

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

Work package N°2: Capacity building of DHS operators

Deliverable D°2.2: Report of Trainings Conducted

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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
LV	Latvia
NGO	Non-Governmental Organisation
RES	Renewable Energy Source(s)
SI	Slovenia
SRB	Serbia
UKR	Ukraine
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 (mainly 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
 <small>Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH</small>	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 České 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 Vinča	VINCA	Serbia

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Executive summary

The project “Improving the performance of district heating systems in Central and Eastern Europe” – or KeepWarm for short, targets the largest energy user in the EU – energy demand for heating and cooling (49%). KeepWarm is working intensively with DHS operators in seven countries: Austria, Croatia, Czech Republic, Latvia, Serbia, Slovenia and Ukraine; to increase the energy efficiency of these systems; and to reduce greenhouse gas emissions by promoting a switch from fossil to renewable fuels. The first step, in this process, is a capacity building of DHS operators and other external stakeholders. This document describes conducted training, used training methods, training objectives, and summarises training achievements and feedback from the participants.

The main capacity building objective was to design and organise a tailor-made training programme to address specific objectives and capacities of target groups. The tailor-made approach was based on the real necessities of DHS operators, which were learned during the training needs assessment phase. To effectively address all relevant aspects of DHSs, capacity development was oriented in five main directions:

- Capacity development on technical concerns
- Capacity development on the utilisation of RES, waste and excess heat
- Organisational capacity development
- Capacity development on financing topics
- Managerial capacity development

Based on a previously developed training plan and collaboration with DHS operators, the organisers conducted capacity building in 7 partner countries. Capacity building in five key KeepWarm topic groups was mostly organised as a series of lectures, workshops and study visits. Some training sessions were suited for a large number of participants, and some oriented on individual approach to one or few DHS operators to precisely address their specific needs. The lecturers were representatives of partnering institutions, academia, advanced DHSs, and companies involved in the DH sector. The participants were mostly employees of DHSs in charge of various aspects of their systems, with a background in engineering, management, organisational aspects and/or financing.

In total, 617 employees of DHS operators and 196 external stakeholders benefited from 746 hours of capacity building. According to the participants, training effectively developed their capacity and enabled them to implement gained knowledge in improving and modernising their DHSs. In the evaluation questionnaires, they expressed satisfaction with capacity building backed by relatively high numerical grades for different training aspects. The participants also complimented the quality of presented content, experienced lecturers, good practice examples and recognised many useful training aspects. Additionally, they provided valuable comments and advice for the improvement of future training.

In conclusion, capacity building was welcomed by DHS operators and resulted in the successful preparation of DHS operators for the implementation of gained knowledge in everyday work and in improving their DHSs.

Introduction

The Project “Improving the performance of district heating systems in Central and Eastern Europe” – or KeepWarm for short – targets the largest energy user in the EU: Energy demand for heating and cooling (49%). Relying on district heating systems for heat generation is the most effective solution in densely populated areas. However, many district heating systems (DHS) are highly energy inefficient and need to be modernised. Considering that the predominant energy sources are still fossil fuels (oil, gas or coal), interventions are ever more urgent. Both statements hold especially for East European countries where old, inefficient district heating systems, mostly fuelled by fossil sources, urgently need to be modernised.

The project promotes EU goals of improved and environmentally friendly heating and cooling but adapts its exploitation strategy to distinct national windows of opportunities. KeepWarm is working intensively with DHS in seven countries: Austria, Croatia, Czech Republic, Latvia, Serbia, Slovenia and Ukraine; to increase the energy efficiency of these systems; and to reduce greenhouse gas emissions by promoting a switch from fossil to renewable fuels. This is most urgently needed in case of large-scale DH systems that are mostly found in Eastern Europe. Likewise, it is essential to ensure that existing DHS that run on renewables do not switch back to fossil fuels.

Capacity building objectives

Aim of capacity building was to design and organise tailor-made training programme to address the specific objectives and capacities of target groups. The primary objective was to increase the capacity of DHS operators and other relevant stakeholders in topics significant for the improvement and renovation of DHSs in partnering countries. Furthermore, another objective is to reach other DHSs and to be able to replicate the results. To successfully address all aspects of district heating systems, training topics were divided into five main topic groups as follows:

- Capacity development on technical concerns
- Capacity development on the utilisation of RES, waste and excess heat
- Organisational capacity development
- Capacity development on financing topics
- Managerial capacity development

Baseline material for each topic group has been provided by the task leader for a specific topic and further adapted by the local partner/ training organisers concerning the country specific context. To reach project objectives and set out a capacity building strategy, first, training needs assessment was carried out. Based on the evaluation questionnaires submitted by 52 DHSs, top priority topics in each country and from each group of topics were identified. In discussion with DHS operators, favourable training methods were also chosen.

Besides from covering designated training topics, which were defined in the training needs

assessment phase, training duration and the number of individuals participating in the training were previously determined. The training was planned to last for 20 hours per topic group, equalling 100 hours in total, in each country. The consortium goal regarding the number of participants benefiting from the capacity building was set as high as 150 individuals employed in DHS companies/networks. The summary of training duration and the expected number of DHS employees benefiting from capacity building per country are shown in Table 1.

Table 1. Training objectives

COUNTRY	DHS EMPLOYEES TO BE TRAINED	TRAINING HOURS
Austria	30	100
Croatia	20	100
Czech R	15	100
Latvia	15	100
Serbia	20	100
Slovenia	30	100
Ukraine	20	100
Total	150	700

The main objective of capacity building in technical topics was to increase the capacity of target groups on technical optimisation of existing DH systems, CHP plants and internal heat distribution systems in a building, as well as reduction of energy losses and cost-effective optimisation. Aim of capacity building in RES, waste and excess heat topics was to increase the capacity of target groups in the utilisation of waste or excess heat and to switch production to cleaner fuels and RES. In this area, the focus was on biomass and solar thermal energy. The main goal of capacity building in organisational topics was to increase the capacity of target groups in the management of their organisations such as: organisation of DH networks, operation of boiler houses and corporate organisation. Capacity building in financing topics was organised to increase the capacity of target groups in financial issues and analysis, as well as business plan development. Additionally, capacity building in management topics supposed to increase the capacity of the target group in the management of their organisation's primarily demand-oriented service schemes, public relations and communication with end-users.

As already mentioned, topics to be addressed from each of the five main topic groups varied between countries and the list of topics, which was created based on training needs assessment, is given in Table 2. Green highlighted fields mark top priority topics to be covered in capacity building in a particular country. As seen, topics such as reduction of energy losses and demand-oriented service schemes were recognised as a top priority in all partner countries. Furthermore, topics like the integration of RES and public relations also raised the interest of DHS operators in many countries.

Table 2. Summary of training topics

TOPIC N° AND A SHORT DESCRIPTION	AUSTRIA	CROATIA	CZECH REPUBLI	LATVIA	SERBIA	SLOVENIA	UKRAINE
1. Technical topics							
1.1 Reduction of energy losses							
1.2 Control of heat generation and storage							
1.3 System temperatures							
1.4 Energy audits and surveillance							
1.5 Adaptation to reduced heat demand							
1.6. DH vs decentralised solutions							
1.7 Cost-effective optimisation							
1.8 GIS applications							
2. RES and EE topics							
2.1 Integration of RES							
2.2 Industrial waste heat							
2.3 Feasibility of fuel switch							
2.4 Biomass supply							
2.5 Biomass quality							
3. Organisation topics							
3.1 Organization of DH networks							
3.2 Operation of boiler houses							
3.3 Corporate organisation							
4. Financing topics							
4.1 Viability of RES and waste heat							
4.2 Innovative financing							
4.3 Economic feasibility analysis							
4.4 Financial support and funding sources							
4.5 Business planning							

5. Management topics							
5.1 Demand-oriented service schemes							
5.2 Public relations							
5.3 Assessment of user behaviour							
5.4 Individual billing							
5.5 Rewarding energy savings							
5.6 Retrofitting DH networks							
5.7 Ensuring biomass supply							

Organisation of capacity building

KeepWarm project partners organised training in each country with help from national technical planners, energy agencies, consulting companies, public authorities, advanced DHSs, academic institutions, and other relevant stakeholders included in DH sector with an adequate level of knowledge and relevant expertise in specific topics.

Capacity building was held in the period between September 2018 and beginning of June 2019. The delay was caused due to the low availability of employees of DHS companies during the heating season since training dates and venues in most countries were determined in consultations with DHS operators to increase training attendance.

In the consortium, the training sessions varied in length and content distribution. Some organisers opted for 2, or 3-day training sessions which covered all relevant topics from the particular topic group and others opted for shorter training sessions in which they addressed a couple of relevant topics, either from one or more topic groups. The trainings were mainly based and combined out of lectures, workshops and study visits since the knowledge gained in this way remains more sustainable. For the lectures, presenters mostly used presentations, printed materials or videos. Workshops required the participants to participate in training actively and apply gained knowledge, as well as the field trips, where the practical application was demonstrated. Training materials varied but were mostly printed or available online after the training. In some cases, training was organised as lectures or workshops for multiple DHS operators and even other interested stakeholders, and in some cases, the organisers opted for an individual approach towards one or few DHS operators to address their specific challenges and/or obstacles.

The structure of participants varied between countries because of the difference in size and the number of employees in DHSs. In some cases, the participants were experts in a particular aspect of DHS, especially if they are employed in large companies, and in some cases, the participants were employees of small enterprises and in charge of multiple aspects of their DHS. Since their level of knowledge varied, the organisers adopted the content to suit the participants' structure as much as possible.

Capacity building evaluation

Training evaluation played an important role in capacity development since training organisers mostly adapted training methods and other training aspects based on the feedback given by the participants. After training sessions, the participants were usually given a training evaluation form to fill out. The form consisted of 12 questions in which they evaluated 12 different training aspects with grades from 1 to 5, with one being the lowest and five being the highest grade. Furthermore, questions 13-18 required the participants to emphasise major training strengths, interesting, new and meaningful aspects, identify changes they can apply after the training and propose measures to improve the training. The evaluation form is given in the annex of this document. In some partnering countries, training organisers adopted given questionnaires or used their own for training evaluation. Not all evaluation results are included in the report since it would become too long therefore solely examples of training evaluations are given in the report.

Following the completion of a training session, the organisers often discussed the session with the participants to receive feedback which can be used to improve upcoming training sessions further. This method proved to be very effective and less time-consuming. It also enabled the participants to clearly express training advantages and disadvantages, their concerns and propositions for the improvement of the capacity building process.

1. Austria

Capacity building of DHS operators in Austria was organised by LWK Steiermark between 11th of September 2018 and 23rd of May 2019. In general, main capacity development objective was to increase the capacity of the target group – DHS operators in state-of-the-art technologies, subsidies, legal framework, system optimisation, and many other aspects to achieve energy savings and better energy efficiency of their systems. One of the characteristics of capacity development was cooperation with many smaller DHS operators.

Alongside lectures, which were the most common training method, field trips and practical sessions were also organised. Some training sessions were held as a series of lectures for large groups, and during some sessions, individual approach towards one DHS operator was used. In total, 15 training sessions dealing with five KeepWarm topics were held. During the sessions, more topics were usually addressed, depending on the structure of participants and their specific needs.

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. In many cases, DHSs in Austria employ only one person responsible for all aspects. Training materials were usually handed in printed form or are available online.

Since many KeepWarm topics were covered during one training session, in this training report, each session will be separately described, and training topics will be summarised in the end.

Training sessions in Austria

Capacity building in Bad Mitterndorf



The main training objective in Bad Mitterndorf was to increase the capacity of DHS operators in optimising DHS and the use of biomass. The training was held in local DHS, which was recently modernised and partially rebuilt.

During the training, six lectures were held, and a study tour of Bad Mitterndorf DHS was organised. Main topics covered were from technical, organisational and utilisation of RES

and EE topics group. The lecturers were DHS employees and representatives of LWK Steiermark and a private company in the DH sector. They presented a variety of topics regarding the use of biomass in DHS: subsidies, legal framework, ash handling, system temperatures and system optimisation.

In total, 35 individuals participated in a 9-hour capacity building. The general feedback was very good, and the participants were satisfied with the training. The lecturers received positive comments, and the field trip was recognised as very helpful, so LWK Steiermark decided to pursue a similar mix of theoretical knowledge and practical application in the future training sessions. Some negative comments were received regarding training duration because 9-hour capacity building seems too much for the participants. Furthermore, they wanted to have more time for discussion.

Capacity building in Gleinstätten

Training in Gleinstätten was organised to address current topics and challenges in DH and facilitate discussion between DHS operators. It was held in the innovative DHS which uses different types of RES.

The lecturers and discussion covered all five KeepWarm topics during capacity building in Gleinstätten. As an introduction, a guided tour through DHS was organised, and experience with waste heat utilisation was presented. Before the networking and discussion, representatives of KeepWarm project partners gave a short introduction to current topics and challenges in DHSs. After the introduction, the participants talked about their DHSs and challenges they are facing.

17 participants were included in 5.5-hour capacity building. The feedback was very positive, and networking proved to be a very good capacity building method.

Training highlight - networking

During capacity building in Gleinstätten, the focus was put on networking and exchange of experiences between DHS operators. The discussion started with a short overview of current challenges and topics regarding DHS in general. After the introduction, training participants talked about their DHSs, challenges they are facing and possible solutions. This led to a lively discussion



about DH in the region. The feedback was very positive, and the exchange of experiences was very helpful. This training concept resulted in effective capacity building, and LWK Steiermark thinks it should be implemented in other regions as well. DHS operators in many countries consider networking between DHS operators, energy agencies, companies and other relevant stakeholders included in training very beneficial, especially for future cooperation in improving their DHSs.

Capacity building in Steiermarkhof (Graz)

The main objective of capacity building in Steiermarkhof was to present various lectures on top priority topics for DHS operators.

The training focused on technical and organisational capacity development. During capacity building, many topics were addressed, such as reduction and optimisation of



system temperatures, quality management in DHS, visualisation and optimisation in DHS, planning of DHS and the use of adsorption chillers. The lecturers were employees of LWK Steiermark, Danfoss, AEE INTEC, DHS Bad Mitterndorf, Schneid, Ringhofer & Partner and Pink Energie. They presented technologies, gave practical examples, discussed legal and technical frameworks, stressed the

importance of collecting and analysing data, and quality planning. As the final training point, possibilities for the use of adsorption chillers in DHS were presented.

In total, 37 participants benefited from 10.5-hour capacity building in Graz. They expressed strongly positive feedback regarding the selection of topics, lecturers' expertise and personal learning outcomes. Since most of the experts exceeded their time, some complaints regarding training duration were noted.

Capacity building in Judenburg

Capacity building in Judenburg aimed to simplify the data gathering process in local DHS, clear managerial issues and focus attention on important factors to achieve low return temperatures. The training was held in the office of district heating department of Stadtwerke Judenburg. All, but financial aspects of DH were addressed in this training.

After the overview of grid expansion by technical staff, important points regarding system temperatures were discussed. During capacity building, practical possibilities for network optimisations were presented in the form of decreasing return temperature. Furthermore, the preparation of data and further data processing were carried out.

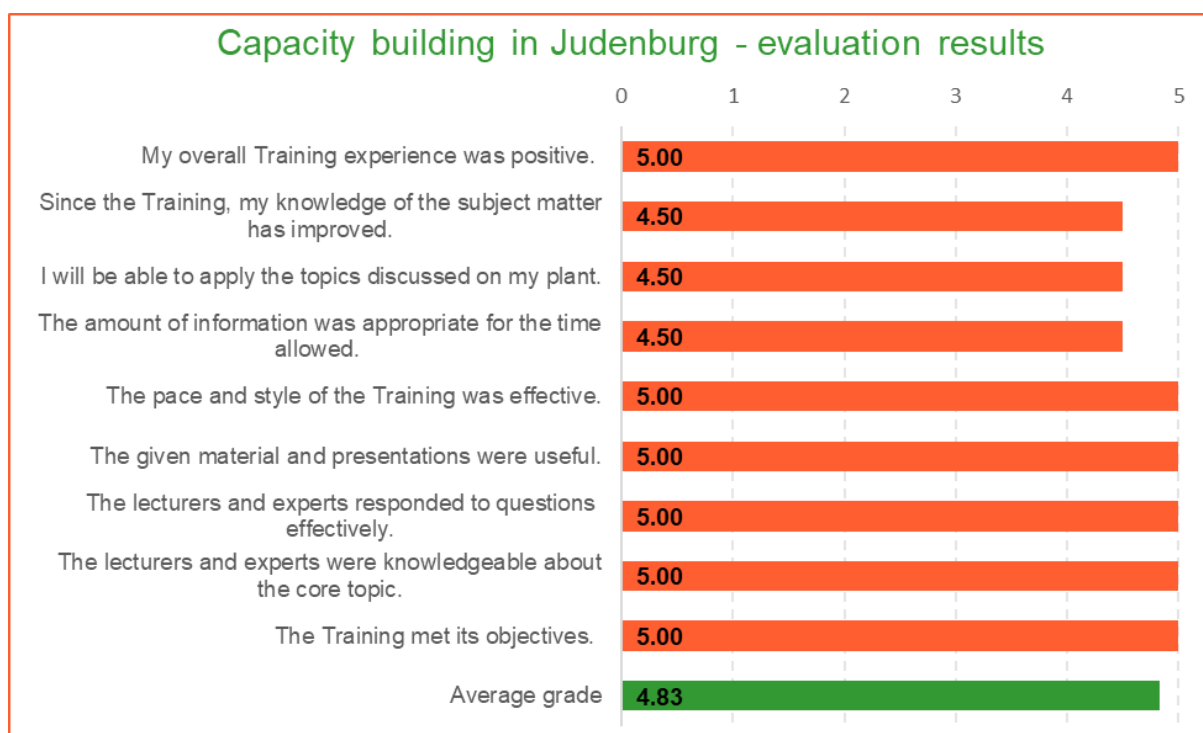


Figure 1. Training evaluation results - Judenburg

In total, three individuals participated in a 5-hour capacity building. The general feedback was excellent. Demonstration of the practical possibilities for the optimisation of network operation was very well received. For the technical staff, it was very helpful to see the lowering of the net return temperature using practical implementation. Likewise, the training for the preparation and further processing of the operating data was very well received and applied in practice. The participants graded all training aspects with 4.5 points or more. The results of the training evaluation questionnaire are given in Figure 1.

Capacity building in St. Barbara im Mürztal

The main goal of capacity building in St. Barbara was to increase the capacity of DHS operators and boiler house operators in biomass use in DH. The training was held in forestry centre of LWK Steiermark. Topics covered were from the utilisation of RES, waste and excess heat and organisational topics group.

The lecturers were employees of LWK Steiermark, Holzforshug Austria (Wood research Austria), Nachwaerme.at and DHS Krieglach. 6 lectures regarding biomass were held with the focus on biomass quality – classification and standards (EN ISO 17225-1, ÖNORM C 4005) and methods for the accurate takeover of the wood chips. Other subtopics ranged from new developments in the biomass sector and use of biomass in DH to experiences from Nahwaerme.at in taking over biomass fuels. To conclude, the capacity building a field trip to DHS Krieglach was organised, where taking over of biomass according to standards was demonstrated.

