uptake

In order to enable the Austrian DHS to realize their plans and achieve investments and modernization of their systems, the project partner LWK Steiermark organized five working group meetings, in which feasibility studies as well as modifications and further steps were discussed with respective DHSs representatives which were attended by 108 participants[8]. Further information can be accessed on the KeepWarm website.

DHS Eibiswald decided to go for a combination of rebuilding their boiler house and expanding their grid, plus a takeover of a nearby grid and connection of those grids. They already finished this project in October 2020 and totally invested 7.2 Million Euros.

LWK Steiermark and Bioenergie-Service provided support to DHS representatives in several different fields with the aim of achieving investments, modernising DH production and heat network, and expanding the grid. A series of meetings were organized between DHS operators and companies (manufacturers/designers) as well as the municipality.

Suitable technologies, grid expansion as well as the subsidy process were discussed. LWK Steiermark and Bioenergie-Service also provided technical assistance in the evaluation of taking over the nearby grid in Aibl. Also, potential new customers in Eibiswald, which are quite far away from the grid, could be connected, are taken into consideration since those were required to receive the full amount of subsidies.

The financial support of the KeepWarm project for the DHS Eibiswald focused on support in getting subsidies. LWK Steiermark and Bioenergie-Service supported in applying for national environmental subsidies for optimising renewable district heating plants (Umweltförderung im Inland). This subsidy supports the optimisation of renewable district heating systems with up to 35% of net investment costs.

LWK Steiermark supported evaluation of heat contracts and adapting them to the current laws and regulations. This new heat contract template was applied for the new connected customers. During the optimisation process, the DHS Eibiswald nearly doubled its customers - mainly from private houses and apartment (and several commercial buildings)

[8] Report on Local Working Group Austria and Report on support provided to DHS

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A case example from DHS Eibiswald, Austria

Policy integration

The main challenges for the improvement and decarbonisation of the DH systems are a decrease in heat demand due to energy improvements of the connected buildings, still too high temperatures in the grid, high investment costs for RES technologies, the lack of a national heating strategy and a lack of DH specific training, especially in small and medium sized utilities.

The country-specific Action Plan formulated 20 key recommendations in the areas of strategic policymaking, technical guidance, planning and regulation, and financing[9].

Apart from country-based legislation, KeepWarm approach defined DHS recommendations for strategy or plan integration[10] and Recommendations for the integration of district heating and cooling in the comprehensive assessment of the potential for efficient heating and cooling[11] as a result of a continuous work on promotion of DH sector in current legislation.

Replication potential

Since the 1970s DHS is getting more and more important. Since the 1980s biomass DHS were built and got more important. A major uptake was since 2000. From 2000 to 2015, the heat production from DHS increase by nearly 75 %. There are about 2,300 DHS in Austria. Mostly small scales biomass DHS. 600 are in Styria[12].

Most of DHSs can follow main features of replication mode based on DHS Eibiswald.

Organize capacity-building programme
Building new boiler-house (biomass)
Applying for national environmental subsidy
Connecting Grids
Grid extension
Heat Contracts

Want to adapt our work to your DHS?

KeepWarm website
KeepWarm - Austria
Learning Centre
Showroom of KeepWarm DHS projects

Find out more and many other services we offer please contact our consortium (info@keepwarmeurope.eu), or even more directly our Austrian partner **LWK Steiermark** (energie@lk-stmk.at).

[9] Action plans for retrofitting of District Heating Systems
[10] DHS recommendations for strategy or plan integration
[11] Recommendations for the integration of district heating and cooling in the CA of the potential for efficient heating and cooling
[12] District heating market in KeepWarm partner countries

This project has received funding from European Union's Horizon 2020 Research and Innovation programme under Grant Agreement N°784966.

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A case example from DHS Zaprešić, Croatia

The DHS Zaprešić (HEP Toplinarstvo Ltd) consists of 8 different heat production stations spread across the city of Zaprešić. It is located in Zagreb County, northwest of and can be characterised as a satellite-city in the Zagreb metropolitan area. Zaprešić is 23rd largest city in Croatia with population of about 25,000 inhabitants.

HEP Toplinarstvo has ambitious plans to expand current heat distribution network, increase energy efficiency, integrate solar thermal energy, as well as to optimize the whole system.

Figure 5 Zaprešić (http://www.zapresic.hr/)

Throughout the project duration, project partners have created the KeepWarm approach to DH modernisation[13] based on which tailor-made support has been given.

Training and capacity-building

Based on training needs assessment[14], specific topics have been identified which resulted with 104 hours of training and 120 included individuals in total. The KeepWarm training approach proved to be flexible and enabled the partners to adapt the training to their national context, focusing on technical concerns and integration of solar energy. The lecturers were employees of REGEA and UNIZAG FSB, as well as companies involved in DH sector through site visits.

The participants were mostly employees of DHSs, but several interested external stakeholders also participated in capacity building. A broad range of relevant topics was covered through methods such as lectures, exercises, software presentations and study visits[15].

TOPIC	TRAINING HOURS	DHS EMPLOYEES	OTHER STAKEHOLDERS	TOTAL INDIVIDUALS
1. Technical topics	33	24	77	101
2. RES and EE topics	25	14	73	87
3. Organization topics	0	0	0	0
4. Financing topics	21	15	5	20
5. Management topics	23	15	2	17
Total	**104**	**39**	**81**	**120**

Table 4 Overview of trainings in Croatia[15]

Stakeholder involvement:
HEP Group, members of academia
NGOs, consulting companies, private companies in the energy sector

[13] Sustainable Adoption Roadmap
[14] KeepWarm Training Needs Assessment and Training Plan
[15] Report on Training Conducted

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A case example from DHS Zaprešić, Croatia

Business plans

After conducting detailed training programme, national partners (REGEA and UNIZAG FSB) has assisted to DHS Zaprešić in creation of tailor-made business plan to support implementation of selected scenarios and assist in decision-making process. For the realisation, there are several activities during planning and construction necessary. The most crucial activities were identification of adequate solar technology for application in DHS.

The total costs for the integration of solar thermal collectors' field, connection pipeline between heating stations, adequate connection pipeline between heating stations and solar field, optimisation systems and others are **around 3,500,000 €.**

Primary energy will be reduced from 20,048 MWh to 18,825 MWh annually which means savings of around 1,223 MWh on a yearly basis. On the life span of 25 years, the total primary energy savings are **30.5 GWh.** Since DHS Zaprešić uses only fossil fuel for heat production, any renewable energy source will have significantly influence on usage of RES.

Solar energy will contribute with 3008 MWh of renewable energy on a yearly basis. On the life span of 25 years, the total use of renewables could be **75.2 GWh.** Investments into connection pipeline, solar energy, thermal storage, and revitalisation of heating network would result with annual CO_2 savings of 1046 tons. On the life span of 25 years, the total CO_2 savings would be **26,150 tons.**

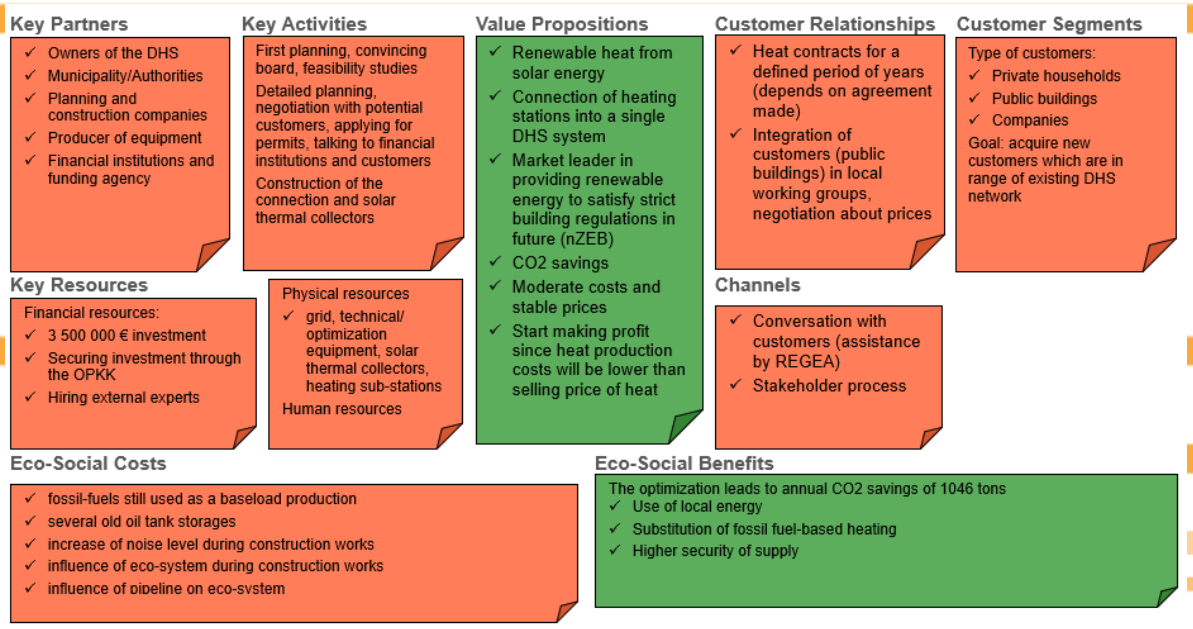

Figure 6 Summary of Business Model DHS Zaprešić

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A case example from DHS Zaprešić, Croatia

Attracting funds for uptake

In Croatia, 11 local working group meetings took place which were attended by a total of 78 participants[16]. The main outcome can be described as a decision-making process by HEP Toplinarstvo to invest into solar thermal collectors (solar energy).

REGEA and UNIZAG FSB organised a series of meetings with stakeholders (manufacturers and designers of solar thermal technology), as well as public authorities which are essential stakeholders in terms of land usage, construction permits and potential public end-users which are the main focus of HEP Toplinarstvo.

Initial plans for modernisation of DHS Zaprešić have been made which should result in a complete large-scale solar energy utilisation, renovation of existing DH network and expansion to uncovered areas in the city. Technical support in terms of additional calculations were provided with the aim of achieving minimum share of RES in DH sector for higher competitiveness of DHS Zaprešić on the market.

Pilot project is finalised and modified for the small-scale Innovation Fund application during 2021 in a cooperation between REGEA, HEP Toplinarstvo, engineering companies, the city of Zaprešić and the Zagreb County, aiming to achieve 60% of subsidised costs through high degree of innovation which combines heat storage, high temperature needs from solar thermal collectors and smart metering.

Assistance in “green” public procurement procedure has been given to HEP Toplinarstvo for additional feasibility studies, as well as on necessary legal assistance in communication with public authorities regarding permits and heat contracts. Also, integration of DH sector in SECAPs is under revision and should be a direct result of the KeepWarm approach.

Identification of the most suitable public buildings as their future end-users in the city of Zaprešić has been performed such as elementary schools, high schools, public office buildings, health service buildings.

Through collaboration with public authorities, a local high school should be connected to the grid in 2021, while other potential customers will be targeted after achieving investments.

[16] Report on Local Working Group Croatia and Report on support provided to DHS

KeepWarm
Renewing district heating

A case example from DHS Zaprešić, Croatia

Policy integration

Main challenges in decarbonization of DHS networks are a constant decrease in heat demand due to energy renovations of connected buildings, lack of financial resources, high investment costs of RES technologies, unclear ownership structure between local authority units and DH companies, as well as lack of proper energy planning and legal framework.

The country-specific Action Plan formulated 29 key recommendations, highlighting the necessity for setting clear long-term goals on local/regional and national level, conducting proper energy planning, utilizing solar and geothermal energy, increasing the energy efficiency in old heat distribution networks, as well as providing necessary funds for sustainable retrofits[17].

Apart from country-based legislation, KeepWarm approach defined DHS recommendations for strategy or plan integration[18] and Recommendations for the integration of district heating and cooling in the comprehensive assessment of the potential for efficient heating and cooling[19] as a result of a continuous work on promotion of DH sector in current legislation.

Replication potential

DHS has been active in major Croatian cities since 1970s and been playing an important role in the heating sector up to date. In total, 16 Croatian cities have DHS which are operated by 11 companies – in total, there are around 110 DHS of different size and type. Most of DHS use gas as the primary fuel, while almost all DHS use fossil fuel for either primary fuel or back up option[20]

Most of DHSs can follow main features of replication mode based on DHS Zaprešić.

Organize capacity-building programme
Connection of public buildings
Applying for Innovation Funds
Solar energy integration
Connecting Grids
Heat Contracts

Useful links

KeepWarm website
KeepWarm - Croatia
Learning Centre
Showroom of KeepWarm DHS projects

Want to adapt our work to your DHS?

Find out more and many other services we offer! Please contact our consortium (info@keepwarmeurope.eu), or even more directly our Croatian partners **REGEA** (mcavar@regea.org) and **UNIZAG FSB** (Goran.krajacic@fsb.hr).

[17] Action plans for retrofitting of District Heating Systems
[18] DHS recommendations for strategy or plan integration.
[19] Recommendations for the integration of district heating and cooling in the CA of the potential for efficient heating and cooling
[20] District heating market in KeepWarm partner countries.

This project has received funding from European Union's Horizon 2020 Research and Innovation programme under Grant Agreement N°784966.

This project has received co-funding from the German Federal Ministry of Economic Cooperation and Development.

Large-scale pipeline renovation and biomass integration

A case example from DHS Brno, Czech Republic

The DHS was founded in 1930 but the current joint-stock company was established on May 1st, 1992 and belongs to a group of companies controlled by the statutory city of Brno. The city of Brno is the sole shareholder of the company and owns all 10 shares of the DHS. The company's core business is heat generation and distribution, electricity generation and trading and gas trading.

The investment plan of the company was designed mainly with the emphasis on increasing the efficiency of the operation of production sources and distribution system, and also from the perspective of ensuring the necessary renewal of the existing equipment.

Figure 7 DHS Brno (Source: https://www.teplarny.cz/cs/provozy-a-szte)

Throughout the project duration, project partners have created the KeepWarm approach to DH modernisation[21] based on which tailor-made support has been given.

Training and capacity-building

Based on training needs assessment[22], specific topics have been identified which resulted with 13 capacity building sessions (103.5 hours) and 271 individuals in total. The KeepWarm training approach proved to be flexible and enabled the partners to adapt the training to their national context. The main objective was to increase participants' competency, so they will be able to design and implement changes, as well as enforce new production methods and working procedures.

Capacity-building programme covered technical, financial, managerial and organisational topics, increasing energy efficiency, and utilisation of RES. The training was mostly lecture-based, and PowerPoint presentations were usually used. Additionally, field trips to the appropriate sites were organised to present real-life examples and practical use of discussed solutions[23].

Stakeholder involvement:

DHS operator, Financial institutions, Suppliers, municipality as DHS owners

TOPIC	TRAINING HOURS	DHS EMPLOYEES	OTHER STAKEHOLDERS	TOTAL INDIVIDUALS
1. Technical topics	35.5	203	7	210
2. RES and EE topics	19	168	8	176
3. Organization topics	17.5	105	5	110
4. Financing topics	18.5	148	7	155
5. Management topics	13	137	3	140
Total	**103.5**	**259**	**12**	**271**

Table 5 Overview of trainings Czech Republic[23]

[21] Sustainable Adoption Roadmap
[22] KeepWarm Training Needs Assessment and Training Plan
[23] Report on Training Conducted

Large-scale pipeline renovation and biomass integration

A case example from DHS Brno, Czech Republic

Business plans

Conversion of steam to hot water distribution grid, which is directly supported by the Enterprise and Innovations for Competitiveness Operational Program, priority axis 3, specific goal 3.5 “Increase of the efficiency of the district heating systems”, which can be used for replacing steam with hot water pipelines.

DHS Brno is started its investment in 2019. Brno should acquire a fully hot water network in 2023. In this project, 27 km of pipelines will be replaced to reduces losses, and 225 supply points will be switched from steam to hot water. The total cost of investments is around **142 million euros**.

By reducing losses and operating costs, DHS Brno and its customers should save more than € 3,850 thousand per year. Even so the lifetime of a new distribution system can be up to 50 years, following numbers are based on 30 years, as worst case. The **annual primary energy** savings through the efficiency **increase is 664 TJ**. On the life span of 30 years, the total primary energy savings are **19,920 TJ**.

DHS Brno will not increase production from renewables. Such an investment would lead to **annual CO2 savings of 232,113 tons**. On the life span of 25 years, the total CO2 savings will be **1,106,670 tons**.

Key Partners
- ✓ Owner of the DHS – Statutory city of Brno
- ✓ Authorities approving the relevant permits
- ✓ Planning and construction companies
- ✓ Technical suppliers
- ✓ Financial institutions and funding agency

Key Activities
Detailed planning, project documentation, applying for subsidies, tender for suppliers, coordination of excavation work with other utilities, informing customers
Pipeline replacement, reconstruction of the heat exchanger stations

Value Propositions
- ✓ Fuel and CO_2 savings
- ✓ High comfort for customers
- ✓ Cost savings for end consumers
- ✓ High security of supply
- ✓ Moderate costs and stable prices

Customer Relationships
- ✓ Customers expect reliable heat supply at reasonable prices, improving the environment
- ✓ Meetings with customers and explaining the environmental benefits

Customer Segments
Type of customers:
- ✓ Private households
- ✓ Public buildings
- ✓ Companies

Goal: getting new customers along existing grid and negotiate with potential customers along new grids.

Key Resources
Financial resources:
- ✓ 18 Million Euro investment
- ✓ 7 Million Euro EU subsidy

Physical resources
- ✓ heat distribution grid, technical equipment, heat transfer stations

Human resources
- ✓ project designers
- ✓ energy construction experts
- ✓ technical engineers
- ✓ heat network operators

Channels
- ✓ DHS meetings with customers
- ✓ Regular municipality meetings
- ✓ DHS website and call center
- ✓ Articles in energy journals and on the internet
- ✓ Information leaflets
- ✓ Annual billing
- ✓ Stakeholder process
- ✓ Municipality website

Figure 8 Summary of Business model DHS Brno

Large-scale pipeline renovation and biomass integration

A case example from DHS Brno, Czech Republic

Attracting funds for uptake

In case of local working groups, TSCR organized 2 local working group meetings bringing together technical experts as well as local stakeholders in order to discuss modernisation options and processes for their DHS. A total number of 14 people participated in the meetings[24].

DHS Brno, DHS Písek and DHS České Budějovice each decided on different scenarios each focussing on the infrastructure of their systems. The main outcome can be described as a decision-making process by the individual DHSs to invest in modernisation projects.

As part of the modernisation process, TSCR analysed the current state of production sources, heat distribution system and the potential for the use of local renewable sources, as well as supported in the selection of optimal scenario. Furthermore, the most optimal variant for the modernisation of DHS regarding the economic condition of the company and the ability to finance projects was given.

Based on development variants, an increase in heat prices for end customers was proposed. Business model was prepared for the most suitable scenario. A reduction of the VAT rate on heat from 15 to 10 % with effect from 1st January 2020 has been a valuable result of the KeepWarm approach, as well as negotiations with national authorities for high-efficiency cogeneration.

Regarding potential grants, the Czech partners aided in preparing and submitting an application of DHS Brno's investment plans to the Operational Program Enterprise and Innovation for Competitiveness (OP EIC) – axis 3, specific goal 3.2 (Increase of energy efficiency of the commercial sector) and Operational program Environment (OPE) – three priority axes for the modernisation of its facilities and increasing the use of renewable energy sources. Subsidies ranges between 35% and 70% based on specific criteria.

The national legislative framework and key barriers, opportunities, and supporting instruments have been identified with the aim of promoting the interests of district heating operators. Also, a decree for municipal authorities has been prepared (in case of disconnections) to compare socio-economic benefits. Lastly, a great effort in promotion have been achieved.

[24] Report on Local Working Group Czech Republic and Report on support provided to DHS

Large-scale pipeline renovation and biomass integration

A case example from DHS Brno, Czech Republic

Policy integration

DHS operators generally face barriers to decarbonisation and modernisation due to heat price regulation, which reduces flexibility for operators and favours unregulated entities, thereby increasing customer interest in decoupling from DHS.

The Action Plan for the retrofitting of the DHS systems in the Czech Republic is a key document that defines problematic elements in the current situation of the heating market and proposes appropriate solutions that may contribute to its sustainability and to the improvement of the environment in the Czech Republic[25].

Apart from country-based legislation, KeepWarm approach defined DHS recommendations for strategy or plan integration[26] and Recommendations for the integration of district heating and cooling in the comprehensive assessment of the potential for efficient heating and cooling[27] as a result of a continuous work on promotion of DH sector in current legislation.

Replication potential

The district heating is an important sector in the energy industry of the Czech Republic, providing heat needs to 1.7 million households and a significant share of industrial heat demand - 663 companies with a license for the production of thermal energy and 651 companies with a license for the distribution of thermal energy. The general opinion on DHS is positive[28].

Most of DHSs can follow main features of replication mode based on DHS Brno.

Organize capacity-building programme
VAT Reduction
Applying for OP Funds
Biomass CHP integration
Modernization of distribution network
Heat tariffs modifications

Useful links

KeepWarm website
KeepWarm – Czech Republic Learning Centre
Showroom of KeepWarm DHS projects

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Find out more and many services we offer! Please contact our consortium (info@keepwarmeurope.eu), or directly our Czech partner **Teplárenské sdružení České republiky** (tscr@tscr.cz, hajek@tscr.cz, vecka@tscr.cz, buganova@tscr.cz).

[25] Action plans for retrofitting of District Heating Systems
[26] DHS recommendations for strategy or plan integration.
[27] Recommendations for the integration of district heating and cooling in the CA of the potential for efficient heating and cooling.
[28] District heating market in KeepWarm partner countries

This project has received funding from European Union's Horizon 2020 Research and Innovation programme under Grant Agreement N°784966.

This project has received co-funding from the German Federal Ministry of Economic Cooperation and Development.

KeepWarm
Renewing district heating

A case example from DHS Lielauce, Latvia

The pilot DHS Lielauce is one of the two operating boiler houses of district heating and utility company "Auces komunālie pakalpojumi", located in Auce county, in Western-Southern part of Zemgale region of Latvia. The total population of the municipality is about 7,000.

The owner of company is municipality of Auce county, it is limited liability company (Ltd.). The goal of the DHS is to provide with heat local residents during heating season from renewables (wood chips).

Figure 9 DHS Lielauce (Source: Auces komunalie pakalpojumi Ltd.)

Throughout the project duration, project partners have created the KeepWarm approach to DH modernisation[29] based on which tailor-made support has been given.

Training and capacity-building

Based on training needs assessment[30], specific topics have been identified which resulted with 13 capacity building sessions (103.5 hours) and 271 individuals in total. The KeepWarm training approach proved to be flexible and enabled the partners to adapt the training to their national context. The main objective was to increase participants' competency, so they will be able to design and implement changes, as well as enforce new production methods and working procedures.

Capacity-building programme covered technical, financial, managerial and organisational topics, increasing energy efficiency, and utilisation of RES. The training was mostly lecture-based, and PowerPoint presentations were usually used. Additionally, field trips to the appropriate sites were organised to present real-life examples and practical use of discussed solutions[31].