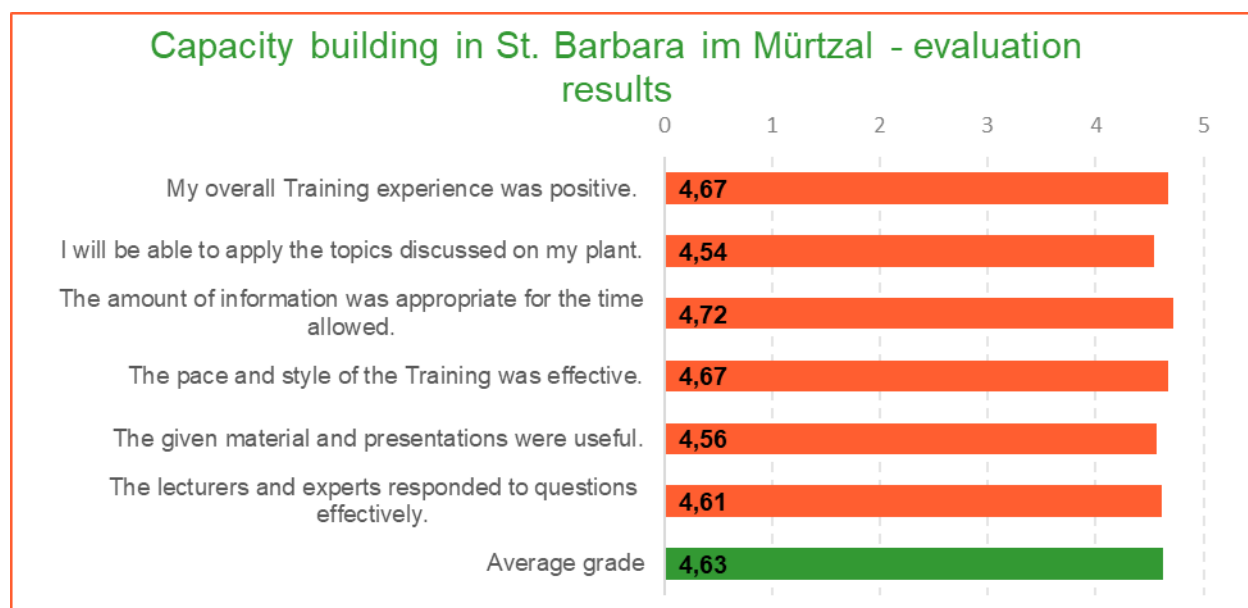


Figure 2. Training evaluation results - St. Barbara im Mürztal

In total, 27 participants benefited from 7.5-hour capacity building. The participants expressed positive feedback, and the overall training experience was graded with 4.67

points. Training duration and working climate received the highest grades (4.72), and the practical application was given relatively the lowest grade of 4.54, which is still excellent. Results of the evaluation questionnaire are given in Figure 2.

Capacity building in Gaishorn, Döllach bei Lassing, Stainach

The goal of the training in Gaishorn, Döllach and Stainach was to have different inputs about current topics and challenges in the DHS and CHP sector, and setting of next support steps to ensure the further production of green electricity and heat based on local wood chips delivered by regional farmers and forest owners. During this capacity building all KeepWarm topic groups, except financing aspects, were addressed.

In this capacity building, individual approach towards three DHSs was used. To guarantee a seamless production of electricity and heat after the expiry of feed-in tariffs, different kinds of solutions were discussed. Within the training, several scenarios for reduction of electricity and increase in heat production were discussed.

Finally, four individuals benefited from 8-hour capacity building. The general feedback was positive, and the exchange between LWK Steiermark and DHS employees was helpful, especially the discussion about solution strategies.

Capacity building in Voitsberg



The Lagerhaus Voitsberg is building a new office and sales building and would like to carry out the heat supply with a biomass plant. It is also planned to connect other commercial customers in the vicinity to the heating network. The training aimed to discuss technical dimensioning of the biomass boilers, the boiler house and the heating network. Furthermore, the objective was to build the capacity of the project manager in an application for funding and implementation of the quality management system.

During the training, many topics were addressed, such as technical dimensioning of boilers and pipelines, quality management – total plant efficiency, requirements for subsidies and project schedule.

One individual benefited from 3.5-hour capacity building. The participant - project manager, was satisfied with the training and further cooperation with LWK Steiermark will probably occur.

Capacity building in Kärnten (Krumpendorf and Klagenfurt)

The goal of the training was to increase the capacity of DHS operators during study visits to two modern biomass DHSs in Kärnten. Furthermore, the focus of the training was put on biomass logistics as well as the use of heat pumps in DHS.

During capacity building, two plants were visited- DHS Krumpendorf and DHS Klagenfurt Ost. During the study visit, guided walk arounds were held, and plant parameters were discussed along with other aspects of the systems. Before and after the visit, discussions on the current state in district heating, framework conditions, subsidies and different technologies were held, and in lectures use of heat pumps in DH was presented.



In total, 12 participants from 7 DHSs participated in 10-hour capacity building. Feedback, in general, was very good. The inclusion of a heat pump into biomass DHS was seen as very interesting, as it is rarely used at the moment. Furthermore, the discussions during the bus drive were also assessed as very positive. Networking and exchange between the different operators were also very helpful. In conclusion, seeing new technologies and best practice examples are very encouraging for the operators of the DHS to start improving their systems.

Good practice example – Krumpendorf DHS

During capacity building in Austria, many site visits were organised to present good practice examples and demonstrate the application of presented and discussed solutions. One of the field trips was organised to Krumpendorf DHS – new and modern biomass DHS. The plant uses several renewable heat sources such as 2 MW biomass boiler, solar thermal, flue gas waste heat and 265 kW heat pump to increase overall efficiency. The system represents modern, energy-efficient DHS and serves as a great example for other DHSs to follow.



Capacity building in Gnas

The main training objective was to have different inputs about current topics and challenges in DHS. Furthermore, the exchange and the networking on a local level between different DHS operators was another objective to be reached in training. From all training topic groups, only managerial issues were not discussed in this training session.

Training started with a guided tour given by the managing director. After the tour, the operating experience was exhibited, and as an introduction for the networking part of the training, the report on new funding opportunities was presented. Furthermore, the participants reported on the current challenges in their heating plants, which helped to facilitate discussion. Some of the more important topics addressed in this training were: current topics and challenges in DH, legal framework, system optimisation, biomass logistics and funding opportunities.

In total, 8 participants benefited from 8.5-hour capacity building, and the overall feedback was very good. The participants see the event in this format as very beneficial. Above all,

the discussion about current topics in this context was very well received. The participants expressed that it would be good to carry out similar training periodically, e.g. every two years.

Capacity building in Heilbrunn



In Heilbrunn, the municipality owns and operates the DHS, but local farmers are also stakeholders. The municipality has to sell their shares, and since the farmers are interested in buying, but have limited knowledge in financing aspects of DHS, training in financing topics was organised. The main training goal was to analyse the current financial situation and train the new operators on how to evaluate their DHS in future. Furthermore, the different options for legal forms and their tax aspects were shown.

After the introduction, practical training using Heilbrunn DHS data was held. During the training, the status quo was analysed, including costs and revenues, investment value, loans etc. Later, key financial indicators were addressed, and the optimisation of revenues and costs was carried out. Finally, legal form and regulations, and their impact on tax calculations were discussed.

In conclusion, 3 participants benefited from 5-hour capacity building. The general feedback on the training was very good. For the new operators, it was very helpful to learn how to evaluate the financial aspects of the operation. Furthermore, the part about the legal forms was very important, as they need a new legal form for the DHS since the municipality is leaving the company.

Capacity building in Salzburg

According to the *Training needs assessment*, there is a need for a basic DHS training course for DHS operators. Therefore, KeepWarm partner, LWK Steiermark cooperated with the biomass DHS association Austria West. Together they elaborated a basic training course for DHS operators. The target group are new operators who do not have plenty of experience. Main topics covered were from technical and RES and waste heat utilisation topic group.



The lecturer presenting in these training sessions were individuals from LWK Steiermark, Holzforschung Austria (Wood research Austria), SEEGEN, ISOplus and Thermocycling company. The goal of this training course was to transfer knowledge to new and inexperienced operators of DHS, to improve their skills and therefore, to improve the long-term performance of their DHSs. In three 2-day training sessions, technical, RES and EE and organisational topics were addressed. The

training was organised as a series of lectures, but practical work with pre-insulated pipes

was also carried out. The focus of the first training session was put on biomass use in DHSs and grid and grid water. The second session focused on hydraulic basics for operating DHS, control settings, electro-technical basics and organisational aspects. During the third training session issues like customer evaluation, customer installations and optimisation, hot water supply, system temperature optimisation, heat gauge and heat transfer stations were discussed.

Finally, many topics were addressed, and some of the most important are listed below:

- use of biomass, biomass take over in compliance with regulations
- EN ISO 17225-1
- grid planning and building, grid water
- safety in DHS boiler house
- control settings for grid, pumps and boiler house
- calculation on heat losses, leakage detection
- technical components in the boiler house
- hydraulic basics of DHS
- organisational qualifications
- electrotechnical basics in DHS
- the heat transfer station, heat gauge, heat meters
- customer evaluation
- customer installations and visualisations
- technical/legal framework on the supply of hot water
- system temperature optimisation

In total, 40 participants from 39 DHSs were included in 49.5-hour capacity building. The general feedback was very good. For the operators, the provided input was very helpful for their operation. During the second day, the training took much longer than planned. Therefore, the participants commented on the training duration. Furthermore, the participants preferred practical lectures and inputs instead of theoretical ones. Training experience was evaluated as very good. The results of the training evaluation questionnaire filled after the first training session are given in Figure 3.

Capacity building in Oberdrauburg

This training aimed to take stock of the biomass heating plant Oberdrauburg in order to be able to show optimisation potential in energy production and network operation.

During this capacity building, trainees visited DHS Oberdrauberg, and many topics important for the improvement of the system were addressed such as operating data, return temperatures, storage tank, replacement of the old boiler and funding options.

Two participants were very satisfied with 5-hour training and the indication of the optimisation potential of their DHS.

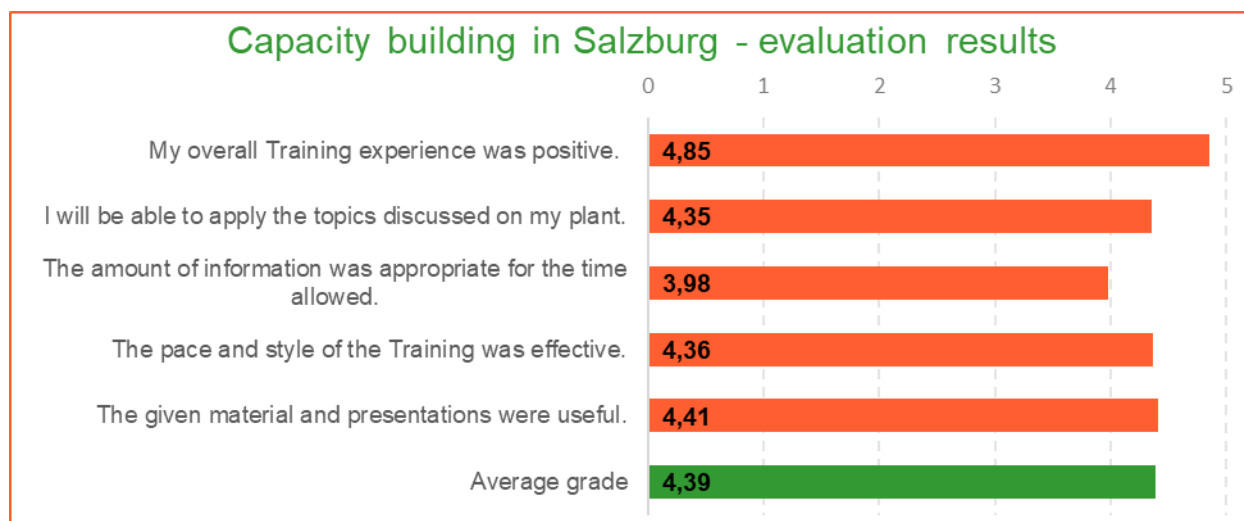


Figure 3. Training evaluation results - Salzburg

Capacity building in Graz

The goal of the training was to present different inputs about improving the performance of DHSs and CHP plants. Furthermore, the objective was to set up a strategy how to address decision-makers on a political level and in the legislation, to ensure the further production of green electricity and heat based on local wood chips delivered by regional farmers and forest owners.

To resume with the production of green electricity and heat, different kind of solutions were discussed during this training. The focus was on expiring feed-in-tariffs and the development of a step-by-step plan, including economic, social and ecological aspects, that they presented to the decision-makers after the training.

In total, 9 participants benefited from 2.75-hour capacity building in Graz. The general feedback was very good, and discussion about the solutions was very helpful, according to DHS operators.

Summary of capacity building in Austria

Table 3 summarises conducted training sessions in Austria. As can be seen, 15 capacity building sessions lasting 130 hours were held, and 166 individuals joined.

The goal of capacity building in Austria was to train at least 30 individuals representing partnering DHS operators. According to *Training needs assessment*, the LWK Steiermark expected the trainees to be able to optimise their own DHS with cost-effective tools, be aware of state-of-the-art technologies and know which modern technologies are available.

The organisation of training went according to previously defined training plan regarding the lecturers, training topics and other training aspects. All training topics considered top priority were covered, and furthermore several other topics, not considered a top priority, were also presented, so it can be concluded that required training topics were successfully covered and the training objective was achieved. Training duration in financing and management topics was reduced because DHS operators expressed the need to learn

more about technical, RES and EE topics and organisational topics. Training organisers acknowledged DHS operators' needs and conducted more training in latter topics on the expense of financial and management topics.

Table 3. List of training sessions in Austria

CAPACITY BUILDING	HOURS	DHS EMPLOYEES	OTHER STAKEHOLDERS	TOTAL INDIVIDUALS
1. Capacity building in Bad Mitterndorf	9	32	3	35
2. Capacity building in Gleinstätten	5.5	13	0	17
3. Capacity building in Steiermarkhof (Graz)	10.5	22	4	37
4. Capacity building in Judenburg	5	2	0	3
5. Capacity building in St. Barbara im Mürztal	7.5	24	1	27
6. Capacity building in Gaishorn	8	3	1	4
7. Capacity building in Voitsberg	3.5	1	0	1
8. Capacity building in Kärnten (Krumpendorf & Klagenfurt)	10.25	6	2	12
9. Capacity building in Gnas	8.5	5	0	8
10. Capacity building in Heilbrunn	5	3	0	3
11. Capacity building in Salzburg Part 1	16.5	36	0	40
12. Capacity building in Oberdrauburg	5	2	0	2
13. Capacity building in Salzburg Part 2	16.5	0	0	40
14. Capacity building in Graz	2.75	6	0	9
15. Capacity building in Salzburg Part 3	16.5	0	0	40
Total	130	155	11	166

The total number of individuals participating in training equalled 166, 155 of which are employees of more than 40 DHS operators and 11 of which are external stakeholders. The organisers in Austria achieved excellent results in training attendance since the number of participants exceeded the goal of 30 individuals more than five times. The summary of the training duration and the number of participants is shown in Table 4.

General feedback towards capacity building was positive, and the participants were satisfied with almost all training aspects, which are supported by high grades given through training evaluation questionnaires. The only negative comments were given for training duration since it is difficult to stay focused during whole-day training sessions. Training in large groups and individual approach both presented with a lot of positive and some

negative aspects, but in general, both approaches proved to be very effective for achieving training objectives.

Table 4. Summary of capacity building in Austria

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	130/100	155/30	11	166

In conclusion, capacity development in Austria achieved the objectives regarding the content, the number of participants and their ability to apply the gained knowledge. The feedback from the participants was very positive, and improvements in their systems are expected.

2. Croatia

Capacity building of DHS operator HEP Toplinarstvo was organised by North-West Croatia Regional Energy Agency (REGEA) with help from UNIZAG FSB. Although the capacity building was planned to be organised from September till the end of April, the training was postponed due to heating season and was held from January 21st till May 14th, 2019.

According to the initial feedback from DHS operator, preferred training options were two-hour slots, but in further discussion with the operator time management plan was changed. The main reason for the change was the employees' unavailability due to the heating season. The timing of the training sessions was carefully planned in cooperation with the DHS operator to increase the number of beneficiaries. Most of the training was organised in blocks; 4 – 5 hours per day, 2 – 3 days in a row depending on the topic. Furthermore, the two-day workshop and two field trips were held as a part of capacity building.

Most of the training consisted of lectures - presentations with an introduction to the topic, theoretical background and application of acquired knowledge on practical examples – existing feasibility studies, good practice examples etc. Presenters mostly used PowerPoint presentations and printed materials. Furthermore, the trainers used videos on several occasions. During and after the presentations, organisers encouraged trainees to participate in a discussion to achieve two-way communication with the lecturers. The main purpose of this type of training was to increase capacity in specific topics using tailor-made training according to the DHS operators' needs and requests.

The second type of training were study visits. During capacity building, two individual site visits were organised – one visit to first Croatian biomass powered district heating system in Pokupsko and the other to Graz – S.O.L.I.D. company and their solar thermal installations in the city. The purpose of this type of training was to present good practice examples, discuss all relevant topics, present general experience from projects and enrich the knowledge acquired in previous training. During the field trips, short introductory presentations were held, and the emphasis was on the practical part of the systems and discussion with piers from plants and S.O.L.I.D. company representatives.

The third type of training was a two-day workshop held at the UNIZAG FSB which was organised as a sequence of presentations with a short window for discussion after each presentation and a panel, in which experts from different backgrounds discussed the future of DHSs and answered the participants' questions ranging from technical to managerial topics. The main purpose of the workshop was to raise awareness of district heating and present solutions for modernisation of DHS and implementation of RES. This type of training was meant to present district heating in a bigger picture, and the target group were not only the employees of DHS operator but members of academia, industry, policymakers, public, etc., which are also relevant for the modernisation of DHSs.

For the majority of the training on technical topics, renewable energy sources and energy efficiency, the lecturers were university professors from UNIZAG FSB – experts in their respective field. Training on financial and managerial concerns was mostly held by experts from North-West Croatia Energy Agency with a background in projects in energy efficiency,

heating, renewable energy sources, projects funded with national or European funds, etc. During the field trips, presenters were major of Pokupsko municipality, technical personnel, S.O.L.I.D company representatives and engineers. The structure of presenters for the workshop held in UNIZAG FSB was very broad as they were from academia, industry, energy agency, local government, etc.

Training participants were employees of HEP Toplinarstvo from Zagreb and Sisak, in charge of systems in Zagreb, Sisak, Velika Gorica, Samobor and Zapresic. Besides from DHS operators, employees of UNIZAG FSB and REGEA were also present in trainings. Furthermore, during the two-day workshop held at UNIZAG FSB many other interested stakeholders, both from Croatia and abroad, participated in capacity building, such as members of academia, representatives of local government, NGOs, private companies, etc.

Capacity building in technical topics

Capacity building in technical topics was organised in Zagreb, Graz and Pokupsko. Training in the form of lectures was organised in Zagreb, and field trips were organised to Pokupsko and Graz. Training in technical topics in Croatia consisted of 3 training blocks in specific subtopics, and additionally, fifty per cent of the two field trips were dedicated to technical topics, and two-day workshop at the Faculty of Mechanical Engineering and Naval Architecture was partially dedicated to technical topics.

Training highlight – discussion with relevant stakeholders



A two-day workshop on Data intelligent operation of DHS was closed with a panel on the future of DHS. The focus of the panel was on the transition from existing to smart, 4th generation, DHSs and its role in smart energy systems of the future. The panellists are experts in fields of energy management and district heating from academia, energy agency and companies in the energy sector. Panellists discussed several aspects of DHS modernisation, legislation, current situation, etc. Most important of all, participants could sense optimism on DHS modernisation in Croatia and hear about good practise examples from Scandinavia. The participants had a positive opinion on this way of training and complemented concrete problem identification and solutions proposed by the panellists. During capacity building in many topics in partnering countries, the participants complimented the possibility to express their thoughts and to be involved in the discussion, so it can be concluded that including time dedicated to the discussion in training is an excellent method for successful capacity building.

The objective of the lectures was to increase the capacity of target groups, namely DHS operator in Croatia (HEP Toplinarstvo) on technical optimisation of existing DH systems,

CHP plants and internal heat distribution systems in buildings. The goal of the workshop was to present possibilities for utilisation of modern equipment in DH, and the main goal of the field trips was to demonstrate the practical use of acquired knowledge and present commercial solutions.

The lecturers were mostly university professors, employees of Pokupsko DHS, S.O.L.I.D. company employees, employees of other companies in district heating and members of academia. Training participants were engineers and technical staff in charge of DHS operation, maintenance and retrofit.



During the lectures, many technical topics were covered with a focus on energy renovation of buildings, heat storage and hydraulic pipeline calculations. Furthermore, during the workshop, the general picture on district heating was presented.

Training evaluation

As already mentioned, training consisted of tailor-made training sessions on technical topics, two field trips and one workshop where both technical topics and RES and EE topics were covered. Training in technical topics lasted for 33 hours.

In total, 101 individuals benefited from the training, 24 employees of DHS operator and 77 participants from other entities such as scientific institutions, NGO-s, local government representatives, company representatives and other interested parties. Summary of capacity building in technical topics is presented in Table 5 below.

Table 5. Summary of capacity building in technical topics in Croatia

TECHNICAL TOPICS	TRAINING HOURS	DHS EMPLOYEES	OTHER STAKEHOLDERS	TOTAL INDIVIDUALS
1. Training in energy renovation of buildings	7	17	3	20
2. Training in heat storage and system optimisation	5	11	2	13
3. Training in pipelines and heat losses	8	10	6	16
4. Study visit Pokupsko	3	10	2	12
5. Study visit Graz	3	15	2	17
6. UNIZAG FSB Workshop	7	7	73	88
Total	33	24	77	101

Based on 13 evaluation questionnaires, the trainees expressed general satisfaction with the training organisation, content and information provided in presentations and discussions. They stated that their capacity had been built in a reasonable time through interesting presentations and excellent good practice examples. The average training grade equalled 4.32, ranging from 3.85 to 4.78. Furthermore, they showed interest in further cooperation with the presenters and emphasised the following positive training aspects:

- presenters with exceptional expertise
- opportunity for discussion and two-way communication with the presenters
- training on energy renovation of buildings and the influence on DHS

The trainees also stated that some training aspects could be improved, so they proposed to increase the portion of practical content and organise more study visits. The results of the training evaluation questionnaire are given in Figure 4.

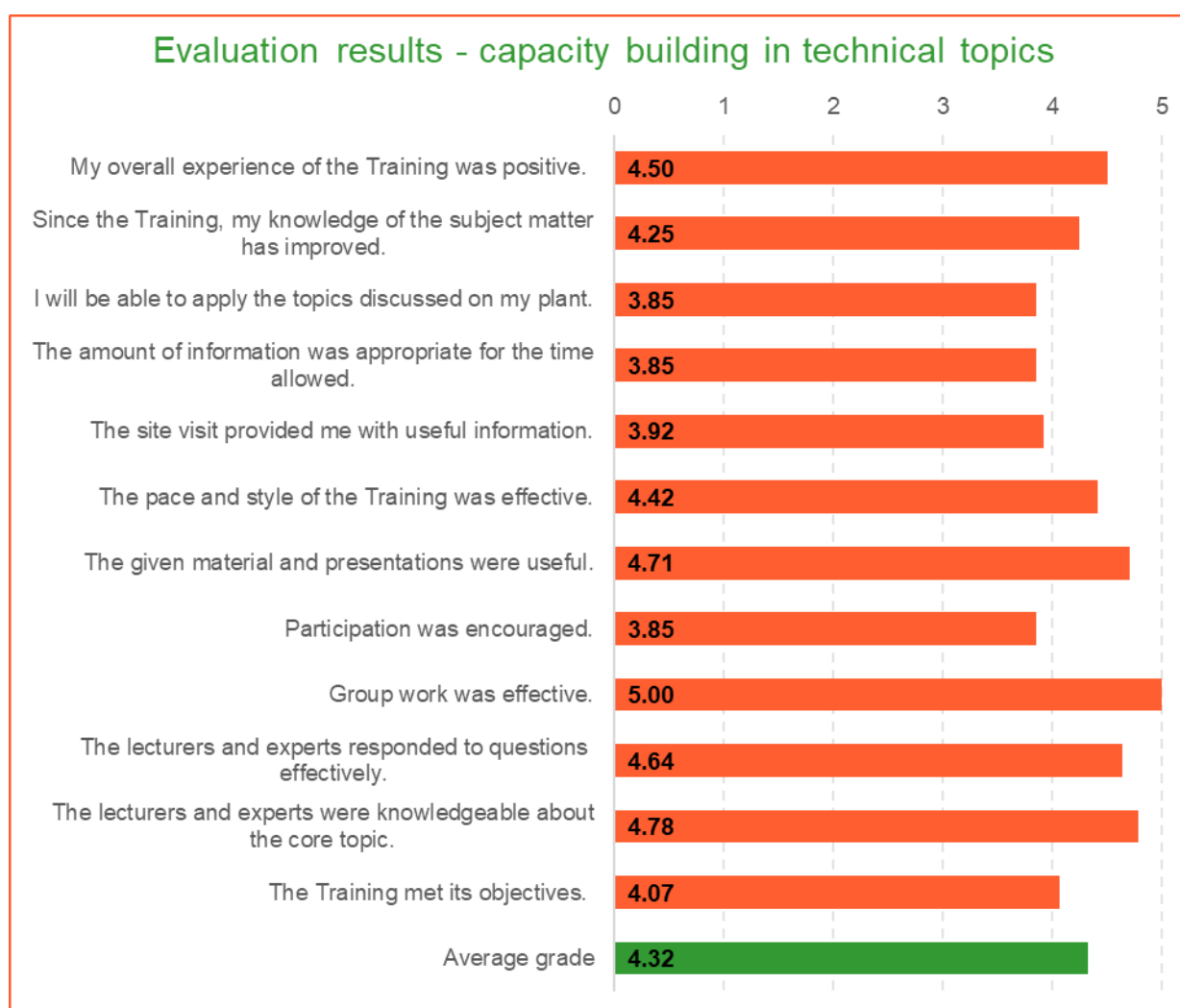


Figure 4. Evaluation results of capacity building in technical topics in Croatia

Regarding the workshop, participants also expressed a positive opinion and stated that the workshop was very informative and interesting. They complimented the panel and panellists for an excellent discussion, concrete problem identification and proposed solutions. The opportunity for discussion and networking with government representatives, DHS operator employees, domestic and international experts, academia etc. was also complimented. Several attendants complained about the duration and the quantity of information presented in a short time.



Capacity building in RES and EE

Capacity building in renewable energy sources and energy efficiency was organised in Zagreb and consisted of several training sessions. The topic of solar thermal was covered in three training blocks (4-5 hours per block) and during the field trip to Graz. Integration of biomass was covered during the field trip to Pokupsko and the UNIZAG FSB workshop. To summarise, capacity building in RES and EE topics consisted of lectures, workshop and field trips.

Good practice example – biomass powered DHS in Pokupsko

During capacity building in Technical and RES and EE topics in Croatia, a field trip to Pokupsko biomass-powered DHS was organised to present the system using 100% renewable energy. The 1 MW biomass-powered boiler produces heat energy for 15 customers, most public buildings and a couple of private households and businesses which are connected via 2.8 km long network. At the moment, the plant is only Croatian DHS running on 100% renewable energy and the experiences gained in this project present valuable resource for potential projects in the integration of RES in DHSs.



The main training objective was to increase the capacity of DHS operator in the utilisation of renewable energy sources to reduce fossil fuel consumption and CO₂ emissions from DHSs and to improve the financial situation of the DHS operator. The focus was on solar thermal systems combined with storage and biomass boilers.

The lectures on training sessions were university professors. During field trips, the presenters were S.O.L.I.D. company representatives and Pokupsko DHS employees, and in the workshop, presenters were employees of other companies involved in the DH sector and members of academia. Participants were mostly engineers in charge of the operation,

maintenance and retrofit of DHSs operated by HEP Toplinarstvo.



To increase the capacity of DHS operator, detailed presentations on solar thermal were held, ranging from theoretical background to real-life examples from Denmark. Some of the presented aspects of solar thermal were: solar technology in general, solar thermal design and heat production calculations, good practice examples from Denmark and Austria and integration of solar thermal in Zapresic – a feasibility study. During the field trip to Graz, the

practical operation of solar DH was presented, and system parameters were discussed to present the successful integration of solar technology into operating DHSs.

Training evaluation

Training in RES and EE was organised in 3 blocks of 4-5 hours per day, and as a part of field trips and workshop - 25 hours in total. 14 DHS employees and 73 representatives from academia, local government and other interested stakeholders were involved in capacity building. The summary of training in RES and EE topics is given in Table 6.

Table 6. Summary of capacity building in RES and EE topics in Croatia

RES AND EE TOPICS	TRAINING HOURS	DHS EMPLOYEES	OTHER STAKEHOLDERS	TOTAL INDIVIDUALS
1. Training in RES – solar thermal	10	9	4	13
2. Study visit Pokupsko	5	10	2	12
3. Study visit Graz	4	15	2	17
4. UNIZAG FSB Workshop	6	7	73	88
Total	25	14	73	87

The participants in training evaluation questionnaires stated that their capacity had been built in a reasonable amount of time, and they recognised a great effort from the presenters in engaging a discussion. Since some of the training in RES and EE topics overlapped with training in technical topics, both were evaluated with the same training evaluation questionnaires, so the results of the training evaluation correspond to the results given in Figure 4. Evaluation results of capacity building in technical topics in Croatia for the training in technical topics.

Capacity building in organisational topics

Although the North-West Croatia Regional Energy Agency (REGEA) and UNIZAG FSB had an intention to conduct capacity building in organisational concerns after discussion with DHS operator HEP Toplinarstvo the training hours were allocated to other topics, mostly technical, which were considered top priority according to HEP Toplinarstvo.

The main reason is the fact that HEP Toplinarstvo is part of HEP Group, which is completely owned by the Republic of Croatia. Apart from HEP Toplinarstvo, the HEP Group oversees numerous activities in the Croatian Energy Sector – electricity/heat production and distribution, natural gas production and distribution, energy services (ESCO), operation of nuclear power plant Krsko, etc.). In a situation like this, where there is a vertical chain of command, HEP Toplinarstvo, as a subsidiary company, has almost no influence on decision making and the organisational structure of HEP Group. In other words, any training conducted on organisational concerns would have not any effect since KeepWarm partners could not organise it for members of HEP Group who are the major stakeholders and decision-makers when it comes to the organisation of the company, management of the organization, etc. REGEA and UNIZAG FSB are solely focused on the HEP Toplinarstvo as a partner in the pilot project and communicate only with its management board and directors.

Capacity building in financing topics

Capacity building in financing topics for business support staff was organised in Zagreb in HEP Toplinarstvo Ltd, Misevacka 15a. Two training blocks were dedicated to financial topics exclusively, and during several other training sessions, financial aspects of different solutions and technologies were presented and discussed.

The main training objective was to increase the capacity of DHS operator in financial issues and financial analysis with a focus on the economic and financial viability of RES, value chains and contractual agreements needed for smooth retrofit, innovative financing and economic/financial viability analyses.

The lecturer for a specific financial training was REGEA employee specialised in financing topics and in other training sessions the lecturers were members of academia and company employees. The participants were DHS operator employees in charge of business support.

During capacity building in financing topics, basics on economic/financial analysis were presented, followed with evaluation criteria and examples of feasibility studies, risk assessment and yearly financial reports. Furthermore, a draft version of a feasibility study for the city of Samobor was presented, which enabled the participants to see the feasibility study on the integration of RES in their system and comment the input data and the results.

Training evaluation

21-hour capacity building in financial topics increased the capacity of 15 DHS employees and five external stakeholders. Training in financial topics was combined with other

training, and a special training session in financial topics was organised. Financial training summary is shown in Table 7.

Table 7. Summary of capacity building in financing topics in Croatia

FINANCING TOPICS	TRAINING HOURS	DHS EMPLOYEES	OTHER STAKEHOLDERS	TOTAL INDIVIDUALS
1. Training in RES – solar thermal	4	9	4	13
2. Training in heat storage and system optimisation	1	11	2	13
3. Field trip Pokupsko	2	10	2	12
4. Field trip Graz	2	15	2	17
5. Training in financing topics	12	7	4	11
Total	21	15	5	20

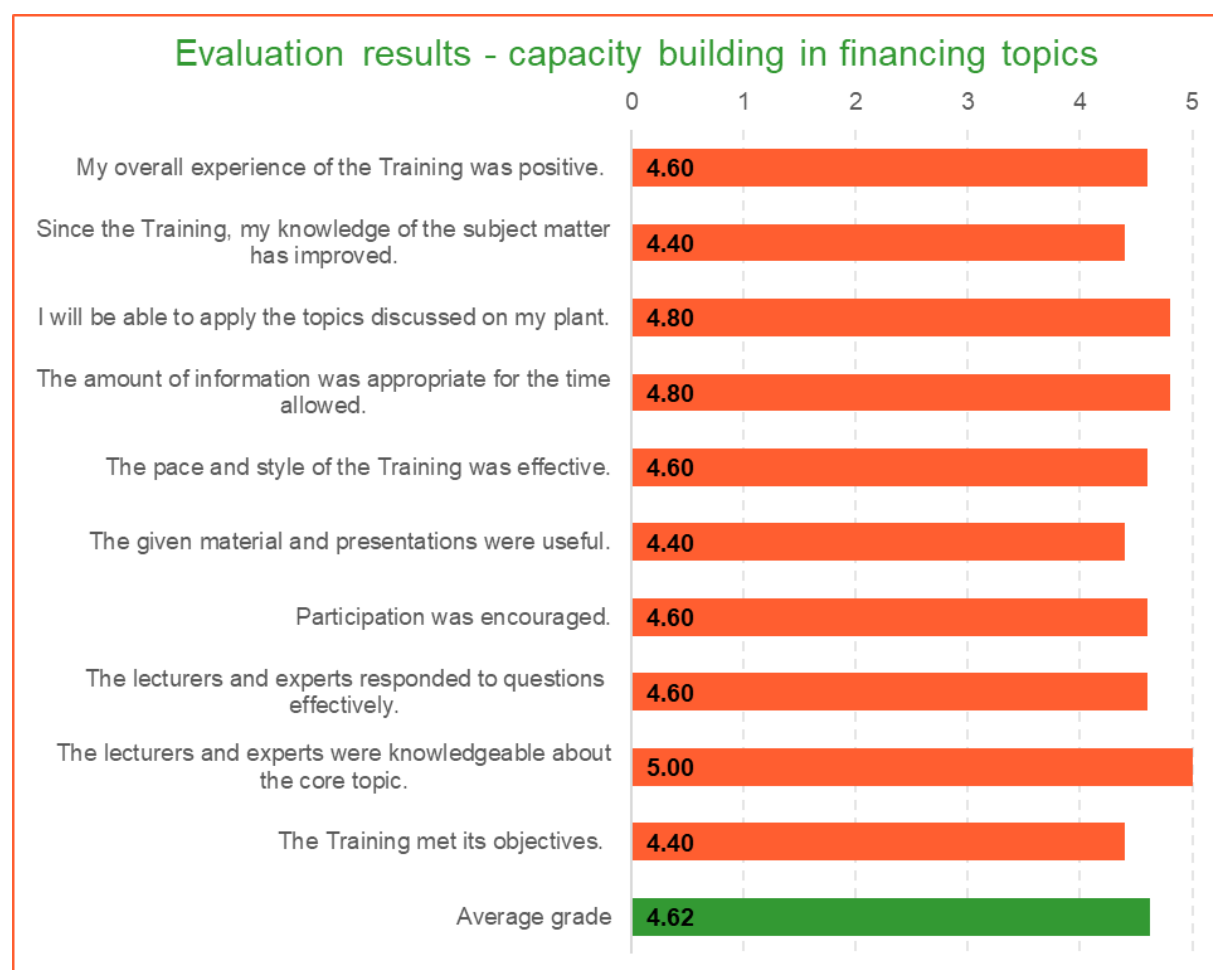


Figure 5. Evaluation results of capacity building in financing topics in Croatia

Based on five evaluation questionnaires, the participants provided positive feedback. They described the lecturer as an expert with adequate presenting style and tempo, expressed satisfaction with the amount of information given throughout presentations and liked the discussion. Furthermore, they proposed the organisation of group work, which would enable them to apply the gained knowledge immediately. Results of the training evaluation are given in Figure 5.

In conclusion, capacity building in financing topics achieved defined objectives, and the participants will be able to use gained knowledge to improve their DHS.

Capacity building in management topics

Capacity building in management topics was held in Zagreb and consisted of four 3-hour blocks, and during a couple of other training, the focus was partially put on management aspects. The training was suited for the managerial staff of DHS operator.

The focus of capacity building in management topics was on public relations, so main training objective was to improve the communication with the wider public, to train the personnel in public relations and to present the importance of communication strategy. Furthermore, during capacity building other management topics such as individual billing and retrofitting DH networks were also addressed. The content was presented by PR expert employed in REGEA and the participants were employees involved in communication with customers.



Training evaluation

Capacity building in management topics reached 15 DHS operators and two external stakeholders. The training was very well accepted, and the participants orally expressed satisfaction with the contents, group work and the lecturers' expertise and presenting style. Numerical grades for various training aspects varied between 4.5 and 5.0, which means all training aspects received excellent grades. Results of the training evaluation questionnaire are given in Figure 6. Furthermore, Table 8 contains a summary of training in management topics which consisted of a training session in management topics and time dedicated to management topics during capacity building in another topics group.

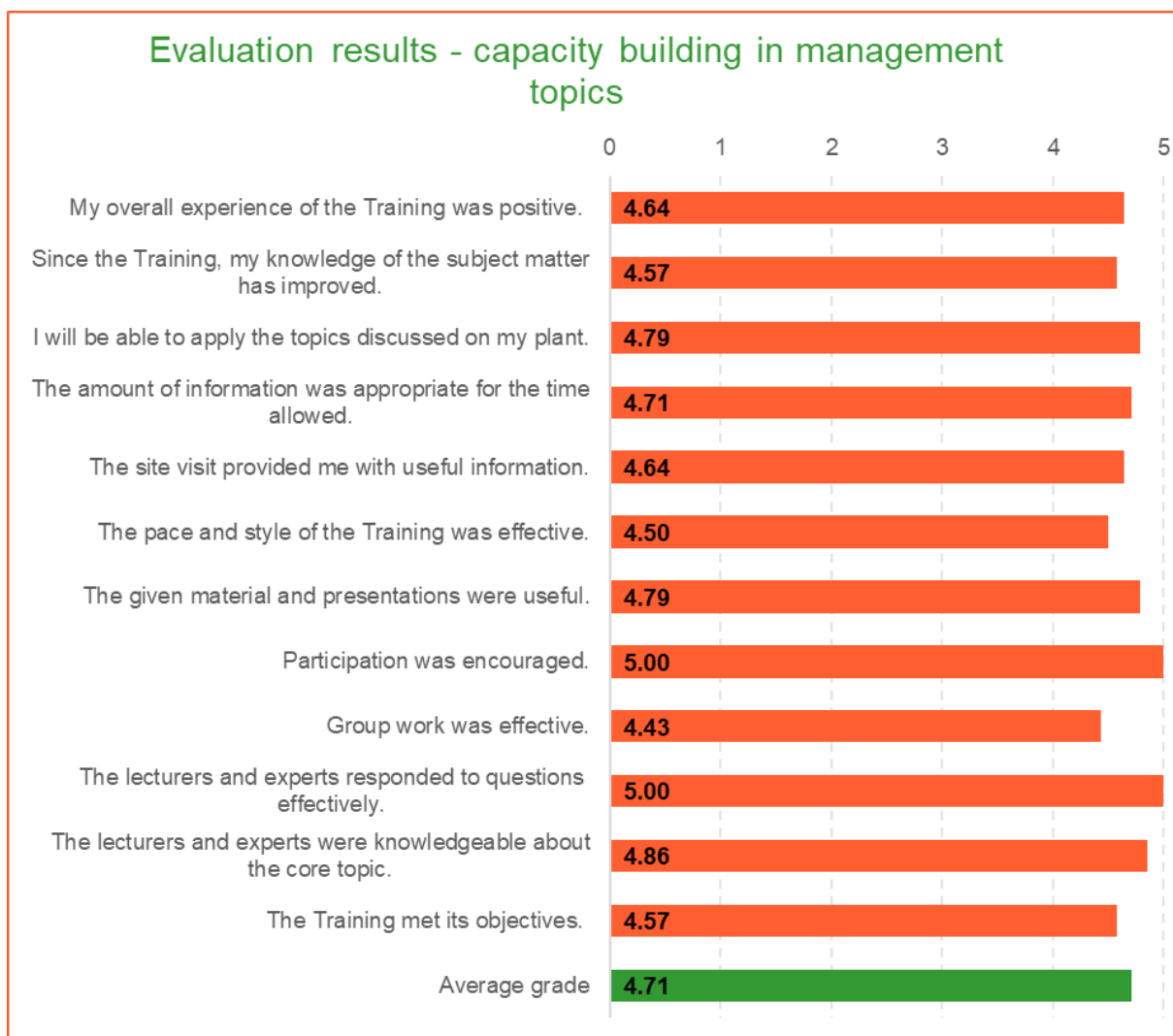


Figure 6. Evaluation results of capacity building in management topics in Croatia

Table 8. Summary of capacity building in management topics in Croatia

MANAGEMENT TOPICS	TRAINING HOURS	DHS EMPLOYEES	OTHER STAKEHOLDERS	TOTAL INDIVIDUALS
1. Training in energy renovation of buildings	1	9	4	13
2. Training in pipelines and heat losses	4	10	2	12
3. Training in management topics	16	15	2	17
4. Field trip Pokupsko	1	10	2	12
5. Field trip Graz	1	15	2	17
Total	23	15	2	17

Summary of capacity building in Croatia

The main objective in Croatia was to increase the capacity of at least 20 individuals representing one district heating system operator – HEP Toplinarstvo. Based on *Training needs assessment* DHS operator would like to have better trained and more educated employees on the topics of inclusion of RES and the ability to implement learned optimisation techniques in the existing DHSs. Furthermore, they would like to improve their approach towards existing and new customers, effectively promote district heating and be able to develop business plans.