TOPIC	TRAINING HOURS	DHS EMPLOYEES	OTHER STAKEHOLDERS	TOTAL INDIVIDUALS
1. Technical topics	20	19	3	22
2. RES and EE topics	19.5	17	18	35
3. Organization topics	14.5	32	4	36
4. Financing topics	24.5	20	10	30
5. Management topics	13	22	2	24
Total	**91.5**	**63**	**30**	**93**

Table 6 Overview of trainings Latvia[31]

Stakeholder Involvement:

DHS owner (municipality), Technologies` suppliers, State financial authorities, Customers, fuel suppliers

[29] Sustainable Adoption Roadmap
[30] KeepWarm Training Needs Assessment and Training Plan
[31] Report on Training Conducted

KeepWarm
Renewing district heating

A case example from DHS Lielauce, Latvia

Business plans

After conducting detailed training programme, national partner ZREA has assisted to DHS Lielauce in creation of tailor-made business plan to support implementation of selected scenarios and assist in decision-making process. The goal of the DHS is to provide heat to residents during heating season from renewables (wood chips).

DHS Lielauce plans to install a frequency changer for network pumps to change heat grid by installing industrially isolated single channel pipes with less diameter, and to automate fuel supply with a sliding floor and a fitted conveyor. Total costs of investment is estimated at **around 66,000 €.**

The lifetime of a pellet boiler house is considered with 25 years. After realizing the investment, it is planned that primary energy input will be 1,178 MWh per year. On the life span of 25 years, the total primary energy savings are **7.28 GWh**. DHS Lielauce uses heat from biomass. In result of optimization the amount of annual used renewable sources will decrease to 1,300 loose m^3.

On the life span of 25 years, the total use of renewables will **29.5 GWh**. The total efficiency of the system would increase slightly. Furthermore, such an investment would not cause CO_2 emissions.

Key Partners
- ✓ Owners of the DHS.
- ✓ Municipality.
- ✓ Technical suppliers.
- ✓ Financial institutions and funding agency.

Key Activities
- ✓ First planning, convincing municipality.
- ✓ Detailed planning, negotiation with potential equipment suppliers, applying for subsidies, talking to financial institutions.
- ✓ Construction works in the the boiler house and grid.

Value Propositions
- ✓ High comfort for customers.
- ✓ Moderate costs and stable prices.
- ✓ High security of supply.
- ✓ High service level.
- ✓ Using local fuels, regional added value.
- ✓ Renewable heat from biomass.
- ✓ No CO2.

Customer Relationships
- ✓ Heat contracts 15 years.
- ✓ Regular communication with customers, problems solutions.
- ✓ Education of customers about topical tendencies of heat supply.

Customer Segments

Type of customers:
- ✓ Residential buildings.
- ✓ Municipal buildings.

Goal: keeping current customers by providing high level service and getting new customers along existing grid.

Key Resources

Financial resources:
- ✓ 65 878 Euro total investment.
- ✓ Including 26 351 Euro subsidy.
- ✓ Rest: loan from financial institution.

Physical resources:
- ✓ New frequency changer for network pumps, new pipes, new sliding floor and a fitted conveyor. Human resources.

Channels
- ✓ Personnel conversations with customers.
- ✓ Annual billing.

Eco-Social Costs
- ✓ Noise and dust emissions during construction phase.

Eco-Social Benefits
- ✓ Use of local fuels.
- ✓ High security of supply.
- ✓ Local added value.
- ✓ Local job security.

Figure 10 Summary of Business model DHS LieLauce

KeepWarm
Renewing district heating

A case example from DHS Lielauce, Latvia

Attracting funds for uptake

Project partner ZREA organised seven working group meetings on different topics with respective DHSs representatives which were attended by 44 participants[32]. Feasibility studies created through the project have been presented, as well as discussed in terms of modifications and further steps. Meetings taken afterwards have been a result of a continuous collaboration.

Several direct consultations on technical solutions between expert and pilot DHS were organised and resulted with further development of selected scenario with less investment costs and start to implement it as soon as possible.

Regular updates on available EU funding, state loans or private investment offers were conducted. There will be chance to apply for the EU funds, namely EU support within 2021-2027 funding period - ZREA will continue to utilize the KeepWarm approach.

Apart from COVID-19 related barrier, the main reason for postponement can be seek in delayed EU funding as well as in current administrative territorial reform

The latest plans are to apply for the EU support within 2021-2027 funding period program`s call to realise both business plans in nearest future.

There was no need for ZREA support to Pilot DHS regarding cooperation with regulatory institutions concerning tariff regulation, public procurement, permissions, etc., because the main chosen focus of support was on technical, financial and potential grant support.

ZREA has provided recommendations on certain activities regarding DHS development/modernization what could be included in Sustainable energy and climate action plan of Zemgale planning region, in which territory`s also Auce county (with Lielauce parish) is located.

Regarding negotiation support with customers, ZREA has not involved directly, as it is more internal competence of pilot DHS. However, concerning work with customers, support was in form of coaching on public relations and on customer services.

[32] Report on Local Working Group Latvia and Report on support provided to DHS

KeepWarm
Renewing district heating

A case example from DHS Lielauce, Latvia

Policy integration

For many DHSs, increasing the energy efficiency of old DH systems and their modernisation remains the biggest challenge. An important task is the increased use of RES, in particular emission-free technologies and modern technologies (such as heat storage, use of waste heat). In parallel, DHS should consider how to solve the decline in consumer demand.

The main prerequisites for successful development of DHS are appropriate national policies and a regulatory environment that provides a stable basis and incentives for DHS development. The availability of direct or indirect subsidies and/or dedicated financial instruments and the availability of low-cost loans are crucial[33].

Apart from country-based legislation, KeepWarm approach defined DHS recommendations for strategy or plan integration[34] and Recommendations for the integration of district heating and cooling in the comprehensive assessment of the potential for efficient heating and cooling[35] as a result of a continuous work on promotion of DH sector in current legislation.

Replication potential

In Latvia, consumers' heat supply is provided through centralized heat supply systems, local heat supply and individual heat supply. Fuelwood and natural gas are fuels, which are mainly used in the production of heat energy from boiler houses. It is essential that the share of local and renewable energy (fuel wood) increases each year, reducing the proportion of natural gas[36].

Most of DHSs can follow main features of replication mode based on DHS Lielauce.

Biomass integration
Automation of biomass supply
Small-scale improvements
Modernisation of distribution network
Applying for national and EU Funds

Useful links

KeepWarm website
KeepWarm - Latvia
Learning Centre
Showroom of KeepWarm DHS projects

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[33] Action plans for retrofitting of District Heating Systems
[34] DHS recommendations for strategy or plan integration.
[35] Recommendations for the integration of district heating and cooling in the CA of the potential for efficient heating and cooling.
[36] District heating market in KeepWarm partner countries

This project has received funding from European Union's Horizon 2020 Research and Innovation programme under Grant Agreement N°784966.

This project has received co-funding from the German Federal Ministry of Economic Cooperation and Development.

New small-scale biomass boiler house (container type)

A case example from DHS Bene, Latvia

The pilot DHS Bene is operating district heating grid and belongs to utility company / district heating company "Auces komunālie pakalpojumi", located in Auce county, Bene parish in Western-Southern part of Zemgale region of Latvia. The total population of the municipality is about 7,000. The owner of company is municipality of Auce county, it is limited liability company (Ltd.).

The goal of the DHS is to provide with heat local residents during heating season from renewables (wood chips). In 2014 company took over the provision of heating services to Bene parish multi-apartment houses.

Figure 11 DHS Bene (Source: Auces komunalie pakalpojumi Ltd)

In Bene parish, the company does not perform heat production, but purchases heat energy from nearby biogas cogeneration station. Throughout the project duration, project partners have created a KeepWarm approach to DH modernisation[37].

Training and capacity-building

Based on training needs assessment[38], specific topics have been identified which resulted with 13 capacity building sessions (103.5 hours) and 271 individuals in total. The KeepWarm training approach proved to be flexible and enabled the partners to adapt the training to their national context.

The main objective was to increase participants' competency, so they will be able to design and implement changes, as well as enforce new production methods and working procedures. Capacity-building programme covered technical, financial, managerial and organisational topics, increasing energy efficiency, and utilisation of RES. The training was mostly lecture-based, and PowerPoint presentations were usually used. Additionally, field trips to the appropriate sites were organised to present real-life examples and practical use of discussed solutions[39].

Stakeholder Involvement:

DHS owner (municipality)
Technologies` suppliers
State financial authorities
Customers, fuel suppliers

TOPIC	TRAINING HOURS	DHS EMPLOYEES	OTHER STAKEHOLDERS	TOTAL INDIVIDUALS
1. Technical topics	20	19	3	22
2. RES and EE topics	19.5	17	18	35
3. Organization topics	14.5	32	4	36
4. Financing topics	24.5	20	10	30
5. Management topics	13	22	2	24
Total	**91.5**	**63**	**30**	**93**

Table 7 Overview of trainings Latvia[39]

[37] Sustainable Adoption Roadmap
[38] KeepWarm Training Needs Assessment and Training Plan
[39] Report on Training Conducted

New small-scale biomass boiler house (container type)

A case example from DHS Bene, Latvia

Business plans

The operators of Bene opted for retrofitting in case of favourable internal and external circumstances (availability of EU funds, low interest on loan, support from municipality). If current biogas supplier stops its operation, then DHS Bene shall be ready to replace it by own heat production source/ plant.

Currently biogas supplier continues to work, but now in government there is ongoing work on new order for subsidies receiving (current obligatory purchase schemes for electricity producers), which will be diminished drastically, creating threat of operation interruption.

Therefore, DHS Bene is planning to install new pellets boiler which is suitable for wood chips as fuel in the company`s hangar. The total costs of this scenario would be 165,000.00 €, but with deducted possible subsidies 90,750.00 € (in tune of 40% from total investment). This investment should increase the security of supply and create more competitive prices of heat for DHS Bene.

After the installation of combined pellets boiler, it is planned that primary energy input will be 1,760 MWh on a yearly basis. As there is no information about primary energy input of current heat producer (produces biogas), it is not possible to calculate the life span of 25 years of total primary energy savings. As there are currently no CO2 produced by the DHS there is no reduction after the investment.

Key Partners
- ✓ Owners of the DHS.
- ✓ Municipality.
- ✓ Technical suppliers.
- ✓ Financial institutions and funding agency.
- ✓ Construction company.

Key Activities
- ✓ First planning, convincing municipality.
- ✓ Detailed planning, negotiation with potential equipment suppliers, construction companies applying for subsidies, talking to financial institutions.
- ✓ Construction works.

Value Propositions
- ✓ High comfort for customers.
- ✓ Moderate costs and stable prices.
- ✓ High security of supply
- ✓ High service level.
- ✓ Using local fuels, regional added value.
- ✓ Renewable heat from biomass.
- ✓ No CO2.

Customer Relationships
- ✓ Heat contracts 15 years.
- ✓ Regular communication with customers, problems solutions.
- ✓ Education of customers about heat supply topical tendencies.

Customer Segments

Type of customers:
- ✓ Residential buildings.
- ✓ Kinder garden and industrial building.

Goal: keeping current customers by providing high level service and getting new customers along existing grid.

Key Resources

Financial resources:
- ✓ 165 000 Euro total investment.
- ✓ Including 74 250 Euro subsidy.
- ✓ Rest: loan from financial institution.

Physical resources:
- ✓ New automated boiler house.
- ✓ Human resources.

Channels
- ✓ Personnel conversations with customers.
- ✓ Monthly billing.

Eco-Social Costs
- ✓ Noise and dust emissions during construction phase.

Eco-Social Benefits
- ✓ Use of local fuels.
- ✓ High security of supply.
- ✓ Local added value.
- ✓ Local job security.

Figure 12 Summary of Business Model DHS Bene

New small-scale biomass boiler house (container type)

A case example from DHS Bene, Latvia

Attracting funds for uptake

Project partner ZREA organised seven working group meetings on different topics with respective DHSs representatives which were attended by 44 participants[40]. Feasibility studies created through the project have been presented, as well as discussed in terms of modifications and further steps. Meetings taken afterwards have been a result of a continuous collaboration.