In total, 104 hours of training were held in four topics defined within KeepWarm project. In Croatia, training in organisation topics was not held and time was redistributed to other topics, mostly technical, which were considered the most important according to the DHS operator. All subtopics considered top priority from other four thematic areas, and several other important topics were covered during capacity building.

A total number of participants in Croatia equalled 120, 39 DHS employees and 81 other interested stakeholders such as members of academia, HEP group, NGOs, consulting companies, private companies in the energy sector etc. The objective of 20 individuals employed in DHS was exceeded almost two times, and the number of external stakeholders benefiting from the capacity building was rather high. The structure of the participants and the duration of capacity building in five key KeepWarm topics are presented in Table 9.

Feedback from the participants was, in general, very positive, and they were satisfied with capacity building. They complimented several training aspects and even proposed improvements to increase training efficiency, such as increasing the share of practical content and study visits. Additionally, and most important of all, they recognised the opportunity to practically apply the knowledge gained during capacity building, especially in areas such as the introduction of RES and preparation of the business plan. In conclusion, capacity building in Croatia was successful, and training participants will be able to apply gained knowledge to improve the energy efficiency of their systems and work on the inclusion of RES.

Table 9. Summary of capacity building in Croatia

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	104/100	39/20	81	120

3. Czech Republic

TSCR organised capacity building in the Czech Republic with help from university specialists and experts from energy companies and institutions. The training was organised in the period between 12th of September 2018 and 30th of May 2019. Main capacity building objective was to increase knowledge of DHS operators in innovative technologies, financial mechanisms, organisational arrangements, managerial procedures, adopting new ways of approaches for employees of heating plants and improving the communication with customers. Furthermore, the additional objective was concluding the discussion between DHS operators and other relevant stakeholders and finding solutions for problems DHS operators are facing.

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. The training was separated into 13 training sessions in which the number of participants and training duration varied. Several KeepWarm topic groups were usually addressed in one training session, but in some sessions, training was concentrated on a single topic group.

The lecturers were employees of TSCR, ministry representatives, members of academia and experts from energy companies and other relevant institutions. The participants were mostly employees of DHS companies, but several external stakeholders such as local and regional public authorities, members of academia, technical planners and DHS lobbying groups were also included in capacity building.

Since many training sessions in the Czech Republic usually addressed more than one KeepWarm topic group, all sessions are shortly described in the following paragraphs and training topics are summarised in the end.

1st Capacity building in Prague

The main objective of capacity building in Prague was to encourage participants to think about possibilities of improving the operation of district heating sources in technical and environmental aspects by familiarising them with new technologies, procedures, in DHSs.

The training was mostly focused on technical topics group, so topics such as electric boilers, energy losses, system temperature optimisation and district cooling were covered. Furthermore, topics like national legislation on RES, heat price regulation and cooperation with municipalities, from RES and EE, organisational and financing topic group were also addressed. 2-day training began with a general introduction of the KeepWarm project, and legislation in the heating industry continued with detailed lectures in specific areas in technical topics and ended with a discussion between the participants and lecturers from Brno University.

In total, 42 individuals from 23 DHSs and two external stakeholders participated in 14-hour capacity building in Prague. Based on the training evaluation form, which was completed by 50% of the participants, the feedback was positive, and it confirmed that the training was useful for them. The most useful aspects, according to the participants, were energy

legislation in Europe and the Czech Republic and lecture Turbines and Motors in Heat Industry. Other topics considered interesting were waste to energy technologies and new developments in heat exchangers. In this capacity building, the participants missed financing topics such as return on investment and financial analysis.

2nd Capacity building in Prague

Second capacity building in Prague aimed to familiarise the participants with the current situation in the EU climate and energy policy and legislation, to introduce the development of factors affecting the competitiveness of the heating industry and the EU ETS. Additionally, the objective was to explain how to include the cost of allowances in the price of heat energy and create motivation for investing in RES.

In this training, RES and EE, financial and managerial topics were addressed. Generally, the training consisted of two parts, development of emission allowance market and investment support in the heating industry. Topics like national legislation on renewable energy, heat price formation and regulation, financial support schemes, funding resources, and suitable pricing models were presented by representatives from Ministry of Environment, risk management company and TSCR. In this training, the focus was on the market situation, risk management and factor influencing the competitiveness of DHSs.

In total, 25 participants from 23 DHS, and one external stakeholder were included in 4-hour capacity building. 50% of the participants filled training evaluation forms in which 90% of them provided positive feedback and confirmed they would be able to use gained knowledge in the upcoming investment projects for system modernisation and renovation. According to the participants' feedback, most interesting topics of this capacity building were steps for maintaining highly efficient energy production and distribution in DHSs, free allocation of emission allowances in 4th training period and market situation with EUA and risk management.

Capacity building in Plzeň

The training aimed to familiarise participants with the content of the RES Directive, the Energy Efficiency Directive and the Directive on the energy performance of buildings, their interconnections and the impact on DHSs.

In this capacity building, a combination of lectures and study visit was used to address technical, RES and EE and organisational topics. During this lecture, the representative from the Ministry of Industry and Trade covered topics such as current share of renewables in the heating and cooling sector, principles of creating a climate-energy plan, and target setting for the Czech Republic. Furthermore, basic information on the draft of the Energy Union Governance Regulation was provided. Later, lectures on Renewable Energy Directive, support of RES, the stability of financial support, administrative procedures and regulation, energy performance of the building and many others were held by representatives of TSCR. Besides lectures, a study visit to Plzeň heating plant was organised, in which the participants saw the sources and discussed the cooling system used in Plzeň brewery.

Finally, 22 participants from 18 DHSs were included in 10-hour capacity building. 60% of the participants completed the training evaluation form and expressed satisfaction with training content and the lecturers. They stated their capacity had been increased and the training will enable them to orientate themselves in European legislation. To improve future training, the participants suggested leaving more time for discussion.

Capacity building in Pardubice

Capacity building in Pardubice aimed to provide information on the legislative conditions in the district heating sector in the Czech Republic for 2019 and organise an event in which networking with representatives from Ministry of Industry and Trade, Energy Regulation Office, and Ministry of Environment will take place.

The training focused on business conditions in the DH sector. Many relevant documents were addressed and explained such as Energy Management act, Clean Energy Legislative Package for All Europeans, Energy Union Governance Regulation, RES Directive, Energy Efficiency Directive, Amendment to the Act on Supported Energy Sources by Ministry and TSCR representatives. Furthermore, basic principles for the regulation of thermal energy prices, the current situation in emission allowance and some others were covered in this capacity building session. The interesting lecture was held on the results of the case claiming compensation for damage to the forest stands caused by SO₂ and NO_x emissions.

58 participants from 44 DHSs and one external stakeholder benefited from 5-hour capacity building in Pardubice. Their structure was diverse since many training topics were covered. 50% of the participants filled training evaluation forms, and the feedback was positive. The participants stated they would be able to use gained knowledge in their work and recognised the lecture on the case claiming compensation as very interesting and concrete.

Capacity building in Blovice

The objective of capacity building in Blovice was to present current trends in resource recovery, and in particular, to point out the needs to analyse the operation of heat distribution systems to reduce losses and ensure streamlining of the operations.

The training consisted of lectures and field trips to DHS Přestice and biogas station Kladruby in which technical and RES and EE topics were addressed. The training was focused on energy savings in DHS. For the introduction, European and Czech regulation was presented, and the training resumed with technical and RES and EE topics such as trends in energy saving, installation of small decentralised systems, analysis of system operation, new trends in simulation and control of medium and large DHSs, new SW applications etc.

In total, 17 participants benefited from 5.5-hour capacity building in Blovice. Most of the participants work either in a technical or managerial position. More than 80% of the participants provided feedback, which was positive, and in which they stated that training was very useful. They emphasised the following topics as very interesting:

- Current trends in DH industry with impacts on DHS operation

- Application for heating control

The participants lacked lecture on waste heat and panel discussion.

Capacity building in Humpolec

The goal of capacity building in Humpolec was to acquaint the participants with the topic of customer care, customer behaviour, PR activities towards new and existing customers and cooperation with municipalities and to discuss specific experiences with activities against customer disconnection.



The focus on this training was put on managerial topics such as PR, assessment of user behaviour and models of investment cost-sharing when connecting new customers. During the training, many topics such as PR activities, promoting company reputation, PR strategy, support for regional activities, arguments against customer disconnection and many others were presented by representatives from TSCR, Veolia Energi CR and DHS Pilsen. Besides lectures, a study visit to a biomass processing plant was organised, where the participants could see and discuss biomass processing on a real-life example.

Good practice example – biomass heating plant IROMEZ

An interesting part of the training was also a site visit to the biomass heating plant IROMEZ, which ranked among the five best heating projects of the year, which were successfully implemented in the Czech Republic in 2017. IROMEZ was awarded for a unique partnership project between the heating plant, customers and the town of Pelhřimov. The heating plant significantly changed its business policy and based it on the concept of reciprocity, i.e. cooperation within balanced and long-term relationships. The implementation of the project confirmed that long-term partnership makes sense and brings mutual benefits for all stakeholders. By entering the loyalty program of the heating plant, the average Pelhřimov household for 2017 saved almost EUR 80 a year thanks to a long-term contract. The long-term partnership created the basic prerequisite for the company's technical and economic development and enabled investment projects to be launched, in particular, the reconstruction of the primary part of the network and the transition from the steam to the hot-water pipeline. The greening of operations was also completed. Through the support of Pelhřimov city, it was possible to preserve the district heating system, which ensures an environmentally friendly way of heating and increased standard of living for the citizens.



In total, 18 individuals from 17 DHSs benefited from 7-hour capacity building in managerial topics. 90% of the participants evaluated the training using training evaluation forms and concluded that training was useful for their work. They recognised several interesting and useful lectures such as PR strategy – loyalty programme, Marketing and PR in Customer Care and new customer responsibilities resulting from the revision of the Energy Efficiency Directive. Furthermore, the participants appreciated and complimented the joint discussion on activities against customer disconnecting. In conclusion, the participants consider capacity building very beneficial and suggest continuing with training because it helps them solve problems, get new ideas and examples for future work with customers.

3rd Capacity building in Prague

The training aimed to inform participants about the processes for obtaining permits for energy constructions in connection with the latest amendment to the Building Act. The training introduced Act on Acceleration of Construction and Processes of expropriation in practice.



During this capacity building, managerial and organisational topics were addressed. Main training topic was the authorisation of the process for the construction and reconstruction of DHSs and their facilities. Many topics such as identification of measures for increasing attractiveness of DHS for end-consumers in close interaction with end-consumers and public authorities, assessment of user behaviour and building code/regulations, environmental requirements and cooperation with local/regional authorities in planning, preparation and implementing DHS network refurbishment were covered.

In total, 12 participants from 6 different DHSs and one external stakeholder were included in 8-hour capacity building. Two-thirds were legal specialists, and others work in business or managerial positions. 70% of them submitted training evaluation forms in which they expressed that training was useful and that they will be able to apply acquired knowledge in practice. The most interesting training topic was the process of expropriation in practice with focus on the DH sector.

4th capacity building in Prague

The seminar aimed to acquaint the participants with new trends in the field of heating systems management, with the new application Dymos, and to show practical examples of heat network calculations and modelling of hydraulic conditions in the heating system.

The focus of this training was on modern trends in calculations and modelling of heating networks. During the training preparation and creation of thermal network model, topological model, parametrisation and calibration were shown.

In total, 24 participants from 14 DHSs benefited from 8-hour capacity development. Around 75% of the participants filled the training evaluation form. They confirmed that the training

was useful and appreciated the opportunity to familiarise with new trends in the field and discuss and compare their working procedures.

Training highlight – software training

4th capacity building session in Prague was focused on modern trends in calculation and modelling of networks since software solutions represent a valuable tool for the reduction of energy losses and improving the performance of DHSs. After the introduction in thermal networks, topological models, parametrisation and calibration, examples of solved networks were presented. In the next part, DYMOS – a new generation system was introduced. Examples of 5-day prediction of the behaviour of Prague DHS network, including the display of pressure diagram, display of lines and working areas were presented. In the end, the participants complimented the practical demonstration and evaluated the lecture as one of the most interesting.



Capacity building in Třebíč

The training aimed to acquaint the participants with the current possibilities of using RES in the Czech Republic presenting the future development of renewable energy potential, the economics of renewable energy heat production and possible solutions for waste heat utilisation and energy recovery.

The main focus of the training was on the current situation and possibilities for RES integration. During the training, many interesting topics were addressed such as sustainable use of biomass, use of biofuels in DHSs, use of municipal waste, potential and utilisation of waste heat from the industry etc.



In general, the participants were satisfied with the training and provided positive feedback. Practical experience with biomass combustion and waste to energy technologies were recognised as the most interesting presentations. Furthermore, the overview of development in related legislation was considered very beneficial.

5th capacity building in Prague

Capacity building aimed to provide participants with updates on issues related to the free allocation of emission allowances and to report on new emission limits and related obligations in the heating sector.



The training focused on EU ETS issues, waste management and environmental protection. During the lectures, many legislative documents regarding EU ETS, alongside with technical requirements and best available technologies in waste incineration were discussed.

The participants provided positive feedback and confirmed that the training was very useful. They complimented the lectures on emission trading and information on current developments in environmental legislation. Furthermore, the participants appreciated the opportunity for discussion with the representatives from the Ministry of Environment.

6th capacity building in Prague

The capacity building aimed to inform participants about obligations in the field of heat measurement under the revised Energy Efficiency Directive and about setting up an energy efficiency scheme under Article 7 of the Energy Efficiency Directive after 2020.

Training mostly addressed management topics and was focused on the requirements of the revised EED for the Czech heating industry. During the training, many documents regarding energy efficiency, heat metering and billing were addressed.

Participants provided positive feedback and commented that the given information would help them decide on the future development of their company.

Capacity building in Hradec Králové

The training aimed to acquaint the participants in detail with issues on the electricity market and ancillary services and energy storage technologies in the heating industry. The second day of the training was devoted to legislation related to supported sources of energy, allowances trading, use of waste heat and analysis of carbon tax impacts on the heating industry in the Czech Republic.

Participants provided positive feedback and complimented several lectures. Furthermore, they greatly appreciated the opportunity to discuss issues with state authorities.

7th capacity building in Prague

This training aimed to provide participants with an overview of the financial mechanisms for successful investment in the heating sector and to present how to assess the DHS retrofit strategy from a techno-economical perspective.

In this training, the focus was on financial topics and issues like the modernisation of DHSs, key factors influencing future development, financing of the projects, business plans and financial models.

The participants provided positive feedback. They highly appreciated the lively discussion, especially on the implementation of the EPC concept in the heating industry. They considered the seminar as very beneficial and suggest continuing in training organising.

Sharing the experience with other DHS representatives, getting new ideas and presenting examples of successful projects was assessed as very useful.

Summary of capacity building in the Czech Republic

Table 10 contains a list of all training sessions in the Czech Republic.

Table 10. List of training sessions in the Czech Republic

CAPACITY BUILDING	HOURS	DHS EMPLOYEES	OTHER STAKEHOLDERS	TOTAL INDIVIDUALS
1. 1 st Capacity building in Prague	14	42	2	44
2. 2 nd Capacity building in Prague	4	25	1	26
3. Capacity building in Plzeň	10	21	1	22
4. Capacity building in Pardubice	5	58	1	59
5. Capacity building in Blovice	5.5	17	0	17
6. Capacity building in Humpolec	7	18	0	18
7. 3 rd Capacity building in Prague	8	12	1	13
8. 4 th capacity building in Prague	8	12	0	12
9. Capacity building in Třebíč	12	13	2	15
10. 5 th capacity building in Prague	4	11	0	11
11. 6 th capacity building in Prague	4	6	0	6
12. Capacity building in Hradec Králové	17	18	1	19
13. 7 th capacity building in Prague	5	6	3	9
Total	103.5	259	12	271

Capacity building in the Czech Republic aimed to increase the capacity of at least 15 individuals employed in DHS companies. 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.

To achieve the goals, 13 training sessions lasting 103.5 hours were organised in technical, financial, managerial and organisational topics, increasing energy efficiency, and utilisation of RES. All topics considered top priority by DHS operators during the assessment phase were adequately addressed. Additionally, several other, less important topics were also presented and discussed. In conclusion, all relevant content was effectively presented. Regarding the training hours, the overall goal of 100 hours of training was exceeded by 3.5 hours. Capacity building in technical topics lasted much longer than anticipated on the

expense of other topics, especially management topics. Capacity building in the Czech Republic is summarised in Table 11.

Participants' feedback was positive, and they were satisfied with the training. They appreciated the lectures and complimented the opportunity for discussion. Furthermore, the participants stated that capacity building was useful and that they will be able to use gained knowledge in improving their DHSs.

Table 11. Summary of capacity building in the Czech Republic

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	103.5/100	259/15	12	271

In conclusion, capacity development in the Czech Republic achieved planned objectives and successfully increased the capacity of DHS operators and other stakeholders. Training duration was exceeded by only 3.5 hours, but the number of topics addressed, and the number of participants greatly exceeded planned goals. The general feedback was very positive since the participants were very satisfied with the capacity building process and knowledge they can utilise to improve their DHSs.

4. Latvia

Capacity building of DHS operators in Latvia was organised by Zemgale Regional Energy Agency (ZREA). The training was organised in the period from September 26th, 2018 till May 16th, 2019. The small delay was caused due to the heating season, which caused DHS operators to become unavailable.

Based on the initial feedback from DHS operators, ZREA opted for 1-3-day training blocks. Technical, RES and EE topics were addressed in 3-day training. Organisational topics were also covered for three days but were shorter in duration. Training in managerial topics lasted for two days and training in financial topics consisted of two 2-day blocks.

The training was organised as lectures on vital subtopics presented by experts in their respective fields. Some training sessions included videos and software training. Furthermore, during capacity building, many site visits were organised to present practical examples and good solutions and enable training participants to see systems in operation. Additionally, the discussion was encouraged to exchange experience between DHS operators.

The participants were employees of 17 different DHSs ranging from technical and maintenance staff to managerial staff. Besides from DHS operators, many external stakeholders were also included in capacity building in Latvia.

Capacity building in Technical topics

Capacity building in technical topics was organised in Ozolnieki county. During three-day training engineers, technical, maintenance and managerial staff attended six lectures and participated in three field trips.

The main training objective was to strengthen the capacity of selected pilot DHS operators' specialists and other DHS operators' employees, academic sector representatives, energy experts and other interested stakeholders. This was done by raising their knowledge about new tendencies, technologies and other innovative experiences in their field of work, sharing their experiences among themselves and seeing in practice newest technologies and solutions such as insulated pipe production, woodchips boiler house and biomass cogeneration operation.

University professors and representatives of private companies presented ways of evaluating energy losses, remote measuring systems, modelling heat supply systems after energy renovation of buildings, boiler house automation and optimisation, optimising flow temperatures, use of GIS-based tools, the transition to 4th generation district heating and many other related topics. The training also contained practical cases and exercises. Additionally, site visits to the following locations were organised:



- "POLIURS" Ltd. - manufacturer of industrially insulated pipes
- "Ozolnieki KSDU" Ltd. - district heating provider in Ozolnieki county - boiler house
- "Fortum Jelgava", Ltd. - district heating provider in Jelgava city - cogeneration

Training participants were employees of ZREA, selected DHSs, other heat supply companies and municipalities, representatives of various energy sectors and members of academia.

Training evaluation

In total, 22 participants were engaged in training during the lectures, and 16 participated in the field trip. 19 individuals were from 9 DHSs, and 3 were external stakeholders. Capacity building in technical topics lasted for 20 hours.

The lectures were graded, on average, with 4.38 points and training average grades ranged between 3.8 and 4.6. The organisers explained the gap between grades, which can be seen since the same topic was awarded 2 and 5 points, with the difference in experience, knowledge and expectations between the trainees. The participants were in general satisfied with conducted training. They were thankful for the opportunity to participate in study visits and would like to continue with similar training. The favourable style of training was practical work with real examples and exercises. Detailed training evaluation results are given in Figure 7.



Several positive training aspects were complimented such as field trips, the future vision for DHS and lectures with work and life experience in specific areas. Besides from GIS applications which were especially interesting to participants, some other topics such as data gathering, analysis and automation by SCADA, heat storage and boiler automation, opportunity to decrease temperatures in existing DHS without additional investments and many others were also considered interesting and meaningful.

To further improve training, the participants proposed to resume with field trips and invite more practitioners and representatives from different progressive companies to share knowledge and experience. They also stated they would like to see posters and leaflets on the newest products, equipment and services related to DH.

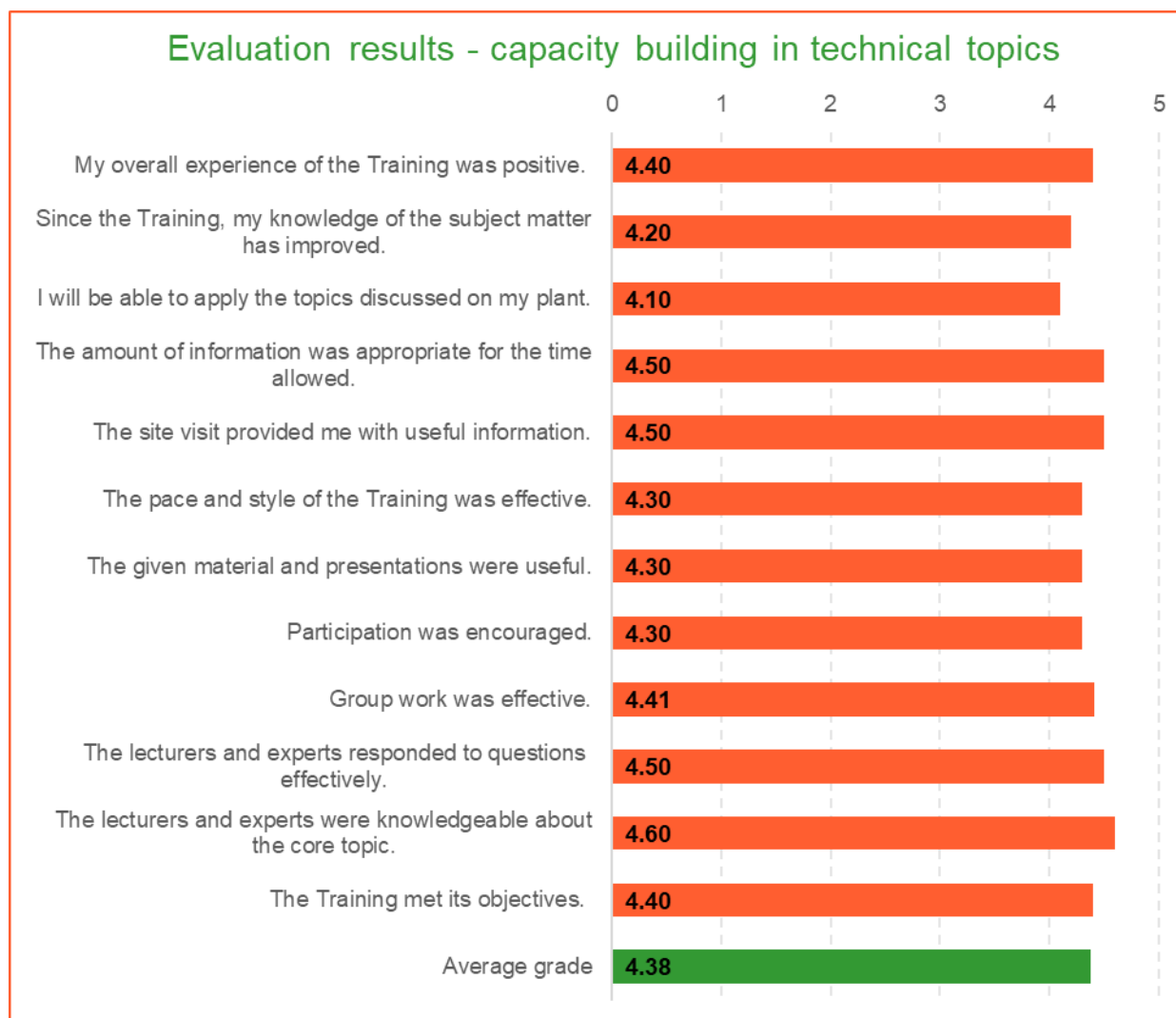


Figure 7. Evaluation results of capacity building in technical topics in Latvia

Capacity building in RES and EE topics

Capacity building in RES and EE topics was organised in Jelgava city. During three training days, eight lectures were presented, and a field trip to waste incineration plant Fortum Klaipeda UAB was organised.

The main training objective was to increase the capacity of DHS in RES and EE topics such as integration of renewable energy sources, utilisation of waste heat etc.



The lecturers presenting the topics were university professors, representatives of consulting companies and employees of more advanced DH companies. In several lectures, they presented various aspects of biomass quality and logistics, biomass boiler performance, biomass gasification process, and burning of waste products. Additionally, they presented experience regarding fuel diversification in DH energy production, impacts

of RES on efficiency and trends, and solutions for advancement to smart district heating systems.

Training participants were employees of pilot DHSs, as well as employees of other heat supply companies, municipal employees, representatives of various companies in the energy sector, as well as representatives of the Life Science University Technical Faculty and Riga Technical University.

Training evaluation

In total, 35 individuals participated in the training and 16 participated in the field trip. The training lasted for 19.5 hours. 17 participants were employees of 7 DHS, and additionally, 18 participants were other interested stakeholders.

In general, the participants expressed satisfaction with the training, and all lectures received very good grades. Since the training was organised before the official training evaluation form was completed, the organisers evaluated the training using their materials and questionnaires. The training was graded on a 10-point scale, and the results were scaled down to a 5-point scale to be comparable with other training sessions. In average, lectures were graded with 4.25 points, and the average grades for individual lectures ranged from 3.75 to 4.55 points. The field trip was awarded highest grade - 4.65.

Participants complimented the field trip and stated that seeing one time is better than hearing three times. Apart from many topics and discussions, the participants recognised some of the aspects as interesting and meaningful such as:

- Importance of boiler selection and constant monitoring
- Properties of wood chips for efficient operation
- Co-firing waste with traditional fuels
- Gas and hydrogen as future energy sources
- Importance of recycling scheme and priorities
- Feasibility of RES and waste
- Calculation and market of emission quotas
- 4th generation district heating
- Exploitation principles of boilers and utility of flue gas condenser

Capacity building in Organization topics



Capacity building in organisation topics was organised in Jelgava City and consisted of nine lectures and one study visit. The training was appropriate for managerial staff, DHS operators, maintenance, administrative and technical staff.

The main training objective was to increase the capacity of DHS operators, employees, energy experts, members of academia and other interested

stakeholders in the management of their organisations and exchange of experiences between the participants.

The lecturers were high-level professionals such as energy efficiency specialists, production managers, board members, public authority representatives, etc. They presented a wide range of topics regarding organisational aspects of DH systems. The topics ranged from national legislation, possibilities for improvement and identification of measures to improving production efficiency, experience in identifying measures for improvement and good practice examples such as Fortum Jelgava.

Training participants were DHS operators, members of academia, and individuals from development/energy agencies.

Training evaluation

Thirty-six individuals were engaged in training in organisational topics, which expressed positive feedback about training in general. 32 participants are employees of 13 different DHSs, and the other 4 participants are external stakeholders. The average grade for whole training equals 4.62 points, with best grade 4.8 for the study visits. The participants complimented study visits and suggested to continue and organise more sessions. Detailed results of the training evaluation questionnaire are available in Figure 8.

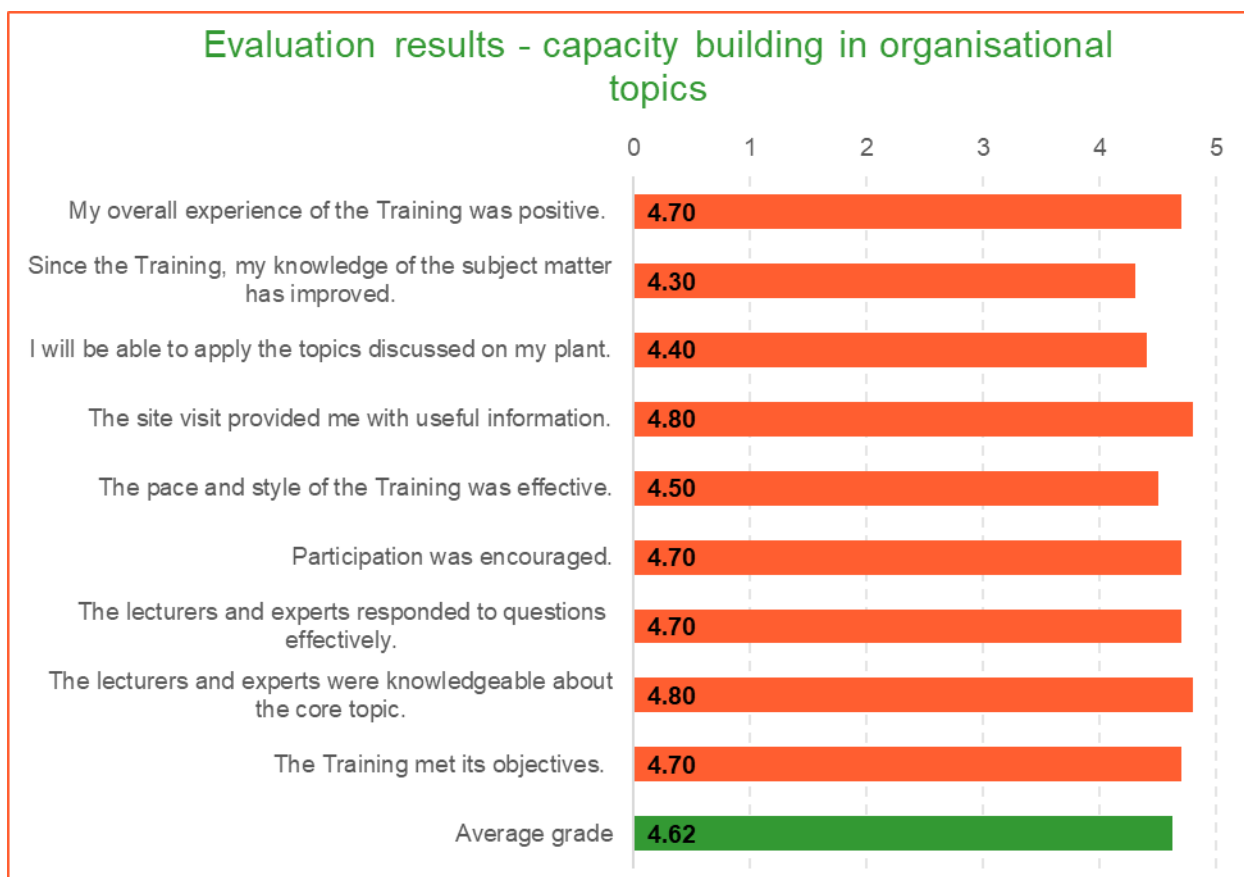


Figure 8. Evaluation results of capacity building in organisational topics in Latvia

Capacity building in Financing topics

Capacity building in financing topics for business support staff, managerial staff, maintenance and administrative staff was organised in Jelgava, Liepaja and Salaspils city. The training consisted of twelve lectures and two field trips distributed in two 2-day training blocks.



The training objective was to increase the capacity of DHS operators and other interested stakeholders in the financial aspects of DHS and the exchange of experiences among participants. Furthermore, to increase the capacity of selected pilot DHS operators' specialists in Latvia and other district heating system operators' employees, municipalities, NGO's representatives, energy experts and other interested stakeholders on business plan elaboration, and elaboration of technical feasibility studies.

The lecturers were members of academia, investment fund representatives, DHS employees, representatives of consulting companies and energy efficiency specialists. The participants were employees of DHSs and several external stakeholders.

During the training, various financing topics were covered from economic assessments, business planning, funding sources to real-life good practice examples such as Salaspils Siltums, Talsu-Bio-Energija and Ventspils Siltums. In the first training block experience from several DHSs was presented, and relevant topics such as alternative financing and economic assessment of investment projects were addressed. In the second training block, the focus was on business planning. In this training, many business planning aspects were thoroughly addressed such as business planning and management, drawing of a business plan, financial forecasts, feasibility studies, challenges in DH sector etc.

Training evaluation

30 individuals were engaged in 24.5 hours of capacity building in financing topics. 20 individuals are employees of 9 DHSs, and 10 are external stakeholders. In discussion with DHS operators, second training block was organised, and training duration was increased to cover feasibility study elaboration and business planning in greater detail.

Participants' assessment was positive, and the training, in general, was awarded 4.75 points. The average grade for all training days equalled 4.52, and the highest grade was awarded for a study visit. The participants stated that their knowledge levels increased, and they will be able to apply it in practice. Figure 9 summarises training evaluation results.

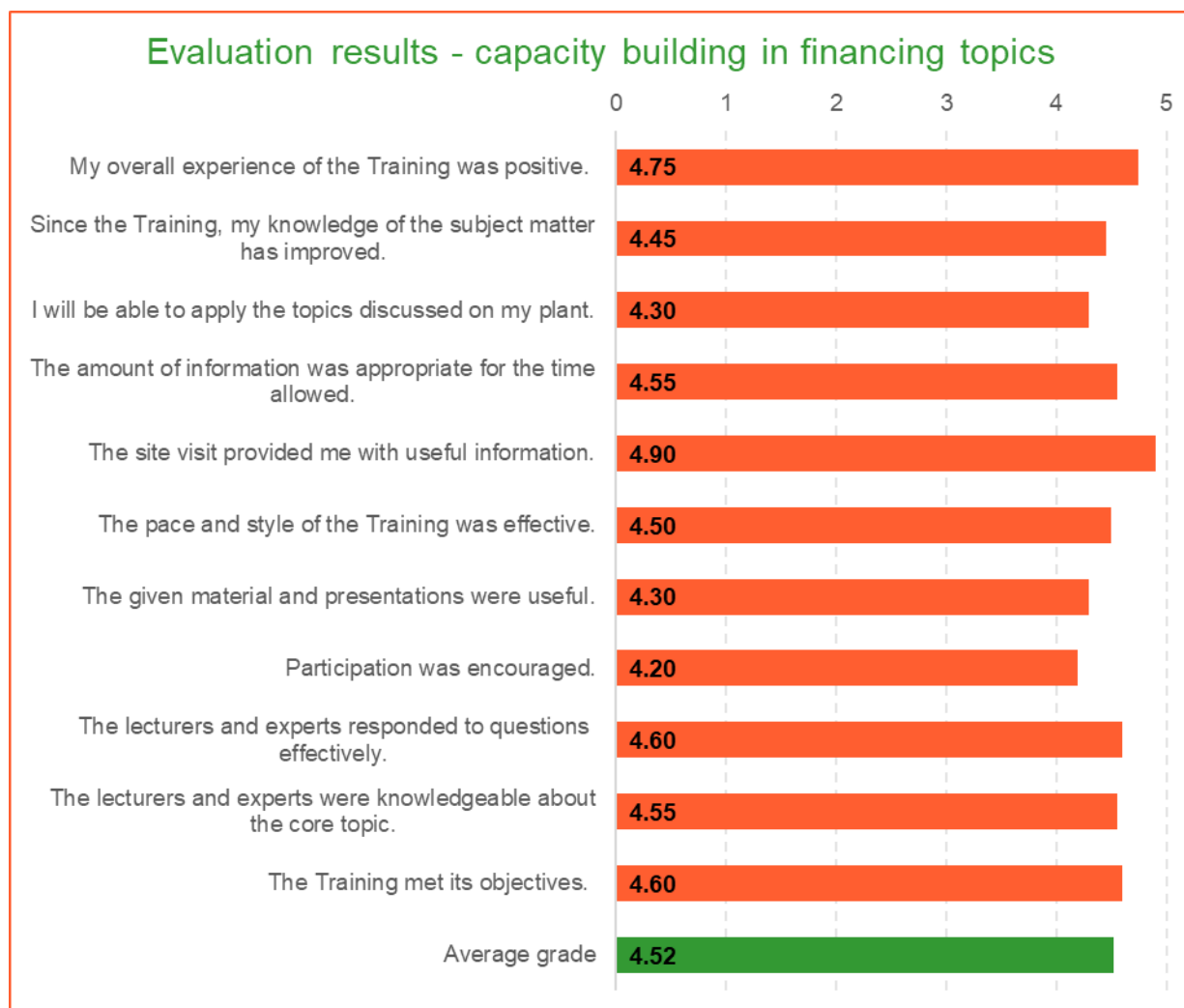


Figure 9. Evaluation results of capacity building in financing topics in Latvia

Capacity building in Management topics

Capacity building in management topics for managerial and administrative staff was held in Jelgava. The main training objective was to increase the capacity of selected pilot DHS operators, other DHS operators and other interested stakeholders in the management of DHSs and exchange of experiences on daily management in DHSs.

The lecturers were managers and employees of DHSs, Lithuanian energy exchange Baltpool and business trainer from Komercizglitibas centrs. For the training, they used presentations, videos and software for trading biomass. The participants were employees of selected and other DHSs and several external stakeholders.

The focus of capacity development in management topics in Latvia was on practical experience from various more advanced DHSs. Many topics and approaches were presented such as: identifying measures for increasing the attractiveness of DHSs, management experience from “Liepājas energija”, Ltd. and “Fortum Jelgava”, Ltd., communication with customers, biomass supply etc. Using real-life experience, the lecturers presented many important aspects such as building the company image, working with customers and institutions, keeping existing and attracting new customers,

communication with suppliers etc. Regarding the biomass supply, alternative methods for the purchase and contract provisions needed to ensure smooth supply were discussed.

Training evaluation

In total, 24 individuals participated in capacity building in Management topics. 22 are employees of 9 DHSs, and other 2 are external stakeholders. In general, they provided positive feedback and awarded the training with 4.69 points on average. Average grades for individual training aspects ranged from 4.50 for the ability to practically apply gained knowledge 4.90 for lecturers' competency. A detailed evaluation of the capacity building in management topics in Latvia is available in Figure 10.

The participants liked the presentations and obtained knowledge and complimented the exchange between participants. They liked practical tasks and working in groups. They also acknowledged presenting style and good advice during the training.