Several direct consultations on technical solutions between expert and pilot DHS were organised and resulted with further development of selected scenario with less investment costs and start to implement it as soon as possible.

Regular updates on available EU funding, state loans or private investment offers were conducted. There will be chance to apply for the EU funds, namely EU support within 2021-2027 funding period - ZREA will continue to utilize the KeepWarm approach. Apart from COVID-19 related barrier, the main reason for postponement can be seek in delayed EU funding as well as in current administrative territorial reform.

The latest plans are to apply for the EU support within 2021-2027 funding period program`s call to realise both business plans in nearest future.

There was no need for ZREA support to Pilot DHS regarding cooperation with regulatory institutions concerning tariff regulation, public procurement, permissions, etc., because the main chosen focus of support was on technical, financial and potential grant support.

ZREA has provided recommendations on certain activities regarding DHS development/modernization what could be included in Sustainable energy and climate action plan of Zemgale planning region, in which territory`s also Auce county (with Lielauce parish) is located.

Regarding negotiation support with customers, ZREA has not involved directly, as it is more internal competence of pilot DHS. However, concerning work with customers, support was in form of coaching on public relations and on customer services.

[40] Report on Local Working Group Latvia and Report on support provided to DHS

New small-scale biomass boiler house (container type)

A case example from DHS Bene, Latvia

Policy integration

For many DHSs, increasing the energy efficiency of old DH systems and their modernisation remains the biggest challenge. An important task is the increased use of RES, in particular emission-free technologies and modern technologies (such as heat storage, use of waste heat). In parallel, DHS should consider how to solve the decline in consumer demand.

The main prerequisites for successful development of DHS are appropriate national policies and a regulatory environment that provides a stable basis and incentives for DHS development. The availability of direct or indirect subsidies and/or dedicated financial instruments and the availability of low-cost loans are crucial[41].

Apart from country-based legislation, KeepWarm approach defined DHS recommendations for strategy or plan integration[42] and Recommendations for the integration of district heating and cooling in the comprehensive assessment of the potential for efficient heating and cooling[43] as a result of a continuous work on promotion of DH sector in current legislation.

Replication potential

In Latvia, consumers' heat supply is provided through centralized heat supply systems, local heat supply and individual heat supply. Fuelwood and natural gas are fuels, which are mainly used in the production of heat energy from boiler houses. It is essential that the share of local and renewable energy (fuel wood) increases each year, reducing the proportion of natural gas[44].

Most of DHSs can follow main features of replication mode based on DHS Bene.

Biomass integration
Automation of biomass supply
Small-scale improvements
Modernisation of distribution network
Applying for national and EU Funds

Useful links

KeepWarm website
KeepWarm - Latvia
Learning Centre
Showroom of KeepWarm DHS projects

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[41] Action plans for retrofitting of District Heating Systems
[42] DHS recommendations for strategy or plan integration.
[43] Recommendations for the integration of district heating and cooling in the CA of the potential for efficient heating and cooling.
[44] District heating market in KeepWarm partner countries

This project has received funding from European Union's Horizon 2020 Research and Innovation programme under Grant Agreement N°784966.

This project has received co-funding from the German Federal Ministry of Economic Cooperation and Development.

KeepWarm
Renewing district heating

A case example from DHS Priboj, Serbia

The DHS in Priboj (JP Toplana Priboj) is located in the municipality with the same name, in the southwestern part of Serbia. The population of the town Priboj is 14,920 inhabitants, while the population of the municipality is 27,133. Aside from the town of Priboj, the municipality includes 33 settlements.

The public company Toplana Priboj was established in 2012 and is 100% owned by the municipality. The DHS is responsible for both production and distribution of heat - The DHS in Priboj (company JP Toplana Priboj) operates from 2012 but uses boilers that are more than 30 years old.

Figure 13 DHS Priboj (Source: http://www.bioenergy-serbia.rs/images/documents/studies/BSCstudy_final.pdf)

Throughout the project duration, project partners have created a KeepWarm approach to DH modernisation[45].

Training and capacity-building

In total, 100 hours of capacity building was held within five training blocks according to topics defined in the KeepWarm project. Training organisation went according to a previously defined training plan[46], and all topics considered a top priority, while additional topics proposed by DHS operators were included such as sustainable development in light of climate change, motivating consumers to start using RES and promotional/presentational activities of company in DH sector.

The number of individuals participating in capacity building in Serbia equalled 55, of which 28 are employees of DHS operators and 27 are external stakeholders from development/energy agencies, local and regional public authorities and ESCO companies[47].

TOPIC	TRAINING HOURS	DHS EMPLOYEES	OTHER STAKEHOLDERS	TOTAL INDIVIDUALS
1. Technical topics	20	11	8	19
2. RES and EE topics	20	8	5	13
3. Organization topics	20	17	6	23
4. Financing topics	20	5	8	13
5. Management topics	20	10	2	12
Total	**100**	**28**	**27**	**55**

Table 8 Overview of trainings Republic of Serbia[47]

Stakeholder involvement:

Priboj municipality
DHS operators
KfW, PIMO
Regulatory and energy agencies Wood chips producers (Srbijašume, Jela Star)

[45] Sustainable Adoption Roadmap
[46] KeepWarm Training Needs Assessment and Training Plan
[47] Report on Training Conducted

KeepWarm
Renewing district heating

A case example from DHS Priboj, Serbia

Business plans

DHS Priboj's plans include total replacement of fossil fuels (mazut) with biomass, lower fuel costs (practically cut in half), integration of presently segmented grid into one unified system, enabling increase in heat consumption, i.e. joining of new customers.

The total cost is estimated in the **order of 7,000,000 €.** The biggest share goes to the boilers with auxiliary equipment and civil works in connection with the new boiler house. The investment will not change the Primary Energy Savings, as the efficiencies of the present mazut boiler and the new biomass boiler_the present mazut boiler and the new biomass boiler have the same efficiency of 80 %.

Investment has started, the project for the construction permit is in progress Furthermore, the implementation will practically eliminate any need of this fossil fuel. The needed input of 26,080 MWh with fuel will be supplied with 5,550 tons of wood chips.

Over the life span of 25 years, the total (additional) use of renewables will be around **650 GWh**. The replacement of mazut with wood chips will result in yearly savings of 7305 tons of CO2. Over the life span of 25 years, the total CO2 savings will be **182,625 tons**.

Key Partners
- ✓ Municipality of Priboj – as owners of DHS
- ✓ PIMO (Public Investm. Manage. Office, in Serbian: Kancelarija za upravljanje javnim ulaganjima)
- ✓ Planning and construction

Key Activities
First planning, coordination of project
Contract with PIMO or kfW, producing documentation, selection of bidder,
Construction phase, obtaining new customers, involvement of personnel
Test phase, training of staff

Value Propositions
- ✓ Renewable heat from biomass
- ✓ CO2 savings
- ✓ Using local fuels (30 km radius)
- ✓ High comfort for customers
- ✓ High security of supply (replacement of more than 30 years boilers)
- ✓ Moderate costs and stable prices

Customer Relationships
- ✓ Informing customers and potential customers on the benefits of DHS modernization and optimization

Customer Segments
Type of customers:
- ✓ Private households
- ✓ Public buildings
- ✓ Companies

Goal: getting new customers along existing grid

Key Resources
Financial resources:
- ✓ 3.83 Million Euro investment
- ✓ Possible 16% grant
- ✓ Loan from bank, grace period 2 years, 1.1% interest rate, 18 years return period

Physical resources:
- ✓ new boiler, boiler house, grid connect.
- ✓ 5550 t/a wood chips

Human resources:
- ✓ reallocation of own

Channels
- ✓ Local media (TV and newspaper)
- ✓ Annual billing

Eco-Social Costs
- ✓ Minimized fossil fuel usage (only back-up purposes)
- ✓ Noise and dust emissions during construction phase

Eco-Social Benefits
The optimization leads to annual CO2 savings of 7305 tons.
- ✓ Use of local fuels, substitution of imported with domestic fuel
- ✓ Substitution of fossil heatings
- ✓ High security of supply
- ✓ Local added value
- ✓ Local job security

Figure 14 Summary of Business model DHS Priboj

KeepWarm
Renewing district heating

A case example from DHS Priboj, Serbia

Attracting funds for uptake

In case of Serbia, the project partner VINČA organised eight local working group meetings on different topics with respective DHSs representatives, on four local one regional and three national level which were attended by 90 participants[48]. Main goal of activities was implementation of planned investment and application of biomass in DH sector.

All activities regarding technical aspects were done in cooperation with the technical and managerial staff of DHS Priboj, the energy manager of the municipality of Priboj as well as representatives of the authorities of this municipality

The municipality is well acquainted with financing schemes and ways to support biomass and energy efficiency projects. Moreover, at the end of September 2019, the Mayor of Priboj (as a guarantor of the Priboj heating plant) signed an agreement with the Ministry of Mining and Energy and the German Development Bank KfW on the construction of a combined city heating plant on wood biomass (8 MW wood-fired boiler) and heating oil (15 MW).

A contract was signed with selected contractor at the tender, in the Ministry of Mining and Energy in Belgrade. The project is financed by the German and Swiss governments finance 16.5%, while the rest is a long-term loan from the German Development Bank KfW - one of the largest foreign banks which in cooperation with domestic banks provides favourable loans and approves loans to the R. Serbia to finance agriculture, EE, renewable energy and municipal infrastructure.

There was no need to support Pilot DHS regarding cooperation with regulatory institutions in terms of tariff regulation, public procurement, permits, etc. because these matters are regulated by law at the national level. The main chosen focus of Vinča's support to the heating plants was, above all, technical, then financial and potential support of grants

Regarding negotiation support with customers, VINČA has not involved directly, as it is more internal competence of pilot DHS and their owner-municipalities. VINČA support concerning work with customers – was in form of provided trainings, within which persons who are not DHS staff, but are also their users was attracted.

[48] Report on Local Working Group Republic of Serbia and Report on support provided to DHS

KeepWarm
Renewing district heating

A case example from DHS Priboj, Serbia

Policy integration

The main challenges for decarbonization and improvement of DHS networks are the unfavourable position of the DH sector compared to other individual heating options due to inappropriate energy price parity, lack of financial resources, high investment costs of RES technologies, a complex ownership structure between local authority units and DH companies,

The main recommendations of in (Serbian) Action Plan aim at a systematic promotion of the DH sector in terms of strategies and plans, technical guidance, planning and regulation and financing. A total of 23 recommendations were made, highlighting the need to set clear long-term targets at local, regional and national level[49].

Apart from country-based legislation, KeepWarm approach defined DHS recommendations for strategy or plan integration[50] and Recommendations for the integration of district heating and cooling in the comprehensive assessment of the potential for efficient heating and cooling[51] as a result of a continuous work on promotion of DH sector in current legislation.

Replication potential

Most important fuel for household heating in Serbia is wood (34%), while 25.1% of households use heat from district heating (DH) systems (48.3% of urban households), 20.1% electricity, 10.5% coal and 9.6% natural gas. It should be noticed that electricity consumption is mostly by direct conversion to heat (via heaters and furnaces) and not for heat pumps or air condition units[52]..

Most of DHSs can follow main features of replication mode based on DHS Priboj.

Biomass (boilers) integration
Fuel (biomass) storage
Connecting boiler rooms
Bank loans
Modernisation of distribution network

Useful links

KeepWarm website
KeepWarm – Serbia
Learning Centre
Showroom of KeepWarm DHS projects

Want to adapt our work to your DHS?

Please contact our consortium (info@keepwarmeurope.eu), or even more directly our Serbian partner **VINČA INSTITUTE** - gzivkovi@vinca.rs, mica@vinca.rs, 140@vinca.rs.

[49] Action plans for retrofitting of District Heating Systems
[50] DHS recommendations for strategy or plan integration.
[51] Recommendations for the integration of district heating and cooling in the CA of the potential for efficient heating and cooling.
[52] District heating market in KeepWarm partner countries

This project has received funding from European Union's Horizon 2020 Research and Innovation programme under Grant Agreement N°784966.