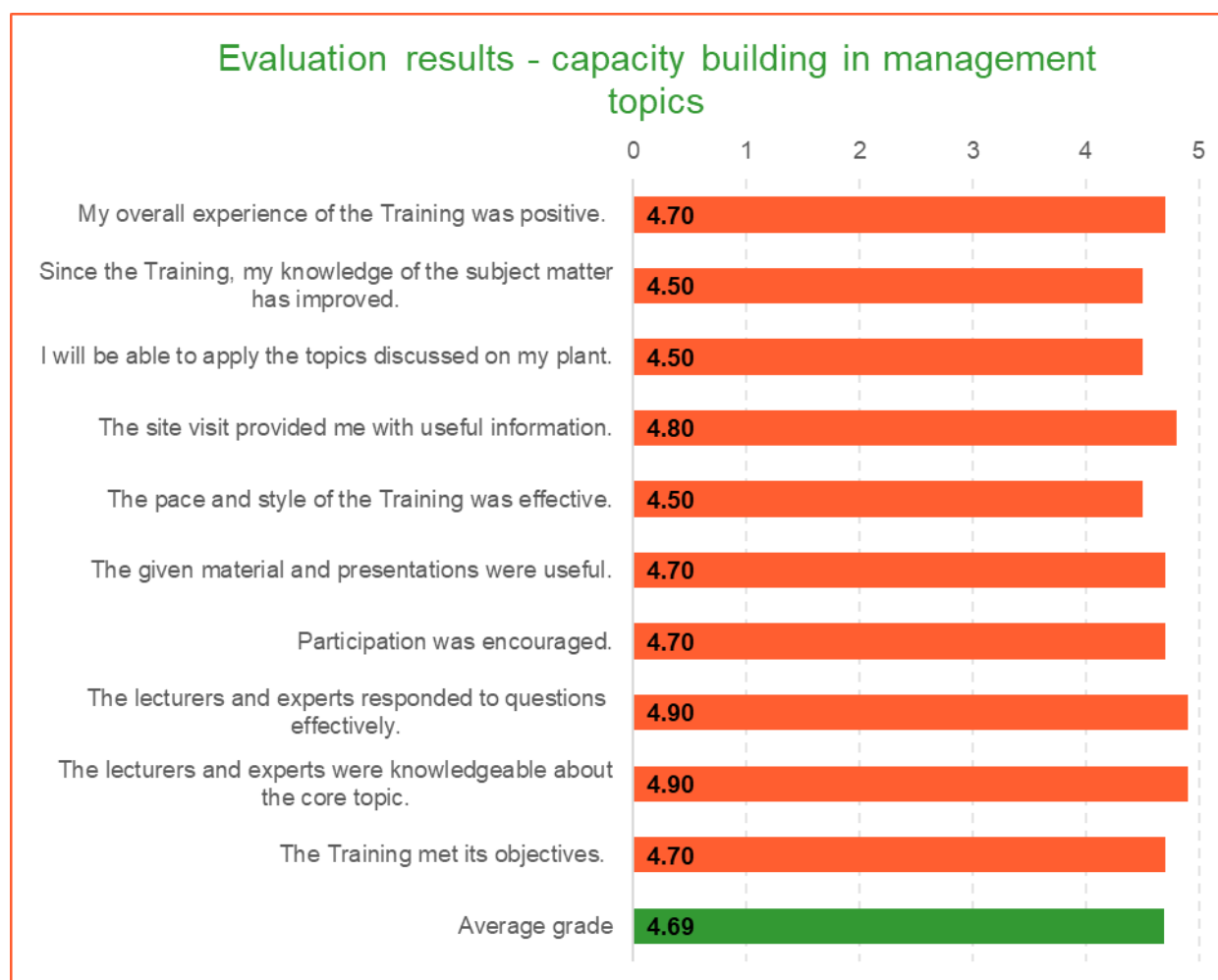


Figure 10. Evaluation results of capacity building in management topics in Latvia

Good practice example – Fortum Jelgava



During capacity building in management topics site visit to Fortum Jelgava was organised. Fortum Jelgava biomass cogeneration plant provides up to 85% of DHS needs and sells electricity on Nordpool spot market and industrial customers. Besides from using RES and European Structural Funds, Fortum Jelgava actively improves heating supply service for the customers and plays an active role in the city's life.

The company takes part in social life, gives donations, helps in project development and opens doors of biomass CHP for residents and guests interested in the plant. This approach significantly improves the relations between the company and end users and Fortum Jelgava represents a great role model for other DHS enterprises to follow.

Summary of capacity building in Latvia

The main training objective in Latvia was to increase the capacity of at least 15 individuals from partnering DHS operators. The main training outcomes were to increase knowledge in five topics defined within KeepWarm project and enable DHS operators to increase systems' efficiency, to be capable of attracting new funds and developing pilot projects.

Capacity building in Latvia lasted for 91.5 hours and was held in 6 training sessions. An additional training session was supposed to be organised, but it was cancelled due to several reasons. A planned study visit for the financial training had to be cancelled shortly before, since the company, who planned to host the event and provide deeper insight to the DHS operators, had to fulfil other company obligations. Additionally, the organisation of alternative training was not possible due to the limited period, unavailability of desired lecturers, and unavailability of DHS operators. Although capacity building goal of 100 hours was not reached, all topics considered a top priority, and even some other topics considered important were successfully addressed, and training objective regarding the content was successfully reached.

93 individuals participated in capacity building, including participants from pilot DH systems, participants from other DHSs and external stakeholders. In total, 17 DHSs were included in capacity building. As can be seen, the number of training participants exceeded the objective several times. Table 12 summarises numbers regarding training duration and number of participants.

Training participants provided positive feedback, which is supported by very high grades and positive descriptive marks given in the training evaluation questionnaire. The participants stated that training effectively increased their capacity and enabled them to apply the gained knowledge practically.

Table 12. Summary of capacity building in Latvia

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	91.5/100	63/15	30	93

In conclusion, capacity development in Latvia successfully reached planned objectives, although the number of training hours did not reach 100. The number of participants and addressed topics exceeded the objectives, and the feedback was very positive.

5. Serbia

Vinca Institute for Nuclear Sciences organised the capacity building of DHS operators in Serbia. The training was organised from January 30th to May 22nd, 2019. The minor delay was caused by weak availability of DHS operators during the heating season.

Vinca Institute acknowledged the participants' feedback during training needs assessment and organised training as two-day workshops. The workshops were organised as a series of lectures with room for discussion. Besides lectures, field trips to neighbouring plants were organised to present good practice examples and enrich the lectures with a practical demonstration.

The lecturers were employees of Vinca Institute, academic professionals and employees of companies involved in DH with relevant knowledge and experience. The participants were mostly employees of DH companies, but other external stakeholders such as representatives of development and energy agencies, members of academia and local government also participated in training sessions.

Training materials were mostly printed scripts and presentations. Materials are also available online.

Capacity building in Technical topics

Capacity building in technical topics, dominantly for engineers, was organised in Zlatar as a two-day block which consisted of 8 lectures and two field trips.

The main training objective was to strengthen the capacity of selected DHS operator specialists and other DHS employees, academic sector representatives, energy experts and other interested stakeholders. To extend their knowledge about new tendencies, technologies and other innovative experiences as well as to share experiences among themselves and see the applied solution in practice by participating in site visits.



The lecturers were employees of Vinca Institute for Nuclear Sciences, university professors and employees of visited plants. Individuals participating in training on technical topics are employees of DHSs, municipality representatives, members of academia etc.

During capacity building, many technical topics were addressed, with emphasis on the reduction of energy losses, heat storage, heat losses, system optimisation and practical application. Capacity building was introduced with a lecture on sustainable development and renewable energy and continued with technical aspects such as energy efficiency in buildings, system optimisation and other mentioned technical topics. The training was concluded with study visits to a biomass plant and company for the production of wood pellets. During the study visits, practical aspects and benefits of using renewable energy were discussed.

Good practice example – Energy transition in Priboj



Priboj in Serbia is a leading example in the transition from fossil fuels to biomass, and the first transition phase requires switchover from heating oil to biomass. In 2016 light fuel oil-powered boiler was replaced with a pellet-powered boiler, which resulted in significant environmental benefits, especially for citizens living in the narrower centre where soot and pollution were common. The plant supplies four objects: a school, preschool, cultural centre and municipal building. During capacity building in technical topics, a study visit to Priboj city was organised, and the operation of a biomass boiler (0,9 MW) was demonstrated. Participants were introduced with benefits of using renewable energy source – biomass and presented with the operation of boiler house starting with delivery and storage of woodchips and ending with automatic managing system of boiler and heat storage.

Training evaluation

Training in technical aspects gathered 19 participants for a two-day session in various technical aspects of DHS. 11 participants are employees of 7 DHSs, and 8 participants are external stakeholders. In total, training lasted for 20 hours. All topics considered top priority were addressed, besides from GIS applications.

Participants assessed the training as a very positive experience and suggested to resume with training activities, especially with presenting real-life examples. Average training grade equalled 4.72, ranging from 4.41 for the effectiveness of group work to 5.0 for presenters' expertise and knowledge. The participants also stated that their favourite training methods are site visits and real-life examples. Detailed results of training evaluation questionnaires can be seen in Figure 11.

Training in technical topics in Serbia effectively increased the capacity of DHS operators and other interested stakeholders in increasing efficiency of DHSs and system optimisation. Furthermore, the discussion among peers was fruitful and enabled the exchange of experiences between the participants. Based on their feedback and given numerical grades capacity development successfully reached planned objectives regarding the content, number of trained individuals and training duration.

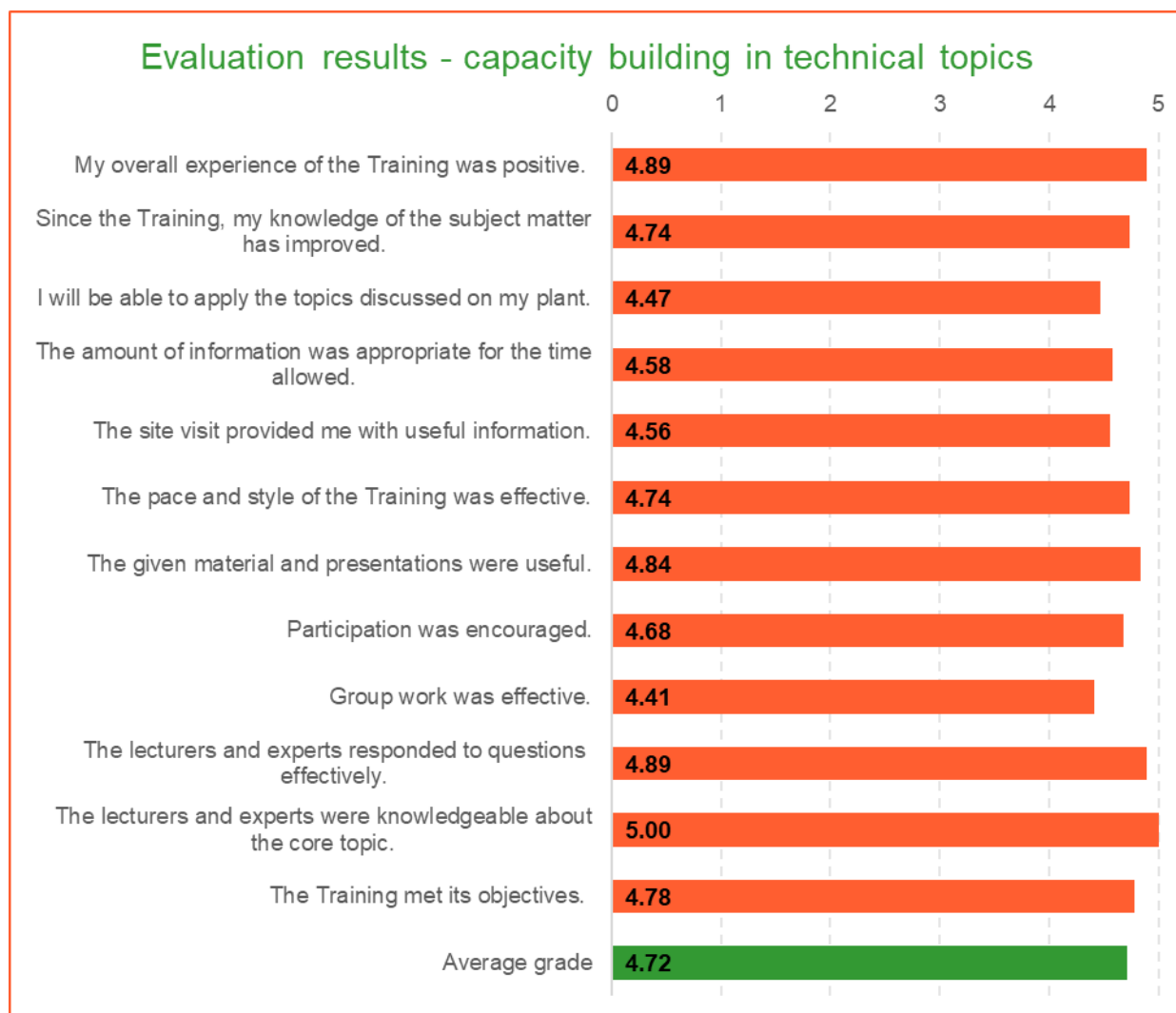


Figure 11. Evaluation results of capacity building in technical topics in Serbia

Capacity building in RES and EE topics

Capacity building in RES and EE topics was organised in Vinca Institute for Nuclear Science as a two-day workshop consisting of 9 lectures and 2 study visits.

The main training objective was to strengthen the capacity of selected DHS operator specialists, other DHS employees and all other interested stakeholders in using RES for energy production, especially biomass. Furthermore, the goal was to increase knowledge in new tendencies, technologies and other innovative experiences in their field of work, as well as to share experiences among DHS operators.



Presenters were employees of Vinca Institute, and the participants were employees of DHS involved in the project (13), GIZ and SANU of the Institute of Technological Sciences.

During capacity building, many topics regarding renewable energy sources were addressed. The topics ranged from renewable energy in general to specific biomass preparation and combustion technologies. The lecturers presented renewable energy in Serbia with emphasis on biomass supply. Furthermore, they presented possible models for biomass collecting and recommendations for promotion and better organisation of available biomass use in Serbia. Detailed lectures on biomass preparation and combustion technologies were held, and practical aspects of experimental biomass testing were elaborated in presentations and during laboratory visit.

Training evaluation

13 individuals were included in 20 hours of training in RES and EE topics. Eight are employees of 5 DHS operators, and 5 are other stakeholders. They expressed positive feedback evaluating the training with 4.85 points on average. Training aspects such as quality of materials and lecturers' competencies were awarded excellent 5.0 points and, on average, 4.73 points were given for usefulness of the presented information. Participants especially appreciated the opportunity to get acquainted with accredited laboratories and methods for biomass quality assessment. Results of training evaluation questionnaire are given in Figure 12.

Furthermore, the participants proposed several solutions for improving further training such as inviting more practitioners and representatives of different progressive companies to share their experiences and placing posters or leaflets on the newest products, equipment and services.

Additionally, they recognised several aspects as interesting, useful and meaningful such as biomass specifics and market prices, good practice examples in EU and recommendations for promotion and better organisation of biomass resources in Serbia. What is most important - participants stated that they would be able to apply gained knowledge in practice, such as:

- insist on biomass quality control before purchase
- constantly monitor biomass quality to improve heat production efficiency
- more thoroughly prepare project assignments
- to choose biomass boilers and appropriate fuel easily

To conclude, capacity building in RES and EE topics achieved predetermined objectives in all aspects such as the content, number of participants and training duration. Furthermore, the participants provided positive feedback in which they stated they would be able to apply gained knowledge for improving their DHSs.

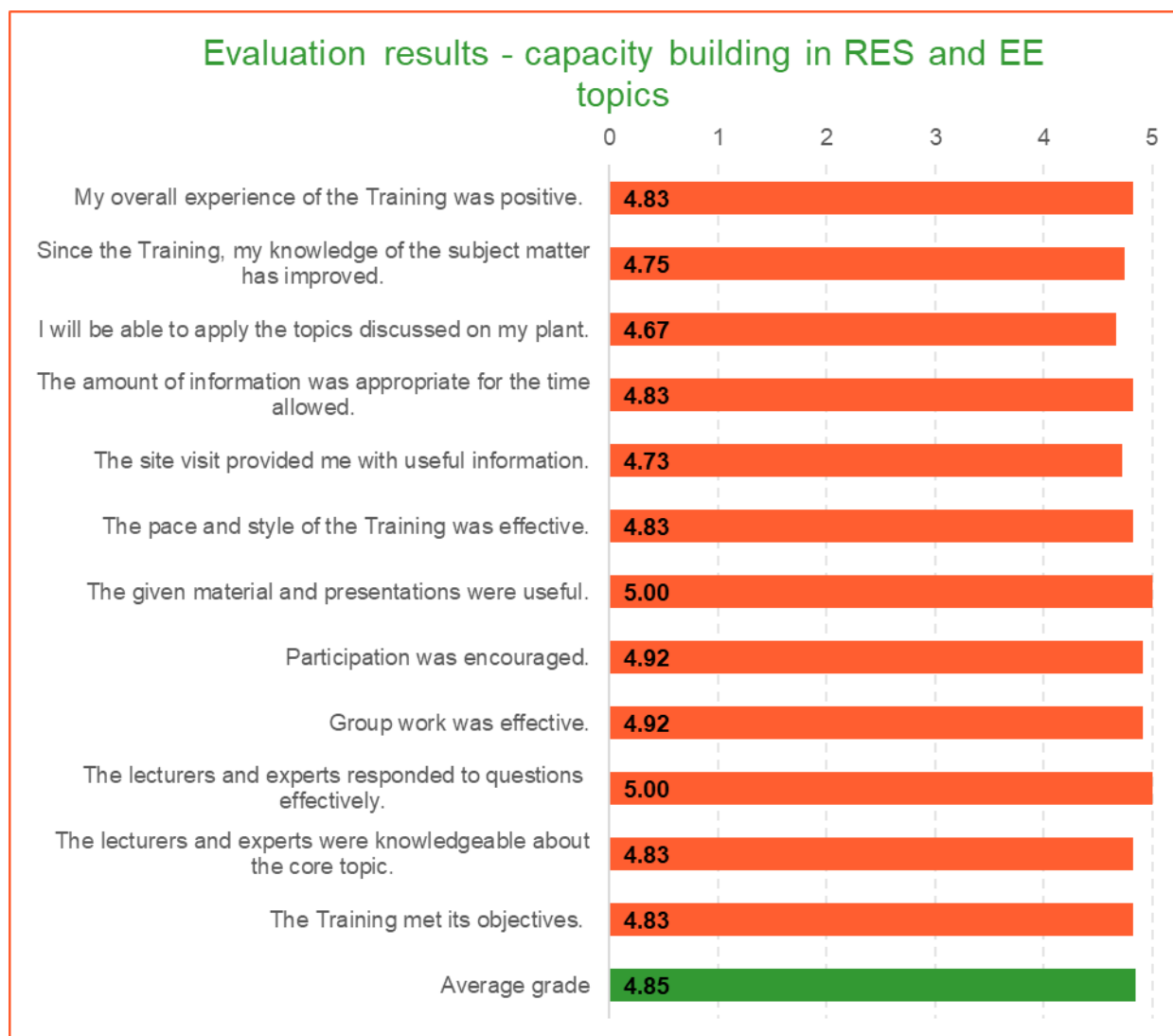


Figure 12. Evaluation results of capacity building in RES and EE topics in Serbia

Capacity building in Organisation topics

Training in organisational topics was held in Sabac and consisted of 8 lectures and 3 study visits. The main objective was to strengthen the capacity of selected Serbian pilot DHS operators' specialists and other DHS employees, academic sector representatives, energy experts and other interested stakeholders. The training was meant to extend their knowledge about new tendencies, technologies and other innovative experiences, to share experiences among themselves and to see in practice applied solutions in Sabac as a city that smartly plans its energy development.

The lecturers were university professors, representative of Business Association of DHS Serbia, DHS operators' representatives and representative of a private company in gas and heating installations. The participants were employees of DHS operators, members of the Business Association of DHS of Serbia, and member of the city council.



During capacity building in organisational aspects of DHSs, many interesting topics were addressed, ranging from sustainable development and renewable energy, considering climate change to a site visit, where the practical application of addressed content was demonstrated. The lecturers presented current state and challenges in DH in Serbia, legislative framework, energy efficiency in buildings, and many other topics. Furthermore, they addressed the issues such as

increasing the efficiency in production and distribution of energy and increasing the quality of heating services through compliance with standards and written procedures on real-life example – Sabac DHS. Additionally, site visits to Sabac DHS, Sabac swimming pool, and wastewater treatment plants were organised to present the use of biomass, solar heat and heating pumps. Furthermore, during the capacity building representative from the company for plumbing, gas and heating installations presented thermal energy projects from design to construction and installation of pre-insulated pipes.

Training evaluation

In total, 23 individuals participated in capacity building in organisational topics, 17 employees of 6 DH companies and six external stakeholders. In general, they expressed positive feedback and rated overall training experience with 4.89 points. They were thankful for the opportunity to visit biomass facilities and facilities using RES. They also complimented the opportunity to acquaint themselves with the company for plumbing, gas and heating installations and modern setting of pipelines. The results of the training evaluation are available in Figure 13.

The participants suggested inviting more practitioners and representatives of different progressive companies to share their knowledge. Furthermore, they proposed placing posters and leaflets on the newest products and companies related to DH.

The participants stated that they would be able to apply gained knowledge practically to:

- motivate users and improve relations between DHS operator and users
- apply flexible pre-insulated pipes
- introduce systematisation of noticed breakdowns

To conclude, capacity development in organisational aspects in Serbia achieved desired objectives, and the participants will be able to apply acquired knowledge.

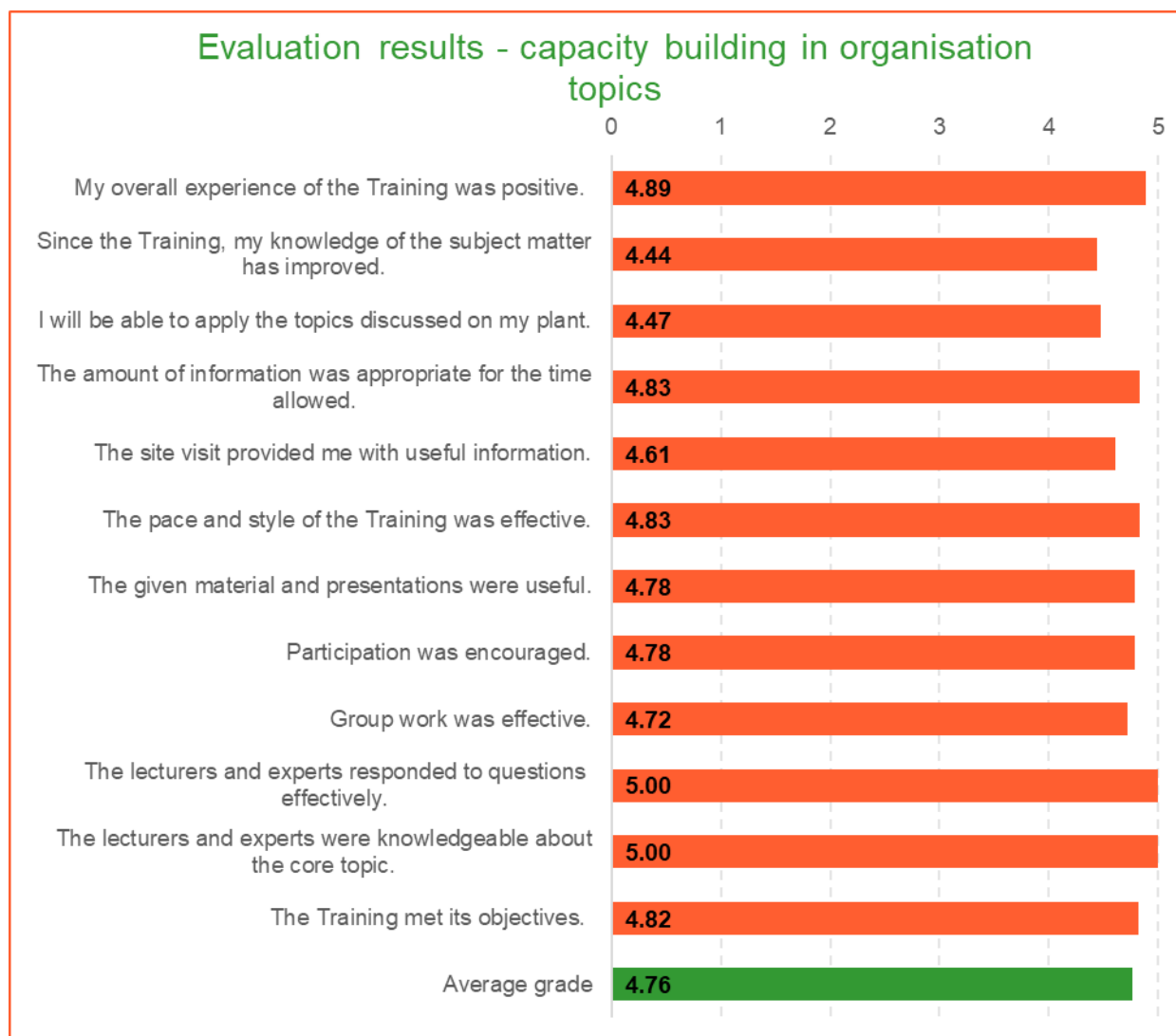


Figure 13. Evaluation results of capacity building in organisation topics in Serbia

Capacity building in Financing topics

Capacity building in financing topics was organised in Vinca Institute in Belgrade. The training was organised as a two-day workshop consisting of lectures and visit to accredited laboratories and experimental installations for the characterisation and combustion of biomass.

The main training objective was to strengthen the capacity of specialists selected from Serbian DHS operators and other DHS employees, academic sector representatives, energy experts and other interested stakeholders in financial issues to extend their knowledge about preparation of business plans for DHS modernisation and identification of potential sources of financing, and to share experiences among participants.



Lecturers from the private consulting company and Vinca Institute held 13 lectures mostly focused on business plan development. Training participants were DHS employees, consulting company employees and members of academia.

During capacity development, many topics from financing topics group were addressed with a focus on business plan development. The lectures were organised to cover key business plan elements such as business plan preparation process, necessary information, market analysis, capital requirements, financial analysis, financial resources etc. In relation to the lectures, a workshop was also organised. Besides from business plan development techno-economic analysis of replacement of heavy fuel oil boiler with biomass boiler was presented in detail and a study visit to the Laboratory for Thermal Engineering of Vinca Institute was organised.

Training highlight – workshop



The largest part of capacity development in financing topics in Serbia was devoted to business plan development. The training was based on lectures in which the presenter addressed all the necessary aspects of a business plan. A workshop was organised, in which the participants practically applied acquired knowledge in business plan preparation. In general, the workshops were very well received among participants during capacity development in many countries because they enable immediate use of gained knowledge, and the participants usually remember the learned content for longer.

Training evaluation

In total, 13 participants were included in capacity building in financial topics. Five of the participants are employees of 5 DHS operators, and 8 are external stakeholders.

Generally, participants provided positive feedback, especially regarding the opportunity to visit an accredited testing laboratory. In average, training was awarded 4.73 points with grades ranging from 3.92 for the ability to apply the gained knowledge to 5.0 for the lecturers' competence and knowledge. Detailed results of the training evaluation questionnaires are available in Figure 14.

Participants collected very useful information on various methodologies for preparation of business plans, learned about compulsory parts of a business plan, such as business plan parts, and which time period should be included in the financial analysis. Furthermore, they trained for SWOT, market and financial analysis.

In conclusion, training in financial concerns achieved its objectives, and the participants provided positive feedback.

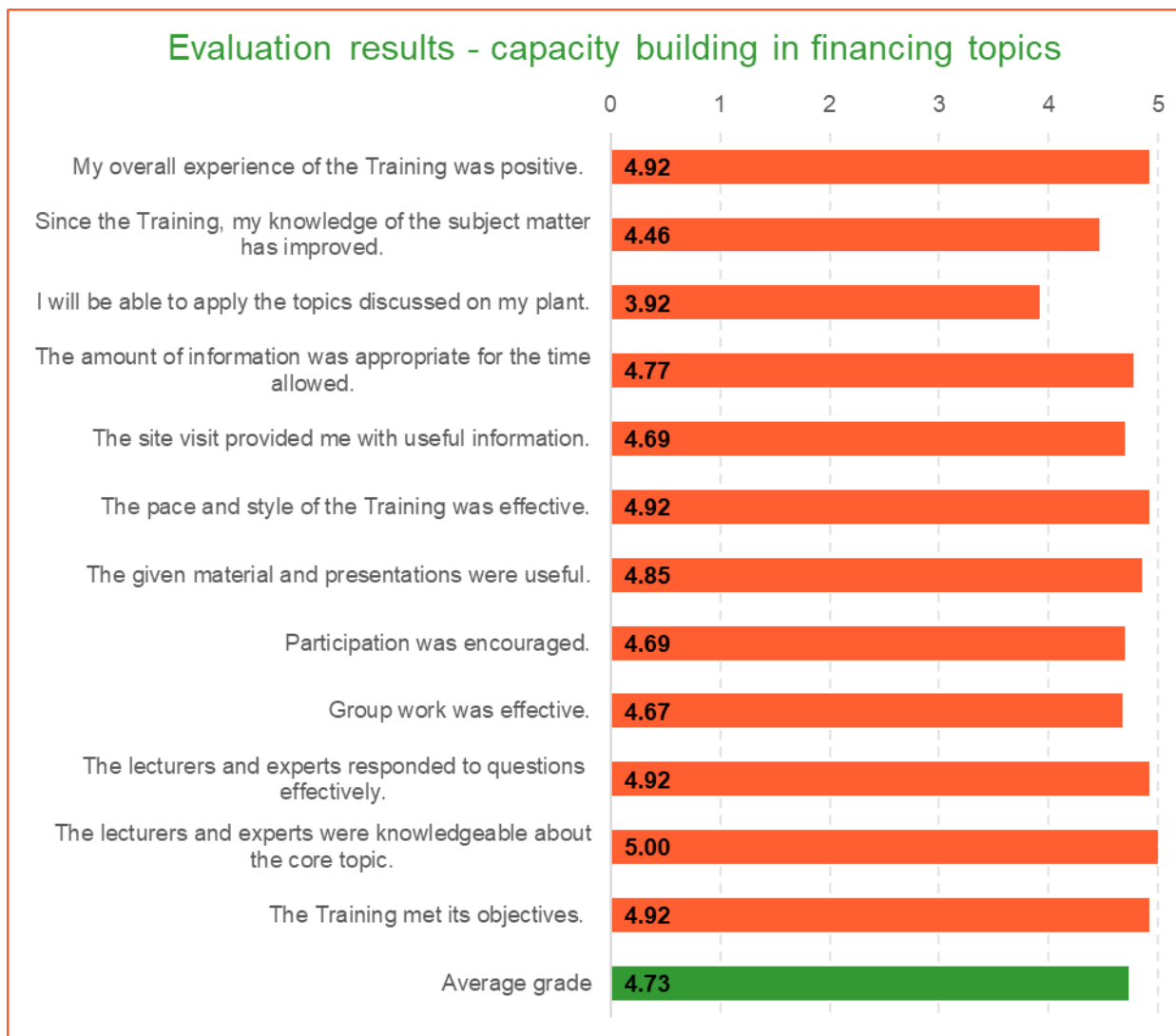


Figure 14. Evaluation results of capacity building in financing topics in Serbia

Capacity building in Management topics

Capacity building in management topics was organised in Herz company in Nova Pazova. Training for managerial and business support staff consisted of 9 lectures and one study visit where 45 kW biomass boiler was demonstrated.

The main training objective was to increase the capacity of selected specialists from DHS operators, other DHS employees and other interested stakeholders in managerial aspects of DHS to extend their knowledge about new tendencies, technologies and innovative experiences.

Lecturers were Herz Armature company employee and professors from Vinca Institute who presented modern heating systems, information on the legal framework for the application



of RES and held several lectures regarding biomass as a renewable fuel. Training participants are the managerial staff of heating plants or DHSs, and one person is a financial officer in DHS.

The presenters mostly concentrated their lectures on different aspects regarding biomass powered DHSs such as the use of biomass in cities and densely populated villages, ecological and economic aspects of biomass use, the security of supply, techno-economic analysis of replacement of fossil fuel-powered boiler with a biomass boiler, planning and reconstruction of biomass heating plant etc. During the study visit the operation of wood chips/wood pellet boiler was presented as well as the operation of boiler house and regulation and automation of boiler and storage.

Training evaluation

Capacity building in management topics gathered 10 employees from 7 DHS companies and two other stakeholders, equalling 12 participants in total.

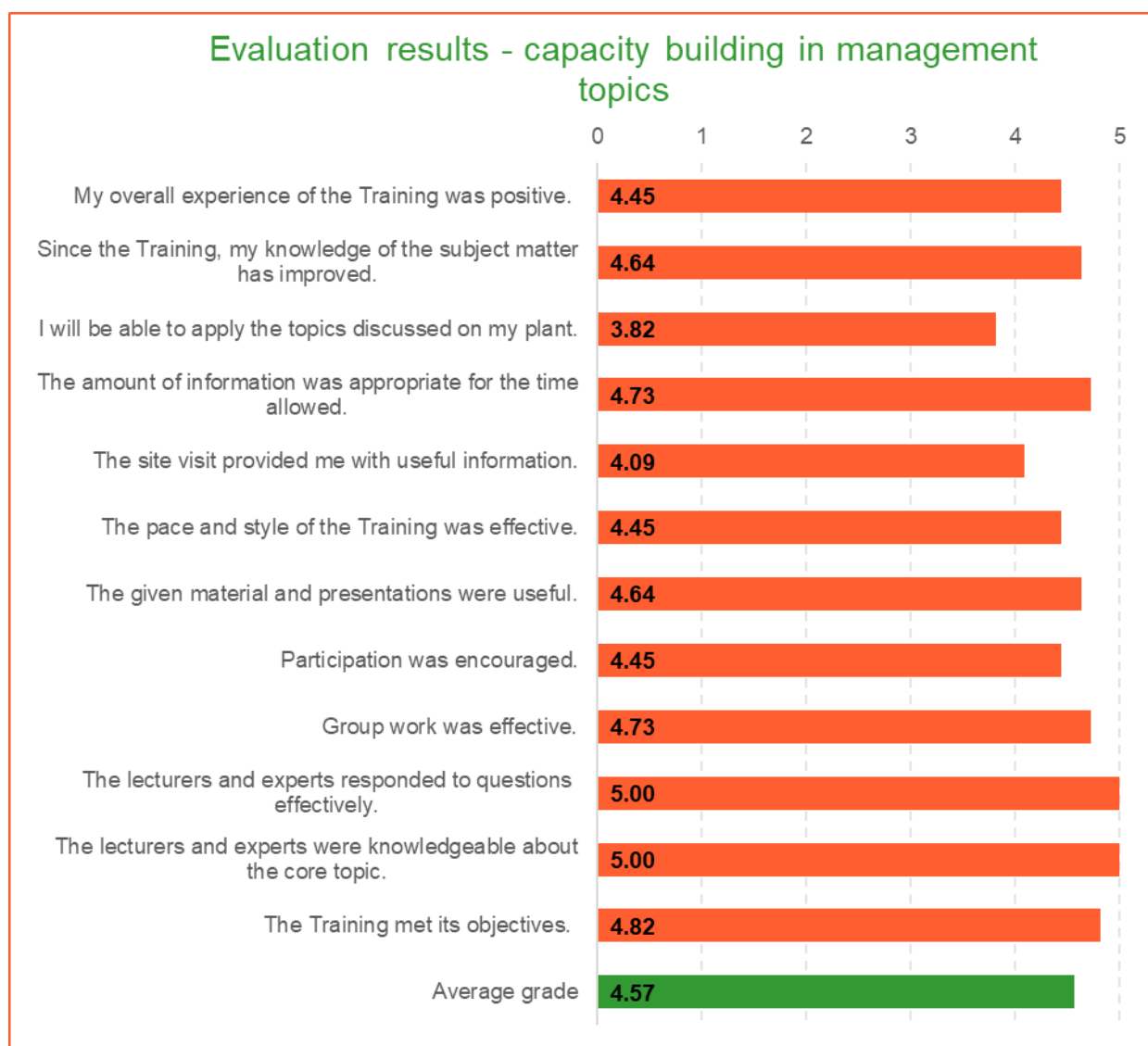


Figure 15. Evaluation results of capacity building in management topics in Serbia

Trainees provided positive feedback and awarded the training with 4.57 points on average. The grades ranged from 3.82 for the ability to apply topics in their respective plants to 5.0 for lecturers' knowledge and quick response to questions. Results of training evaluation questionnaire can be seen in Figure 15.

Participants complemented the opportunity to visit a biomass facility and to be acquainted with the concepts for the introduction of tailor-made fittings with the aim of energy and financial savings.

In conclusion, capacity development in managerial topics achieved the required objectives and successfully increased the capacity of DHS operators in managerial aspects of DHSs.

Summary of capacity building in Serbia

The goal of capacity building in Serbia was to improve the capacity of 20 employees of DHS operators to enable them to actively take part in the introduction of RES, increasing energy efficiency, and reducing emissions in their DHSs. According to the feedback from DHS operators, workshops with field trips were preferred training options.

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, and all topics considered a top priority, besides from GIS applications were addressed, as well as several additional topics proposed by DHS operators, such as: sustainable development in light of climate change, motivating consumers to start using RES, presentation of company in DH sector etc.

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. Finally, training organisers in Serbia exceeded the goal regarding the number of participants and included an additional 27 external stakeholders in capacity development. Table 13 shows the summarised results of capacity building in Serbia.

Table 13. Summary of capacity building in Serbia

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	100/100	28/20	27	55

Feedback on capacity building was very positive, and the participants complimented many training aspects and even proposed possible improvements in a case similar training will be held in future. They recognised aspects that can be applied in their DHSs to increase systems' efficiency from several angles such as technical, organisational and managerial. To conclude, all capacity development objectives in Serbia were successfully achieved, which is supported by participants feedback, both numerical and descriptive grades given to all five training sessions.

6. Slovenia

KSSENA organised the capacity building of DHS operators in Slovenia with help from JSI and local experts with adequate knowledge in particular topics. The training was organised in the period from December 20th, 2018 to June 14th, 2019.

Based on the feedback from DHS operators, sessions were organised as a combination of joint and individual training with DHS operators. Training topics and duration varied based on training type and availability of lecturers and DHS operators.

The lecturers were employees of KSSENA, JSI, Petrol and ministry representatives. Besides from DHS operators, external stakeholders such as employees of energy agencies and public authority representatives also participated in capacity development.

Since training in Slovenia covered many KeepWarm topics during one training sessions, in this training report, each training will be addressed in the following paragraphs and topics covered will be listed in the end.

Capacity building in Velenje

The main objective of capacity building in Velenje was to acquaint participants with innovative approaches in DHS management and organisation and prepare DHS operator for future challenges. The objective was to focus the training on topics which would be most beneficial to DHS Velenje. Besides from two training sessions organised in Velenje, DHS employees also participated in capacity building workshop Data intelligent operation of district heating and cooling in Zagreb, organised by UNIZAG FSB. During training in Velenje, the individual approach was used to address specific issues and concerns of this DHS operator effectively.



Several topics from organisational, managerial and financing topics group were covered during capacity building in Velenje. The focus was put on the development of sustainable and acceptable business plans, cost-benefit analyses and estimations of life-cycle costs. Furthermore, measures for increasing the attractiveness of DHS and processes for the improvement of organisational management were also addressed. During capacity building in Zagreb, employees of DHS Velenje were presented with a broader picture of district heating and introduced with new tendencies and technologies in DHSs.

The training was held as a sequence of presentations with an opportunity for the participants to take an active role and be involved in the discussion. The lecturers were employees of KSSENA, with knowledge and experience in addressed topics.

In total, 7 participants benefited from 23-hour capacity building. They provided positive feedback and complimented the opportunity to take an active role in training instead of being passive listeners. In conclusion, the capacity building achieved the objectives and successfully developed DHS operators' capacity in relevant topics.

Capacity building in Ptuj

The main objective of capacity building in Ptuj was to acquaint the participants with innovative approaches in DHSs. To help with the transition from gas to biomass, capacity building in organisational, financing, managerial as well as the integration of renewables was held. Two training sessions were organised in Ptuj, and the focus was on preparation of feasibility studies, business plans, planning and organisation of transition on renewable energy sources and cooperation with local authorities. Furthermore, biomass supply chains and biomass quality were addressed since they are very important aspects of biomass use.

The lecturers were employees of KSSENA and IDE (*Institut za daljinsko energetiko*), experts in particular fields. For most of the training, the participants were divided into groups based on their background and role in DHS. Participants working in the field were presented with technical topics, the introduction of renewables and biomass supply and quality, and participants operating the system were presented with financial, organisational and managerial topics such as increasing the attractiveness of DH, interaction with customers and organisational management.