This project has received co-funding from the German Federal Ministry of Economic Cooperation and Development.

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KeepWarm
Renewing district heating

A case example from DHS Velenje, Slovenia

In the Šalek valley, formed by the geographical areas of the Velenje and Šoštanj municipalities, for 60 years the system of centralized supply of heat energy from production sources in TEŠ has been operating, since 1997 the gas pipeline system for the energy supply of the suburban settlements of Škale, Hrastovec and Gaberke. Since 2008, a centralized system of heat absorption district cooling in the Velenje Municipality has been operating.

The main goal is a rational operation of the DHS, from the procurement to the sale of heat and cold, maintenance of the reliable technical condition of the entire DH network, which is a prerequisite for quality and smooth supply of customers.

Figure 15 DHS Velenje (KeepWarm showcase of pilot DHS projects

Throughout the project duration, project partners have created a KeepWarm approach to DH modernisation[53].

Training and capacity-building

One joint training session was organised where more DHS operators participated, and capacity building continued using an individual approach towards DHS operators to address topics marked as a top priority. In total, 117 hours of training were organised. Distribution of training hours was changed because DHS operators prioritised topics from financing topics group on the expense of organisation topics[54].

The total number of individuals participating in capacity building equalled 56, 27 of which are DHS employees and 29 are external stakeholders. Among external stakeholders are researchers, employees of DHS service companies, public servants directly working with district heating systems, and employees of local energy agencies preparing investment plans for smaller DHSs[55].

Stakeholder Involvement

Table 9 Overview of trainings Slovenia[55]

TOPIC	TRAINING HOURS	DHS EMPLOYEES	OTHER STAKEHOLDERS	TOTAL INDIVIDUALS
1. Technical topics	22	14	12	26
2. RES and EE topics	27	27	29	56
3. Organization topics	14	27	14	41
4. Financing topics	31	21	8	29
5. Management topics	23	25	8	33
Total	**117/100**	**27/30**	**29**	**56**

Local decision makers
Costumers
Technology suppliers

[53] Sustainable Adoption Roadmap
[54] KeepWarm Training Needs Assessment and Training Plan
[55] Report on Training Conducted

KeepWarm
Renewing district heating

A case example from DHS Velenje, Slovenia

Business plans

Concrete measures in grid efficiency will be conducted in a yearly plan and investment documentation for a partial renovation. Partial renovation is the only way to renovate the whole network.

KP Velenje will invest around **834,500 EUR** per year in the modernization of the grid in the next five years. The total investment in grid renovation and optimization will be around 3.5 million Euro. KP Velenje prepared a plan for grid renovation, which has to be done step by step.

The goals and tasks have always been ensured by a reliable, safe, environmentally friendly, and economically efficient supply of heat and cold to the users at competitive prices. With this investment primary energy savings will be 1,600 MWh on a yearly basis (**40 GWh** over 25 years lifespan). Annual CO2 savings will be around 784 t (**19 600t** in 25 years). This calculation is based on CO2 conversation factor for lignite.

several steps towards higher efficiency of the system:

- Upgrade of 3 pipeline network (3C) to two pipeline network (2C).
- Replacement od old and bely insulated pipelines
- Modernisation of the main het power stations
- Renovation of substations

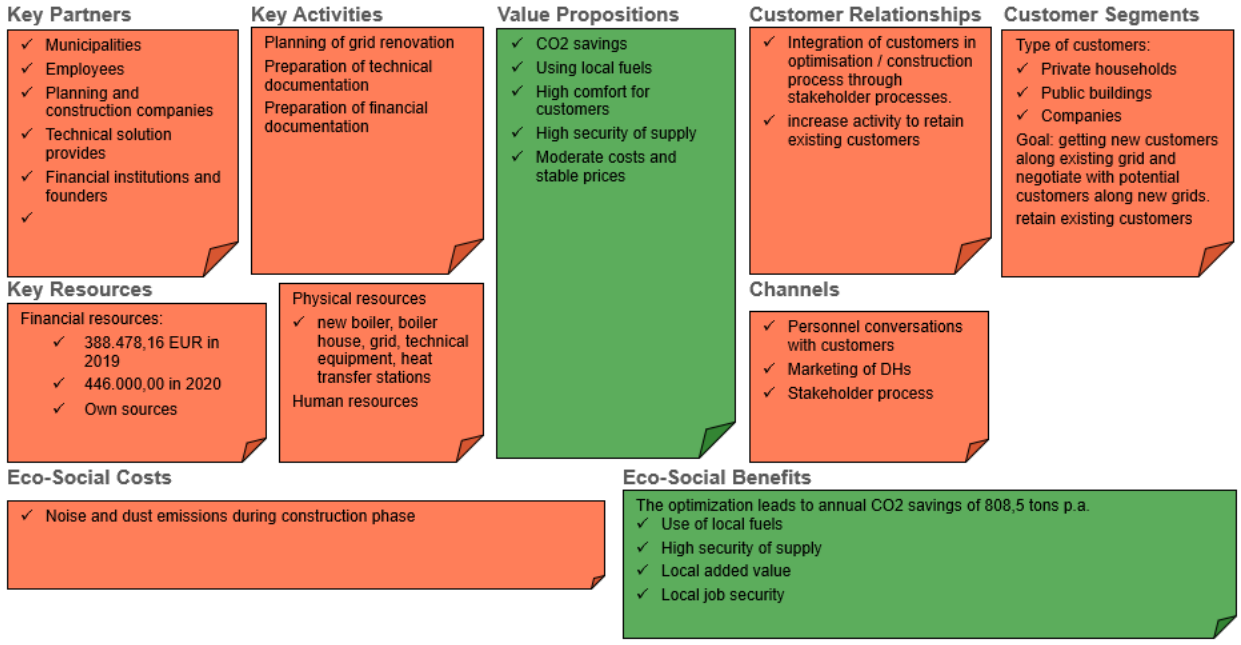

Figure 16 Summary of Business model DHS Velenje

KeepWarm
Renewing district heating

A case example from DHS Velenje, Slovenia

Attracting funds for uptake

In case of Slovenia, the project partner KSSENA organised 11 local working group meetings on different topics with respective DHSs representatives which were attended by 80 participants[56].

Preparation of several documents for future development, modernization, decarbonization and optimisation of Velenje district heating system have been achieved. Slovenian partners supported DHS in preparation of partial investment in grid renovation and modernization of boiler rooms. KSSENA have been involved in economic calculation and calculation of monetary and CO2 savings.

A detail list of potential financial resources for DHS investments have been made. According to national and EU funding schemes, there is potential to combine grants and EIB loans for carbon-free heat generation. Available funds and stable political environment will have a large impact on the decision-making process.

Ministry of infrastructure published call for co-financing of investment in DHs with a focus on the use of renewable energy sources in DHS. The maximum grant is up to 40 % of the investment costs. The documentation for application for these grants its quite complex, so potential investors usually hire an outside consultant to prepare the documentation – in this case our Slovenian Partner.

KSSENA prepared a legal opinion on private investors investing in public infrastructure. Slovenian legislation and the regulatory framework make it possible for a private investor to invest in public infrastructure through various type of legal agreements. Public-private partnership and energy supply contracting are most used. Slovenian partner will continue to support in creation of sustainable environmental and financial projects with added value for the community.

A case study comparing different energy sources for end consumers has been made which shows that DHS is still the best way of space heating from economic, environmental and comfort aspects. Results of this study KPV[57] will use in their consumer relations and marketing materials.

[56] Report on Local Working Group Republic of Slovenia and Report on support provided to DHS
[57] Komunalno podjetje Velenje (Communal company Velenje)

KeepWarm
Renewing district heating

A case example from DHS Velenje, Slovenia

Policy integration

The following drivers to are considered most relevant - the coherent national policy and regulatory environment, direct or indirect subsidies and relevant energy taxation policies, integrative and coherent heat planning at municipal / urban level, alignment of interests through cooperation, sound prices and the price competitiveness of DH supply service and a flexible heat generation that allows better cost-efficiencies.

More than 20 specific actions regarding DHS retrofitting have been recommended, wherein the definition of clear vision, strategic framework and objectives for H&C sector has been recognised as the number one priority. Alongside with other inevitable aspects (support to local authorities, capacity-building programme, financial mechanisms, incentive framework, taxation on fossil fuels)[58].

Apart from country-based legislation, KeepWarm approach defined DHS recommendations for strategy or plan integration[59] and Recommendations for the integration of district heating and cooling in the comprehensive assessment of the potential for efficient heating and cooling[60] as a result of a continuous work on promotion of DH sector in current legislation.

Replication potential

Supply of heat is provided from 93 distribution systems by 55 heat suppliers in 64 Slovenian municipalities. Heat distributors supplies 106,292 consumers and delivers 1,963.2 GWh of heat. The general opinion of the society about DHS is very positive due reliable and cost-effective supply, which among other things enables consumers to lower the costs of regular maintenance[61].

Most of DHSs can follow main features of replication mode based on DHS Velenje.

Short-term pipeline renovation
Continuous pipeline renovation plans
Substations renovation
Fuel optimisation
Biomass (boilers) integration

Useful links

KeepWarm website
KeepWarm – Slovenia
Learning Centre
Showroom of KeepWarm DHS projects

Want to adapt our work to your DHS?

Please contact our consortium (info@keepwarmeurope.eu), or even more directly our Slovenian partners Jozef Stefan Institute, jure.cizman@ijs.si and KSSENA, nejc.jurko@kssena.velenje.eu.

[58] Action plans for retrofitting of District Heating Systems
[59] DHS recommendations for strategy or plan integration.
[60] Recommendations for the integration of district heating and cooling in the CA of the potential for efficient heating and cooling.
[61] District heating market in KeepWarm partner countries

This project has received funding from European Union's Horizon 2020 Research and Innovation programme under Grant Agreement N°784966.

This project has received co-funding from the German Federal Ministry of Economic Cooperation and Development.

A case example from DHS Ptuj, Slovenia

The DHS Ptuj (Javne službe Ptuj, d.o.o.) is located in the street Ulica heroja Lacka 3, 2250 Ptuj, Slovenia. Ptuj is a municipality in east side of Slovenia located in the region "Štajerska". The total population of the municipality is about 23.200. The DHS was founded in 1975. Legal organizational form of utility company of Velenje (hereinafter KP Velenje), is a public company and is owned by three municipalities (Velenje, Šoštanj and Šmartno ob Paki)

The DHS Ptuj has been in operation for more than 40 years. They are planning to optimise it in order to achieve a more efficient operation. Within the next two years the optimisation of the biomass boiler and the boiler house installation is planned. In second phase the plan is also to increase and optimize the grid.

Figure 17 DHS Ptuj (Source: Javne službe Ptuj Ltd

Throughout the project duration, project partners have created a KeepWarm approach to facilitate and guide the DH modernisation[62].

Training and capacity-building

One joint training session was organised where more DHS operators participated, and capacity building continued using an individual approach towards DHS operators to address topics marked as a top priority. In total, 117 hours of training were organised. Distribution of training hours was changed because DHS operators prioritised topics from financing topics group on the expense of organisation topics[63].The total number of individuals participating in capacity building equalled 56, 27 of which are DHS employees and 29 are external stakeholders.

Among external stakeholders are researchers, employees of DHS service companies, public servants directly working with district heating systems, and employees of local energy agencies preparing investment plans for smaller DHSs[64].

Table 10 Overview of trainings Slovenia[64]

TOPIC	TRAINING HOURS	DHS EMPLOYEES	OTHER STAKEHOLDERS	TOTAL INDIVIDUALS
1. Technical topics	22	14	12	26
2. RES and EE topics	27	27	29	56
3. Organization topics	14	27	14	41
4. Financing topics	31	21	8	29
5. Management topics	23	25	8	33
Total	**117/100**	**27/30**	**29**	**56**

Stakeholder Involvement

Local decision makers
Costumers
Technology suppliers

[62] Sustainable Adoption Roadmap
[63] KeepWarm Training Needs Assessment and Training Plan
[64] Report on Training Conducted

KeepWarm
Renewing district heating

A case example from DHS Ptuj, Slovenia

Business plans

To meet EU and national requirements, DHS Ptuj decided to explore possibilities of the use of renewable energy sources. The cost-benefit analyses show that invest in biomass boilers is optimal solutions, especially if it goes together with investment in grid extension and renovation.

The company achieved investments biomass boiler, pipeline optimisation and renovation in several steps. For the investment in biomass boilers national found are available. DHS Ptuj will apply to MZI[65] call where they can receive up to 40 % of subsidy. Own sources and loans from commercial banks will cover the remaining part of the investment. Total investment is estimated at around **2.2 million €**.

With new investment in grid expansion primary energy input should increase for about 2.5 MWh which leads to an increase of 62,5 MWh (in 25 years– **1.57 GWh**). As the DHS currently uses natural gas as only energy source, the share of RES will increase up to around 10,000 MWh per year. In 25 years, span, total production form RES will be around **250 GWh**.

The total efficiency of the system would increase slightly. Furthermore, such an investment would lead to annual CO2 savings of 1,515 tons. On the life span of 25 years, the total CO2 savings will be **37,875 tons**.

Figure 18 Summary of Business model DHS Ptuj

Key Partners
- ✓ Municipality of Ptuj
- ✓ Employees of DHS
- ✓ Civil iniciatives
- ✓ Planning and construction companies
- ✓ Technical suppliers
- ✓ Financial institutions and funding agency

Key Activities
- ✓ Detailed planning,
- ✓ applying for permits,
- ✓ applying for subsidies,
- ✓ arrangement of bank loan
- ✓ Construction of the boiler house and grid

Value Propositions
- ✓ Renewable heat from biomass
- ✓ CO2 savings
- ✓ Using local fuels
- ✓ High comfort for customers
- ✓ High security of supply
- ✓ Moderate costs and stable prices

Customer Relationships
- ✓ Contracts and transparent billing
- ✓ Integration of customers in optimisation / construction process through stakeholder processes.
- ✓ Notification of the

Customer Segments

Type of customers:
- ✓ Private households
- ✓ Public buildings
- ✓ Companies

Goal: getting new customers along existing grid and negotiate with potential customers along new grids.

Key Resources

Financial resources:
- ✓ 6 Million Euro investment
- ✓ 1.75 Million Euro subsidy
- ✓ Rest: loan from financial institution

Physical resources
- ✓ new boiler,
- ✓ grid,
- ✓ technical equipment.
- ✓ Human resources

Channels
- ✓ Meeting with users – citizens
- ✓ Publication in media
- ✓ Leaflets for costumers
- ✓ Stakeholder process

Eco-Social Costs
- ✓ Still using some fossil-fuels (as backup)
- ✓ Noise and dust emissions during construction phase

Eco-Social Benefits

The optimization leads to annual CO2 savings of 1.515 tons.
- ✓ Use of local fuels
- ✓ Substitution of fossil energy source
- ✓ High security of supply
- ✓ Local added value
- ✓ Local job security

[65] The Ministry of Infrastructure in the Republic of Slovenia

KeepWarm
Renewing district heating

A case example from DHS Ptuj, Slovenia

Attracting funds for uptake

In case of Slovenia, the project partner KSSENA organised 11 local working group meetings on different topics with respective DHSs representatives which were attended by 80 participants[66].

Then KSSENA advise JSP Ptuj in preparation of technical documentation such as Project main design and technical studies where KSSENA work closely with engineering companies. The result of this cooperation was successfully obtained Building Permit for new boiler house and respective infrastructure, together with the end of the tendering process for technology supplier.

A detail list of potential financial resources for DHS investments has been created where the financial impacts of the investment and proposed optimum combination of financial sources have been explained. Slovenian partner communicated with several banks to find an optimum loan for the investment.

Ministry of infrastructure published call for co-financing of investment in DHs with a focus on the use of renewable energy sources in DHS. The maximum grant is up to 40 % of the investment costs. The documentation for application for these grants its quite complex, so potential investors usually hire an outside consultant to prepare the documentation – in this case our Slovenian Partner.

Assistance in preparation oof public procurement procedure for selection of technology (boiler) supplier, which has to be selected before application for National Grants. Slovenian partners also prepared a legal opinion on private investors investing in public infrastructure. Slovenian legislation and the regulatory framework make it possible for a private investor to invest in public infrastructure through various type of legal agreements. Public-private partnership and energy supply contracting are mostly used.

Clear and succinct communication strategy, regarding the installation of biomass boilers near the town centre has been created. Clear and efficient communication is crucial for raising awareness among citizens and users, to avoid any dispute in the time of construction of new boiler houses and more importantly in the upcoming operational years.

[66] Report on Local Working Group Republic of Slovenia and Report on support provided to DHS

KeepWarm
Renewing district heating

A case example from DHS Ptuj, Slovenia

Policy integration

The following drivers to are considered most relevant - the coherent national policy and regulatory environment, direct or indirect subsidies and relevant energy taxation policies, integrative and coherent heat planning at municipal / urban level, alignment of interests through cooperation, sound prices and the price competitiveness of DH supply service and a flexible heat generation that allows better cost-efficiencies.

More than 20 specific actions regarding DHS retrofitting have been recommended, wherein the definition of clear vision, strategic framework and objectives for H&C sector has been recognised as the number one priority. Alongside with other inevitable aspects (support to local authorities, capacity-building programme, financial mechanisms, incentive framework, taxation on fossil fuels)[67].

Apart from country-based legislation, KeepWarm approach defined DHS recommendations for strategy or plan integration[68] and Recommendations for the integration of district heating and cooling in the comprehensive assessment of the potential for efficient heating and cooling[69] as a result of a continuous work on promotion of DH sector in current legislation.

Replication potential

Supply of heat is provided from 93 distribution systems by 55 heat suppliers in 64 Slovenian municipalities. Heat distributors supplies 106,292 consumers and delivers 1,963.2 GWh of heat. The general opinion of the society about DHS is very positive due reliable and cost-effective supply, which among other things enables consumers to lower the costs of regular maintenance[70].

Most of DHSs can follow main features of replication mode based on DHS Ptuj.

Short-term pipeline renovation
Continuous pipeline renovation plans
Substations renovation
Fuel optimisation
Biomass (boilers) integration
Grid expansion

Useful links

KeepWarm website
KeepWarm – Slovenia
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Showroom of KeepWarm DHS projects

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[67] Action plans for retrofitting of District Heating Systems
[68] DHS recommendations for strategy or plan integration.
[69] Recommendations for the integration of district heating and cooling in the CA of the potential for efficient heating and cooling..
[70] District heating market in KeepWarm partner countries

This project has received funding from European Union's Horizon 2020 Research and Innovation programme under Grant Agreement N°784966.

This project has received co-funding from the German Federal Ministry of Economic Cooperation and Development.

A case example from DHS Bila Tserkva, Ukraine

DHS Bila Tserkva is a municipally owned enterprise that provides heat supply services to the residents, public institutions, and commercial entities of Bila Tserkva city. The enterprise provides heat energy generation and distribution services. General plans include installation of new efficient natural gas boilers and 1 MW biomass boiler, as well as replacement of pipelines, including 800 mm pipeline connecting DHS with the nearby CHP plant.

DHS Bila Tserkva supplies heat energy produced by own boiler houses as well as heat energy purchased from Bilotserkivska CHP. The DHS provides heat energy to 703 buildings with the total heating area of 2,609,000 m^2 or about 58% of the buildings area in the city.

Figure 19 DHS Bila Tserkva (Source: DHS Bila Tserkva web-site, bctm.com.ua)

Throughout the project duration, project partners have created a KeepWarm approach to DH modernisation[71].

Training and capacity-building

In six training sessions, 100 hours of capacity building was held on five main topics defined within KeepWarm project. Distribution of training hours was changed, and more time appointed for training in technical topics on the expense of management and organisational topics, which corresponds to results of training assessment[72].

The total number of training participants in Ukraine equalled 52 of which 34 participants were DHS operators' employees included in the project, 12 participants were employees of other DHS operators, and 6 participants were representatives of Municipal City Councils[73].

Table 11 Overview of trainings Ukraine[73]

TOPIC	TRAINING HOURS	DHS EMPLOYEES	OTHER STAKEHOLDERS	TOTAL INDIVIDUALS
1. Technical topics	40	24	6	30
2. RES and EE topics	20	15	0	15
3. Organization topics	11	20	0	20
4. Financing topics	20	16	0	16
5. Management topics	9	20	0	20
Total	**100**	**46**	**6**	**52**

Stakeholder involvement:

Bila Tserkva city council
Bilotserkivska CHP
financial organisations

[71] Sustainable Adoption Roadmap
[72] KeepWarm Training Needs Assessment and Training Plan
[73] Report on Training Conducted

KeepWarm
Renewing district heating

A case example from DHS Bila Tserkva, Ukraine

Business plans

The scenarios foresee a modernization of most inefficient generation equipment and complex measures directed at modernisation of most inefficient boiler houses and heat distribution grid elements with high energy losses, replacement of the main pipeline between CHP and DHS.

The priority scenarios are planned to be implemented in 2019-2024. The selected scenarios are in line with the approved Bila Tserkva City Development Strategy for the period up to 2025 and the Plan of Action on Sustainable Energy Development and Climate of the city of Bila Tserkva for 2017-2030.

The implementation of mentioned scenarios achieves primary energy savings of 25.6 GWh on a yearly basis and **640 GWh** in 25 years lifespan. Regarding renewable energy sources, its share will increase for 5.73 GWh which results (for 25 years) in around **143 GWh.** These improvements also contribute to decarbonisation, lowering CO_2 emissions for 6,895 t on a yearly basis (**172,375t** in a 25-year lifespan).

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td>- municipal city council;
- international financial institutions and other donors;
- household owners associations and other customers representatives;
- regional state administration and state authorities;
- sub-contractors for design, construction works, equipment and materials supply;
- fuel and/or energy suppliers (Naftogas of Ukraine, biomass suppliers, etc.)
- other partners (environmental NGOs, media, etc.);</td><td>- planning and design documentation development;
- securing financial resources;
- stakeholder engagement process;
- procurement process;
- construction works, installation, set-up and commissioning;
- operation;</td><td rowspan="2">Increased reliability and efficiency of heat energy supply, which will allow limiting potential increase of energy costs and reducing greenhouse gases emissions.</td><td>- heat supply contracts;
- stakeholder engagement activities (public hearings, meetings, etc.);</td><td>- private households;
- public organizations and institutions;
- other customers (e.g. commercial buildings);

Goal: maintaining the customer base.</td></tr>
<tr><td colspan="2">Key Resources</td><td colspan="2">Channels</td></tr>
<tr><td colspan="2">- EUR 10.8 million of financial resources: loan, grant, subsidies, own cost;
- physical resources: equipment, pipelines, materials;
- energy resources (natural gas, biomass, electricity);
- human resources: employees, sub-contractors, suppliers, consultants of international financial institutions, etc.;</td><td colspan="2">- personal conversations with the customers;
- monthly heat energy bills;
- websites of the DHS and/or municipal council;
- media;
- stakeholders engagement process;
- grievance mechanism;</td></tr>
<tr><td colspan="2">Eco-Social Costs</td><td colspan="3">Eco-Social Benefits</td></tr>
<tr><td colspan="2">- continuation of the use of fossil fuel resources;
- air emissions due to the combustion of natural gas and biomass fuel;
- noise and air emissions during the construction works;
- disturbance of road infrastructure and machinery movement within the residential areas during construction stage;</td><td colspan="3">- greenhouse gases emission reduction by 6,895 tonnes per year;
- increase the share of local biomass use and renewable heat energy generation;
- strengthening the reliability of heat energy supply;
- increasing energy efficiency and reducing the scale of potential energy cost growth;</td></tr>
</table>

Figure 20 Summary of Business model DHS Bila Tserkva

KeepWarm
Renewing district heating

A case example from DHS Bila Tserkva, Ukraine

Attracting funds for uptake

In case of Ukraine, the project partner KT-Energy organized eight meetings on different topics with respective DHSs representatives which were attended by 45 participants[74]. Meetings taken place afterwards have been a result of a continuous collaboration between the Ukrainian partner and DHSs representatives towards achieving investments.

Additional support has been provided for shaping the priority project on replacement of main pipeline between DHS and Bilotserkivska CHP. Ukrainian participated in a meeting with design documentation developer to clarify technical parameters of the project and investment needs.

Applications for the Global Climate City Challenge contest run by European Investment Bank and IFC's platform ECA Cities has been created to attract investment for one of the priority actions identified. Preparation of the application for financing priority modernization project on replacement of pipeline between Bilotserkivska CHP and Bila Tserkva DHS via the State Regional Development Fund have been made.

Promotion of DHS sector in the field of local/regional/national legislation has been performed via the development of the proposals for the National Action Plan for District Heating Modernization in Ukraine taking into account several rounds of stakeholder consultations, including consultations with partnering DHSs and local authorities.

Proposals for the inclusion of district heating modernization support measures (i.e. financing sources for DH modernization and approval of minimum requirements for modernization projects) into the National Energy Efficiency Action Plan.

In addition to support provided to Ukrainian pilot DH systems, DHS Bila Tserkva has strengthened their cooperation with Ukrainian KeepWarm partner and signed a letter of commitment for Global Climate City Challenge.

[74] Report on Local Working Group Ukraine and Report on support provided to DHS

KeepWarm
Renewing district heating

A case example from DHS Bila Tserkva, Ukraine

Policy integration

To promote renewables in DH, additional support measures are needed, including reform of the carbon tax mechanism, improvement of the legal basis for approving the level and structure of heat energy tariffs, incentives for the production of heat from RES and environmental requirements for the use of biomass in heat supply systems.

Ongoing DH energy efficiency projects are aimed at balancing the currently reduced heat loads with existing heat generation and transport facilities, further centralizing DH and modernizing key technological equipment. The scale of investment in these activities throughout the country is to be significantly increased to ensure the medium and long-term reliability of the heat supply[75].

Apart from country-based legislation, KeepWarm approach defined DHS recommendations for strategy or plan integration[76] and Recommendations for the integration of district heating and cooling in the comprehensive assessment of the potential for efficient heating and cooling[77] as a result of a continuous work on promotion of DH sector in current legislation.

Replication potential

Ukraine has well-developed district heating sector in terms of geographical coverage, but it is characterized by outdated equipment, low energy-efficiency, and declining number of customers. The total DH network length is about 21,000 km. Considering generation efficiency, this brings overall efficiency of district heating systems below 75%[78].

Most of DHSs can follow main features of replication mode based on DHS Bila Tserkva.

Replacement of outdated equipment
Pipeline renovation
Development of bankable solutions
Biomass (boilers and CHP) integration
Step-by-step modernisation
Identification of available financing

Want to adapt our work to your DHS?

Please contact our consortium (info@keepwarmeurope.eu), or even more directly our Ukrainian partner: **LLC KT-Energy**, ktomlyak@kt-energy.com.ua.

Useful links

KeepWarm website
KeepWarm – Ukraine
Learning Centre
Showroom of KeepWarm DHS projects

[75] Action plans for retrofitting of District Heating Systems
[76] DHS recommendations for strategy or plan integration.
[77] Recommendations for the integration of district heating and cooling in the CA of the potential for efficient heating and cooling..
[78] District heating market in KeepWarm partner countries

This project has received funding from European Union's Horizon 2020 Research and Innovation programme under Grant Agreement N°784966.

This project has received co-funding from the German Federal Ministry of Economic Cooperation and Development.

KeepWarm
Renewing district heating

A case example from DHS Zhytomyr, Ukraine

DHS Zhytomyr is a municipally owned enterprise that provides heat supply services to the residents, public institutions, and commercial entities of Zhytomyr city. The enterprise provides heat energy generation and distribution services from October to April. Hot water supply is provided during the whole year for some of the consumers.

Figure 21 DHS Zhytomyr (Source: DHS Zhytomyr website,

Heat energy generation equipment requires modernization and replacement due to long operation time and decreasing efficiency levels. Boiler houses have installed capacity significantly exceeding the connected load. There is a potential for capacity optimization and centralization of heat generation.

Throughout the project duration, project partners have created a KeepWarm approach to DH modernisation[79].

Training and capacity-building

In six training sessions, 100 hours of capacity building was held on five main topics defined within KeepWarm project. Distribution of training hours was changed, and more time appointed for training in technical topics on the expense of management and organisational topics, which corresponds to results of training assessment[80].

The total number of training participants in Ukraine equalled 52 of which 34 participants were DHS operators' employees included in the project, 12 participants were employees of other DHS operators, and 6 participants were representatives of Municipal City Councils[81].

Table 12 Overview of trainings Ukraine[81]

TOPIC	TRAINING HOURS	DHS EMPLOYEES	OTHER STAKEHOLDERS	TOTAL INDIVIDUALS
1. Technical topics	40	24	6	30
2. RES and EE topics	20	15	0	15
3. Organization topics	11	20	0	20
4. Financing topics	20	16	0	16
5. Management topics	9	20	0	20
Total	**100**	**46**	**6**	**52**

Stakeholder involvement:
Ternopil city council
financial organisations
customers, contractors

[79] Sustainable Adoption Roadmap
[80] KeepWarm Training Needs Assessment and Training Plan
[81] Report on Training Conducted

KeepWarm
Renewing district heating

A case example from DHS Zhytomyr, Ukraine

Business plans

Installation of a biomass CHP unit applying ORC technology, boilers replacement at 7 First Vilskyi lane boiler house, boilers replacement at 4 Karetnyi lane boiler house, modernization of the district heating sub-network connected to RK-6 boiler house.

All scenarios were selected as priority scenarios for implementation and will be implemented in 2020-2025. Implementation of all scenarios would lead to reduction of greenhouse gas emission due to substitution of natural gas with renewable biomass and increased efficiency of heat energy generation and would bring social benefits due to improved reliability and security of heat energy supply.

The implementation of mentioned scenarios achieves primary energy savings of 28.15 GWh on a yearly basis (**704 GWh** in total over 25 years). Regarding renewable energy sources, its share will increase for 44.14 GWh per year which results (for 25 years) in around 1,104 GWh.

These improvements also contribute to decarbonisation, lowering CO_2 emissions for 17,472 t on a yearly basis (**436,800 t** in a 25-year lifespan).

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td>- municipal city council;
- international financial institutions and other donors;
- household owners associations and other customers representatives;
- regional state administration and state authorities;
- sub-contractors for design, construction works, equipment and materials supply;
- fuel and/or energy suppliers (Naftogas of Ukraine, biomass suppliers, etc.)
- other partners (environmental NGOs, media, etc.);</td><td>- planning and design documentation development;
- securing financial resources;
- stakeholder engagement process;
- procurement process;
- construction works, installation, set-up and commissioning;
- operation;</td><td rowspan="3">Increased reliability and efficiency of heat energy supply, which will allow limiting potential increase of energy costs and reducing greenhouse gases emissions.</td><td>- heat supply contracts;
- stakeholder engagement activities (public hearings, meetings, etc.);</td><td>- private households;
- public organizations and institutions;
- other customers (e.g. commercial buildings);

Goal: maintaining the customer base.</td></tr>
<tr><th colspan="2">Key Resources</th><th>Channels</th><th></th></tr>
<tr><td colspan="2">- EUR 6.36 million of financial resources: loan, grant, subsidies, own cost;
- physical resources: equipment, pipelines, materials;
- energy resources (natural gas, biomass, electricity);
- human resources: employees, sub-contractors, suppliers, consultants of international financial institutions, etc.;</td><td>- personal conversations with the customers;
- monthly heat energy bills;
- websites of the DHS and/or municipal council;
- media;
- stakeholders engagement process;
- grievance mechanism;</td><td></td></tr>
<tr><th colspan="3">Eco-Social Costs</th><th colspan="2">Eco-Social Benefits</th></tr>
<tr><td colspan="3">- continuation of the use of fossil fuel resources;
- air emissions due to the combustion of natural gas and biomass fuel;
- noise and air emissions during the construction works;
- disturbance of road infrastructure and machinery movement within the residential areas during construction stage;</td><td colspan="2">- greenhouse gases emission reduction by 15,569 tonnes per year;
- increase the share of local biomass use and renewable heat energy generation;
- strengthening the reliability of heat energy supply;
- increasing energy efficiency and reducing the scale of potential energy cost growth;</td></tr>
</table>

Figure 22 Summary of Business model DHS Zhytomyr

KeepWarm
Renewing district heating

A case example from DHS Zhytomyr, Ukraine

Attracting funds for uptake

In case of Ukraine, the project partner KT-Energy organized eight meetings on different topics with respective DHSs representatives which were attended by 45 participants[82]. Meetings taken place afterwards have been a result of a continuous collaboration between the Ukrainian partner and DHSs representatives towards achieving investments.

Assistance in creation of necessary study have been proved and further contacts between DHS and experts involved have been facilitated. Based on organized trainings, business models have been discussed and furtherly developed.

The business model includes a detailed overview of potential financing sources for district heating modernization projects in Ukraine. Besides, for Zhytomyr DHS and Zhytomyr City Council proposals for the incorporation of district heating modernization measures into the updated Sustainable Energy and Climate Action Plan (SECAP) of the city have been prepared.

Advisory was provided to Zhytomyr DHS on new methodological requirements for the preparation of district heating development schemes that has been developed by the Ministry of Communities and Territories Development of Ukraine.

Negotiation support with customers has not been covered by KeepWarm project activities in Ukraine. Measures to increase attractiveness of district heating to final consumers and communication activities promoting best practices in district heating were discussed and included in the proposals for the National Action Plan for District Heating Modernisation in Ukraine.

[82] Report on Local Working Group Ukraine and Report on support provided to DHS

Organic Rankine Process in CHP plant

A case example from DHS Zhytomyr, Ukraine

Policy integration

To promote renewables in DH, additional support measures are needed, including reform of the carbon tax mechanism, improvement of the legal basis for approving the level and structure of heat energy tariffs, incentives for the production of heat from RES and environmental requirements for the use of biomass in heat supply systems.

Ongoing DH energy efficiency projects are aimed at balancing the currently reduced heat loads with existing heat generation and transport facilities, further centralizing DH and modernizing key technological equipment. The scale of investment in these activities throughout the country is to be significantly increased to ensure the medium and long-term reliability of the heat supply[83].

Apart from country-based legislation, KeepWarm approach defined DHS recommendations for strategy or plan integration[84] and Recommendations for the integration of district heating and cooling in the comprehensive assessment of the potential for efficient heating and cooling[85] as a result of a continuous work on promotion of DH sector in current legislation.

Replication potential

Ukraine has well-developed district heating sector in terms of geographical coverage, but it is characterised by outdated equipment, low energy-efficiency, and declining customers' base. The total DH network length is about 21,000 km. Considering generation efficiency, this brings overall efficiency of district heating systems below 75%[86].

Most of DHSs can follow main features of replication mode based on DHS Zhytomyr.

Replacement of outdated equipment
Pipeline renovation
Development of bankable solutions
Biomass (boilers and CHP) integration
Step-by-step modernisation
Identification of available financing

Useful links

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[83] Action plans for retrofitting of District Heating Systems
[84] DHS recommendations for strategy or plan integration.
[85] Recommendations for the integration of district heating and cooling in the CA of the potential for efficient heating and cooling.
[86] District heating market in KeepWarm partner countries

This project has received funding from European Union's Horizon 2020 Research and Innovation programme under Grant Agreement N°784966.

This project has received co-funding from the German Federal Ministry of Economic Cooperation and Development.

Diversification of fuel and boiler house automation

A case example from DHS Jekabpils, Latvia

The DHS "Jekabpils Siltums", Ltd. is located in Jekabpils city, Latvia. Jekabpils is a municipality in Eastern part of Zemgale region of Latvia. The total population of the municipality is about 23,600. The DHS was founded in 2003. The owner of company is municipality of Jekabpils city, it is limited liability company (Ltd.).

Figure 23 DHS Jekabpils (Source: Jekabpils Siltums Ltd)

The business idea of the DHS Jekabpils C13A is to continue to produce and distribute district heat out of wood chips basically and additional supplies out of gas. Through this new optimisation and rebuilding steps, the DHS is able to work more effective.

Throughout the project duration, project partners have created a KeepWarm approach to DH modernisation[87].

Training and capacity-building

Based on training needs assessment[88], specific topics have been identified which resulted with 13 capacity building sessions (103.5 hours) and 271 individuals in total. The KeepWarm training approach proved to be flexible and enabled the partners to adapt the training to their national context.

The main objective was to increase participants' competency, so they will be able to design and implement changes, as well as enforce new production methods and working procedures. Capacity-building programme covered technical, financial, managerial and organisational topics, increasing energy efficiency, and utilisation of RES. The training was mostly lecture-based, and PowerPoint presentations were usually used. Additionally, field trips to the appropriate sites were organised to present real-life examples and practical use of discussed solutions[89].

Stakeholder Involvement:

DHS owner (municipality)
Technologies` suppliers
State financial authorities
Customers, fuel suppliers

TOPIC	TRAINING HOURS	DHS EMPLOYEES	OTHER STAKEHOLDERS	TOTAL INDIVIDUALS
1. Technical topics	20	19	3	22
2. RES and EE topics	19.5	17	18	35
3. Organization topics	14.5	32	4	36
4. Financing topics	24.5	20	10	30
5. Management topics	13	22	2	24
Total	**91.5**	**63**	**30**	**93**

Table 13 Overview of trainings Latvia[39]

[87] Sustainable Adoption Roadmap
[88] KeepWarm Training Needs Assessment and Training Plan
[89] Report on Training Conducted

Diversification of fuel and boiler house automation

A case example from DHS Jekabpils, Latvia

Business plans

DH operators are planning to replace the existing AK-1500S wood chip boiler (1.5 MW) to one new fully automated wood chip boiler with a capacity of 1.5 MW (KAPAK). An additional installation of a new automated 0.5 MW gas boiler is intended to provide a summer load, as well as the automation of an existing old RK-1,6 gas boiler so that the boiler house can operate without servicing personnel throughout the year.

The costs are estimated with **470,000.00 €** for installation of new wood chips boiler, **10,000.00 €** for installation of new gas boiler and **30,000.00 €** for the automation of existing gas boiler. On the life span of 25 years, the total primary energy savings are 42.45 GWh. The DHS Jekabpils C13A will use heat from biomass (78%) and gas (22%).

After realizing the investment, it is planned that primary energy input will be 1,698 MWh. On the life span of 25 years, the total primary energy savings are 42.45 GWh. In result of optimization the amount of annual used renewable sources will decrease to 5,371 loose m^3. On the life span of 25 years, the total use of renewables will be 96.69 GWh.

This investment would cause CO2 emissions 205,698 t/ year. The planned optimization will reduce other emissions as filters will be installed for the new chip boiler for flue-gas purification.

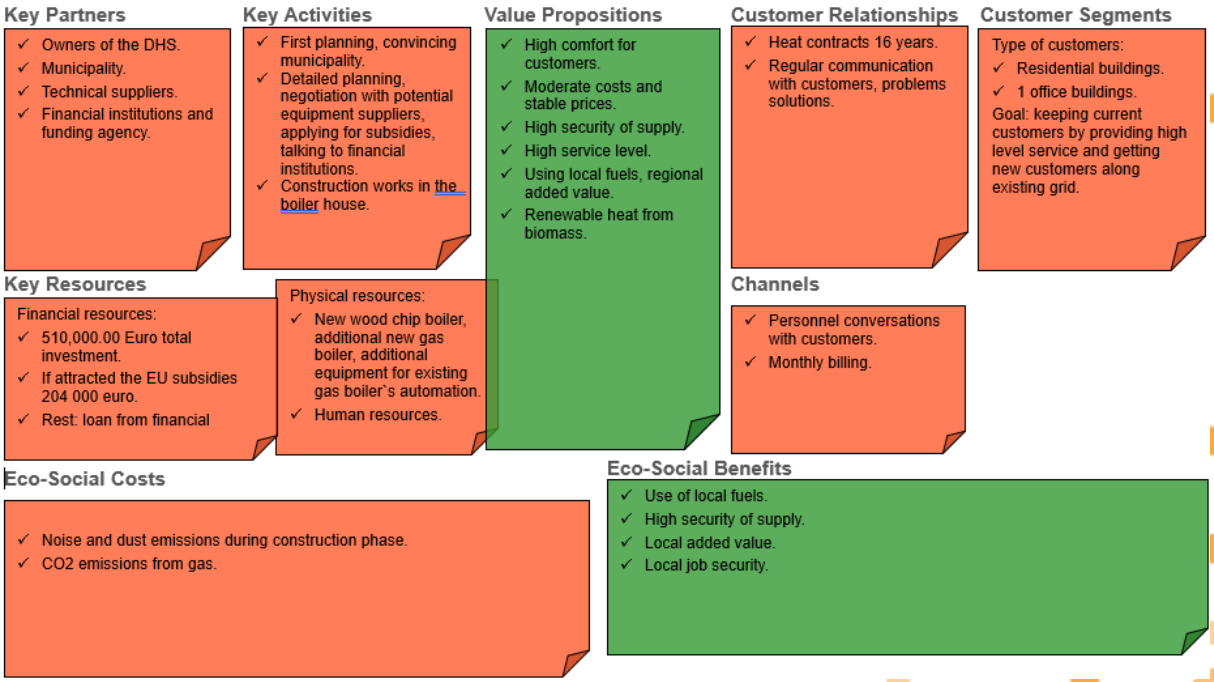

Figure 24 Summary of Business Model DHS Jekabpils

Diversification of fuel and boiler house automation

A case example from DHS Jekabpils, Latvia

Attracting funds for uptake

Project partner ZREA organised seven working group meetings on different topics with respective DHSs representatives which were attended by 44 participants[90]. Feasibility studies created through the project have been presented, as well as discussed in terms of modifications and further steps. Meetings taken afterwards have been a result of a continuous collaboration.

Several direct consultations on technical solutions between expert and pilot DHS were organised and resulted with further development of business plan – additional calculations for assessing the biomass potential and possibility for complete automation of boiler rooms.

In May 2020, contract with equipment supply and installation company ("Filter", Ltd.) was signed, in accordance with it two new gas boilers were installed, and their operation has started in August 2020 (total investment 79 190 €). Next step – regarding change of wood chips boiler (the main heat production source of this boiler house) is planned to implement this of next year, depending on availability of the EU funds.

Regular updates on available EU funding, state loans or private investment offers were conducted. There will be chance to apply for the EU funds, namely EU support within 2021-2027 funding period - ZREA will continue to utilize the KeepWarm approach.

There was no need for ZREA support to Pilot DHS regarding cooperation with regulatory institutions concerning tariff regulation, public procurement, permissions, etc., because the main chosen focus of support was on technical, financial and potential grant support. In cooperation with Jekabpils municipality based on ZREA recommendations, certain activities regarding DHS development/modernization were included in the Sustainable energy and climate action plan of Jekabpils city 2030. At regional level, the same recommendations were given to Zemgale planning region, in which territory also Jekabpils city is located.

Regarding negotiation support with customers, ZREA has not involved directly, as it is more internal competence of pilot DHS. However, concerning work with customers, support was in form of coaching on public relations and on customer services.

[90] Report on Local Working Group Latvia and Report on support provided to DHS

Diversification of fuel and boiler house automation

A case example from DHS Jekabpils, Latvia

Policy integration

For many DHSs, increasing the energy efficiency of old DH systems and their modernisation remains the biggest challenge. An important task is the increased use of RES, emission-free technologies, and modern technologies (such as heat storage, use of waste heat). In parallel, DHS should consider how to solve the decline in consumer demand.

The main prerequisites for successful development of DHS are appropriate national policies and a regulatory environment that provides a stable basis and incentives for DHS development. The availability of direct or indirect subsidies and/or dedicated financial instruments and the availability of low-cost loans are crucial[91].

Apart from country-based legislation, KeepWarm approach defined DHS recommendations for strategy or plan integration[92] and Recommendations for the integration of district heating and cooling in the comprehensive assessment of the potential for efficient heating and cooling[93] as a result of a continuous work on promotion of DH sector in current legislation.

Replication potential

In Latvia, consumers' heat supply is provided through centralised heat supply systems, local heat supply and individual heat supply. Fuelwood and natural gas are fuels, which are mainly used in the production of heat energy from boiler houses. It is essential that the share of local and renewable energy (fuel wood) increases each year, reducing the proportion of natural gas[94].

Most of DHSs can follow main features of replication mode based on DHS Bene.

Reconstruction of boiler rooms **Automation of boiler rooms (houses)**
Small-scale improvements **Biomass integration**
Applying for national and EU Funds

Useful links

KeepWarm website
KeepWarm - Latvia
Learning Centre
Showroom of KeepWarm DHS projects

Want to adapt our work to your DHS?

Please contact our consortium (info@keepwarmeurope.eu), or even more directly our Latvian partners **Zemgale Regional Energy Agency** and E-Mail to: zrea@zrea.lv.

[91] Action plans for retrofitting of District Heating Systems
[92] DHS recommendations for strategy or plan integration.
[93] Recommendations for the integration of district heating and cooling in the CA of the potential for efficient heating and cooling.
[94] District heating market in KeepWarm partner countries

This project has received funding from European Union's Horizon 2020 Research and Innovation programme under Grant Agreement N°784966.

This project has received co-funding from the German Federal Ministry of Economic Cooperation and Development.

Outlook and Summary

Replication models have been created with the aim of presenting applicable retrofits of other DHSs in KeepWarm countries (and beyond where each model represents a different way of modernisation):

- Implementation of new heat source (biomass and solar energy);
- Utilisation of Excess Heat;
- Pipeline renovation projects;
- DH network expansion;
- Small scale improvements;
- Step-by-step approach in both RES and pipeline renovation;
- Continuous investments in different measures.

By combining all aspects of the KeepWarm approach, replication models present main features such as capacity-building, business model highlights, identification of investments and policy integration. When it comes to a capacity-building programme, DHS can request specific training needs which can be provided in terms of training, webinars, workshops and site visits by KeepWarm partners also beyond the project lifetime.

Sustainable Business Model Canvas can be used and developed according to identified needs and objectives of each DHS. They can decide between different options, e.g., spending their own resources, regional or local support, or European funding. Ambitious and future-oriented plans convince partners and investors to support DHS on their way towards green and sustainable heating in Europe.

Lastly, KeepWarm outcomes for Policy Integration[95] present a comprehensive and multi-level support including Action Plans, Recommendations for strategy/plan integration and support to 2nd Comprehensive Assessment.

Based on the current situation in KeepWarm countries in terms of investments opportunities and legislation, each DHS can either copy and apply aspects from the KeepWarm approach or a tailor-made model can be developed using the same methodology. For that purpose, a general overview of replication methodology has been created in order to provide a comprehensive overview of necessary activities (and possible outcomes) for a DHS striving to undergo the KeepWarm modernisation process.

[95] KeepWarm's Policy Recommendations