Six participants benefited from 18 hours of capacity building in various topics. They provided positive feedback, especially about their active role in the training. They complimented the group work, and as a result of capacity building, they become aware of the benefits of changing the organisation and improving relations with customers.

Joint capacity building in Velenje

The main objective of joint capacity building in Velenje was to acquaint the participants with innovative approaches in DHSs by addressing multiple topics. The focus was on the strategic framework, best practice examples in waste heat integration, and technical issues such as energy losses and system optimisation. Capacity building was organised in the Municipality of Velenje and consisted of three sections.



The lecturers were representatives of KSSENA, IJS, Ministry of Infrastructure, Petrol, DHS Velenje and IDE. In the context of the national framework, the role of DHSs in national energy concept and financing experiences from previous financial perspective was presented and discussed. Furthermore, the practical experience of DHS renovation, RES utilisation, and network expansion potential was presented via presentations and a guided study visit to the local DHS Velenje. Finally,

the participants presented their own DHSs and challenges they are facing, which led to a lively discussion about opportunities within the KeepWarm project, further training etc.

Besides from DHS operators (middle or high management and experts), representatives of private companies in DH, institutes, local and national government participated in capacity building in Velenje. In total, 26 individuals benefited from 10-hour training. They provided positive feedback, evaluated training experience as very good and excellent, expressed

that they would like to hear more about technical aspects and good practice examples. What is most important, the knowledge gained during capacity building can be applied in their systems. In conclusion, the training increased DHS operators' capacity and provided networking between stakeholders involved in the DH sector in Slovenia such as national government, administrative bodies, local communities, etc.

Good practice example - Velenje

During capacity development in Velenje, a guided tour of local DHS was organised with a focus on the control room and heat deployment centre. DHS Velenje supplies around 250 000 MWh of heat annually using 476 heating substations. Although the system utilises waste heat from the coal-powered plant, it uses state-of-the-art equipment to effectively control system parameters and increase system efficiency and represent good practice example in modern and efficient system operation.



Capacity building in Slovenj Gradec

The overall goal of capacity building in Slovenj Gradec was to introduce innovative approaches in DHSs to the target group – DHS operator. Since DHS in Slovenj Gradec is planning the transition to biomass, training in biomass introduction, biomass quality, increasing attractiveness of DH, business plant development and feasibility study preparation were organised. The main objective was to increase capacity in the topics mentioned above to help the DHS in transition. The training was organised in Slovenj Gradec and consisted of 4 training sessions held by employees of KSSENA. Lectures and group work were oriented to only one DHS.

Training highlight – individual approach

DHS in Slovenj Grade in Slovenia is planning the transition to biomass, and since DHS operator has limited knowledge in all aspects of biomass use, individual training was organised. This approach ensured a quick and effective transfer of knowledge between the presenter and DHS operator. Besides from that, only topics relevant for the particular DHS operator were addressed, and training duration was minimised. In many training sessions, in partnering countries, individual approach to one DHS operator was used, which resulted in the quick transfer of knowledge and positive feedback from the operator.



In total, 3 participants benefited from 20 hours of capacity building. They provided positive feedback and stated that topics were appropriate, and the training was adequate for them. They complimented their role in training and work in a small group. In conclusion, their capacity in preparation of project documents and biomass use was successfully developed.

Capacity building in Komunala Trbovlje

The overall objective of capacity building was to acquaint participants with innovative approaches in DHSs. The main objective in Trbovlje was to increase knowledge in the optimisation of the DHS network and improve management in the DH unit.

The lecturers from KSENA presented content from organisational and managerial topics group such as identification of measures and processes for the improvement of DHSs and the increasing attractiveness of DH in close interaction with end-users and public authorities. After the lectures, interactive workshop on smart metering, smart DHS and system temperature optimisation was held.

To conclude, 3 participants benefited from 10-hour capacity building in technical, organisational and managerial topics. The participants stated that topics were adequate, and the training level was adopted to their knowledge. Furthermore, they were satisfied with the training type and tempo.

Capacity building in Nova Gorica

The main objective of capacity building in Nova Gorica was to increase the capacity of project facilitators in biomass supply chains and sustainable use of biomass so they can promote the use of RES, especially biomass in their municipalities and to DHS operators. The training was organised as a side event of the annual conference on renewable energy organised by the Alliance of Slovenian energy agencies.

The lecturer was representative of KSENA, and the participants were project facilitators with experience in biomass DHSs. During capacity building topics like the importance of supply chains, public procurement procedures, cooperation with forest owners, biomass supply in different market conditions and many others were addressed and thoroughly discussed.

In total, 15 participants benefited from 5 hours of capacity building. They provided positive feedback and will be able to replicate the training in their municipality and communicate with local DHSs and decision-makers. In conclusion, the training reached its main objective.

Capacity building in Celje

Specific objectives of capacity building in Celje were to increase capacity on network optimisation, stakeholder engagement, and preparation of investment documentation and the main objective was to deploy knowledge on optimisation of DH network and improve management of the unit.

KSSENA prepared three training sessions to address topics like the development of feasibility studies, business plans, assessment of energy losses, optimisation of system temperatures, improvement of organisation management and the increasing attractiveness of DHSs for end-consumers, and support from the local municipality. The focus was on the relationship with users and other stakeholders, business planning and soft measures for the improvement of DHS.

In total, 3 participants benefited from 20-hour capacity building. They provided positive feedback and stated they would use the gained knowledge to improve their system.

Capacity building of trainers

In Slovenia, 12 hours of capacity building of trainers was carried in three sessions, and a capacity of 6 individuals was increased. During the sessions, all key KeepWarm topic groups were addressed, and as a result, the participants were adequately prepared for further dissemination of gained knowledge.

Summary of capacity building in Slovenia

Table 14. summarises eight capacity building session organised in Slovenia.

Table 14. List of training sessions in Slovenia

CAPACITY BUILDING	TRAINING HOURS	DHS EMPLOYEES	OTHER STAKEHOLDERS	TOTAL INDIVIDUALS
1. Capacity building of trainers (3 sessions)	12	0	6	6
2. 1 st Capacity building in Velenje	23	7	0	7
3. Capacity building in Ptuj	18	6	0	6
3. 2 nd Capacity building in Velenje	10	14	12	26
4. Capacity building in Slovenj Gradec	20	2	1	3
5. Capacity building in Komunala Trbovlje	10	2	1	3
6. Capacity building in Nova Gorica	5	0	15	15
7. Capacity building in Celje	20	3	0	3
Total	117/100	27/30	29	56

The main goal of capacity building in Slovenia was to increase the capacity of 30 individuals employed in DHS companies. The organiser wanted to increase the capacity of DHS operators, so they can be able to assess their DHSs, elaborate business plans and develop pilot projects. Furthermore, the aim was to influence the day-to-day work of DHS employees, so they can improve their DHS systems and facilitate internal training to share

knowledge with other employees.

Training in Slovenia was mostly organised as previously planned. 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 where no top priority topic was recognised during the training needs assessment phase. The organiser adapted the training to meet DHS operators' needs. All topics marked as a top priority, and several others were addressed within the capacity development process. Finally, it can be concluded that the objective regarding the content of the capacity development was successfully achieved.

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. These individuals are directly related to the operation of DHS. The number of participants, including external stakeholders, exceeds planned goals, so it can be concluded that this training objective was also met. Summary of capacity building in Slovenia is presented in Table 15.

Table 15. Summary of capacity building in Slovenia

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

General feedback from the participants was very positive, and in conclusion capacity development in Slovenia achieved desired objectives and enabled training participants to improve the efficiency of their DHS systems, analyse their current state and prepare business plans. Furthermore, participants of capacity development for trainers successfully gained adequate knowledge which can be disseminated to other employees of their respective companies.

7. Ukraine

KT-Energy LLC organised the capacity building of DHS operators in Ukraine with help from DHS operators and local experts in particular topics. The training was conducted in the period from December 11th, 2018 to April 25th, 2019.

Based on the initial feedback from DHS operators and training plan, training consisted of five 2.5-day workshops. Technical topics were covered with two workshops, renewable energy sources and financial topics had one workshop each, and the managerial and organisational topics were held as one joint workshop.

The workshops usually consisted of lectures dealing with subtopics recognised as top priority or important. As the training progressed, the organisers adapted the sessions based on feedback from the participants and added more time dedicated for discussion among them. The main purpose of the workshops was to increase capacity in specific topics based on DHS operators' feedback.

Apart from lectures, field trips and practical sessions were also organised as a part of the training. The participants visited several locations – boiler houses and heating units and participated in practical sessions, such as session for leakage detection and set-up and adjustment of individual heating unit's session, where technologies and systems were demonstrated in practice.

The lecturers were employees of KT-Energy, DHS operators and other local experts with adequate knowledge and experience in areas they presented. The participants are employees of DHSs such as engineers, managers, maintenance workers and external stakeholders.

Capacity building in Technical topics

Capacity building in technical topics was organised in Bila Tserkva and Zhytomyr city. The training for engineers, technical and maintenance staff consisted of two 2.5-day workshops which were based on lectures and enriched with field trips and practical sessions.

The main training objective was to present current best practices on technological aspects of DHS modernisation projects and foster discussion among training participants on modernisation priorities.

The lecturers were employees of KT-Energy, DHS operators and local experts such as employees of private companies, accredited laboratories, energy efficiency centre etc. Training participants were engineers, directors, department heads, and a couple of participants were fitters or maintenance and operation specialists working in district heating systems.



In the first capacity building on technical topics, the focus was on network elements such as pipelines, heating units, remote energy monitoring systems and modernisation of gas boilers. Furthermore, instrumental methods for the detection of leakages were demonstrated. In the second capacity building in technical topics many interesting topics were presented such as practical aspects of set-up, adjustment and automation of individual heating units, supervisory control and data management system, remote monitoring, efficient pumping, modernization project in Zhytomyr DHS and role of DHS operators in development of municipal energy management system and energy efficiency projects in public buildings. Apart from lectures, practical sessions were a major part of the training and study visits to three heating units were organised. During the visit, all major and upcoming modernisation projects at Zhytomyr DHS were presented in detail.

Training evaluation

In total, 30 individuals, 24 from 4 DHS and six other stakeholders, participated in 40-hour capacity building in technical topics.

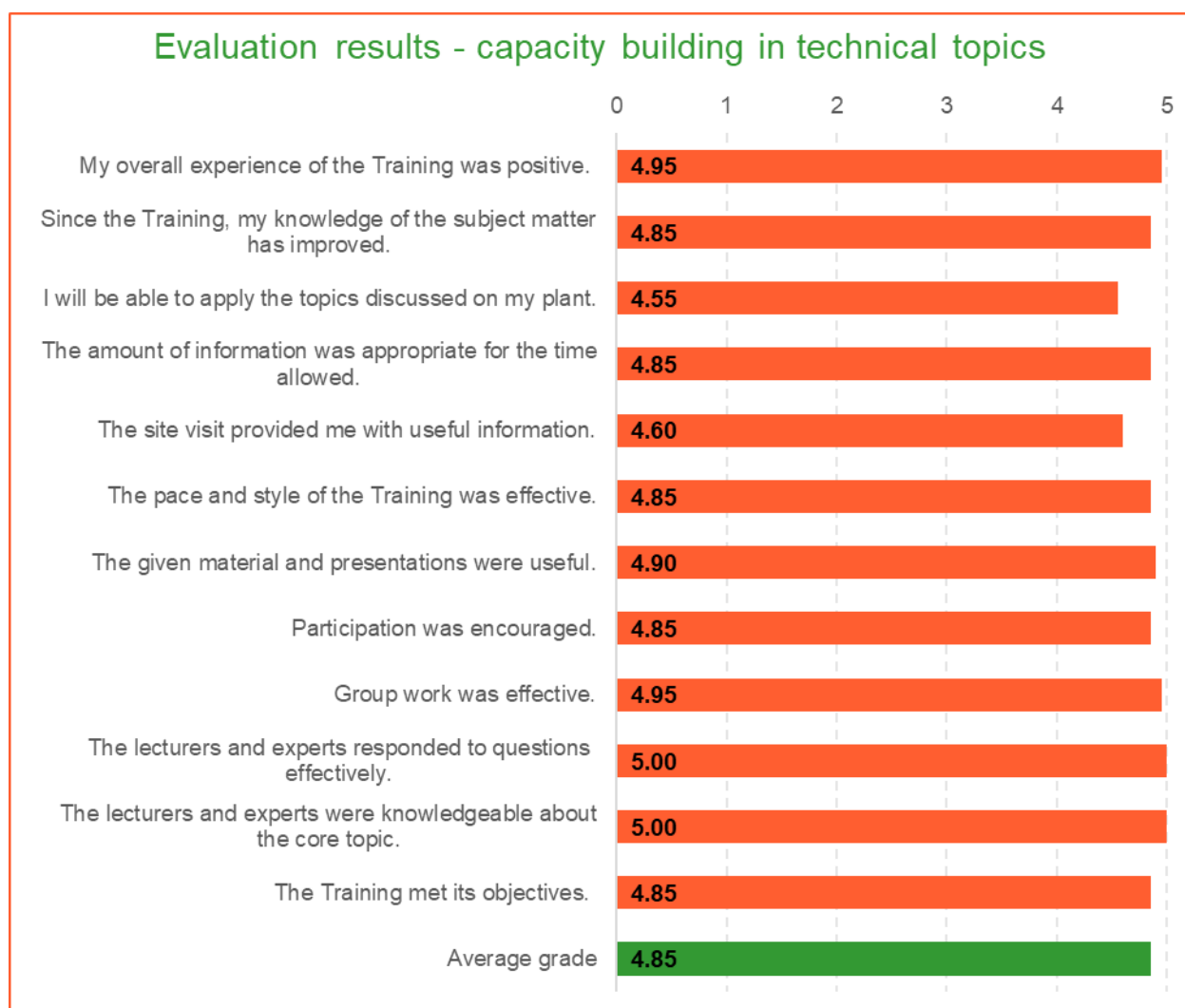


Figure 16. Evaluation results of capacity building in technical topics in Ukraine

In general, participants provided positive feedback about the training organisation and the content of the presentations, as well as the site visits. Since two workshops regarding technical topics were organised, participants' feedback on both workshops was combined, and training in technical topics was awarded 4.85 points on average. All training aspects rated more than 4.5 points varying from 4.55 for the ability to apply gained knowledge to 5.0 for the lecturer's expertise and knowledge. Results of the evaluation questionnaire are given in Figure 16.

Based on the feedback from the participants, lectures in technical topics were improved, and extra time was added for discussion during the second workshop. Furthermore, feedback from the participants resulted in a long list of mayor strengths and the most powerful training aspects, which are stated:

- presence of experienced and reputable lecturers who presented important topics
- involvement of training participants into discussions and communication with competent lecturers and peers from other DHSs
- inclusion of site visits and practical tasks
- presentations of practical examples of the results of modernisation projects and individual heating units set up
- discussions on the cooperation of DHSs operators with international financial institutions

According to the DHS operators, training could be improved via:

- inviting Ukrainian producers of boilers and auxiliary equipment and materials
- adding more practical tasks for training participants and using demonstration equipment and materials more actively
- adding additional site visits to the facilities of DHS operators
- involving representatives of international financial institutions for the discussion of funding for DHSs modernisation projects
- foreseeing more time for discussions

Apart from many topics and discussions, participants recognised some of the aspects as interesting and meaningful:

- scientific studies of Kyiv Polytechnic Institute on the energy efficiency of burners for natural gas-fired boilers
- individual heating unit's set-up and adjustment, as well as the potential for energy savings and automation of individual heating unit's operation
- regulatory requirements for individual heating units
- implementation of independent schemes for residential buildings connection to the heating network
- pre-insulated pipes and modern approaches for construction works
- methods of leakages detection and practical task on leakage identification in the underground pipelines

- meeting and communication with experienced experts and colleagues

The participants also stated that they would be able to apply gained knowledge in their work, especially the following:

- apply the knowledge of individual heating unit's set-up and adjustment
- change information that should be processed and displayed by the automation system
- apply the knowledge on instrumental methods of leakages detection and use acoustic method for leakages identification
- use the knowledge on pre-insulated pipes during the supervision of construction works for heating networks modernisation projects
- consider the introduction of the remote energy monitoring system
- review the technical requirements (terms of references) for the reconstruction of the connection unit with the installation of an individual heating unit at a residential building, considering the new knowledge gained during the training
- review and amend terms of conditions for the design works for projects foreseeing heat supply networks modernisation with the installation of pre-insulated pipes
- replace pumping equipment to increase energy efficiency
- introduce equipment for remote control

In conclusion, training in technical topics achieved its objectives, the participants provided positive feedback and, most important, recognised many ideas and/or changes that can be applied in practice.

Training highlight – practical session



Apart from lectures, training participants in Ukraine had several practical sessions and site visits. During one session, equipment for leakage detection has been demonstrated, and the practical use of measuring equipment has been conducted. During the session, a leakage point in the underground pipeline in Bila Tserekva city has been successfully identified. The participants complimented the session and stated that they would like to participate in more practical tasks

during the training. In general, practical sessions were carried out in several countries and resulted in positive feedback from the participants.

Capacity building in RES and EE topics

Capacity building in RES and EE topics in Ukraine was organised in Kamianets-Podilskyi city in the form of a 2.5-day workshop for engineers, technical and maintenance staff. The training was conducted as a combination of lectures and several site visits.

The main training objective was to present the best practices on renewable energy use in district heating systems and foster discussion among training participants and district heating modernisation projects using renewable energy sources.

The lecturers were employees of KT-Energy, DHS employees and employees of the state agency for energy efficiency. Participants were mostly engineers in charge of district heating systems, production units, planning and energy-saving units.

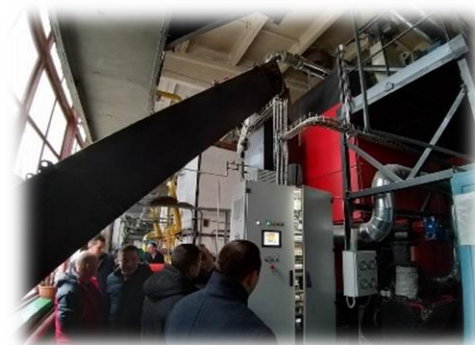
Capacity development in RES and EE topics was oriented on the utilisation of biomass, waste heat, solar energy and heat pumps in DHSs. During capacity building, experience from biomass to energy projects was presented, as well as biomass potential in Ukraine and Europe, biomass logistics and quality control. To increase training efficiency and address participants feedback, the number of study visits in RES and EE topics training was increased. One of the more notable examples presented is Miskteplovoenergiya - a company providing heating, water and hot water and taking care of wastewater in Kamianets-Podilskyi city. The company has actively worked on the substitution of natural gas with biomass fuels and represents a good practice example for the effective transition on RES.

Since Ukrainian DHS operators proposed a long list of additional topics, several of the proposed topics were also included in the capacity building in RES and EE topics:

- heat pumps
- tariff formation and economic aspects of biomass energy products
- energy resources consumption monitoring

Good practice example - Miskteplovoenergiya

Capacity building in RES and EE topics in Ukraine included site visits to several boiler houses owned and operated by Miskteplovoenergiya. The company has actively worked on the substitution of natural gas with RES (biomass) since 2014 and achieved a 20% share of RES and is on the way to increase the share to 33% with the commissioning of the new power plant. During the last five years, the municipal company gained valuable experience, which can be helpful to other DHS operators.



Training evaluation

20-hour capacity building in RES and EE topics gathered 15 participants from 4 DHSs. They provided positive feedback about training organisation, contents of the presentations and field trips. The average evaluation grade for different training aspects ranged from 4.4 to 5.0, and the training was graded with 4.8 points on average. Results of the training evaluation questionnaire are available in Figure 17.

The participants acknowledged several major strengths and useful aspects:

- information about the use of biofuel in the district heating system
- involvement of professional lecturers
- detailed information about biomass boilers and site visits to operating biomass boiler houses
- information about tariff setting for heat energy produced with alternative fuels
- shared lessons from the operation of biomass boilers based on the experience of Kamianets-Podilskyi DHS
- real-life examples of biomass to energy projects in district heating
- financial and logistical aspects of biomass to energy projects implementation in district heating systems
- information about climate change impacts and climate policy as related to district heating.

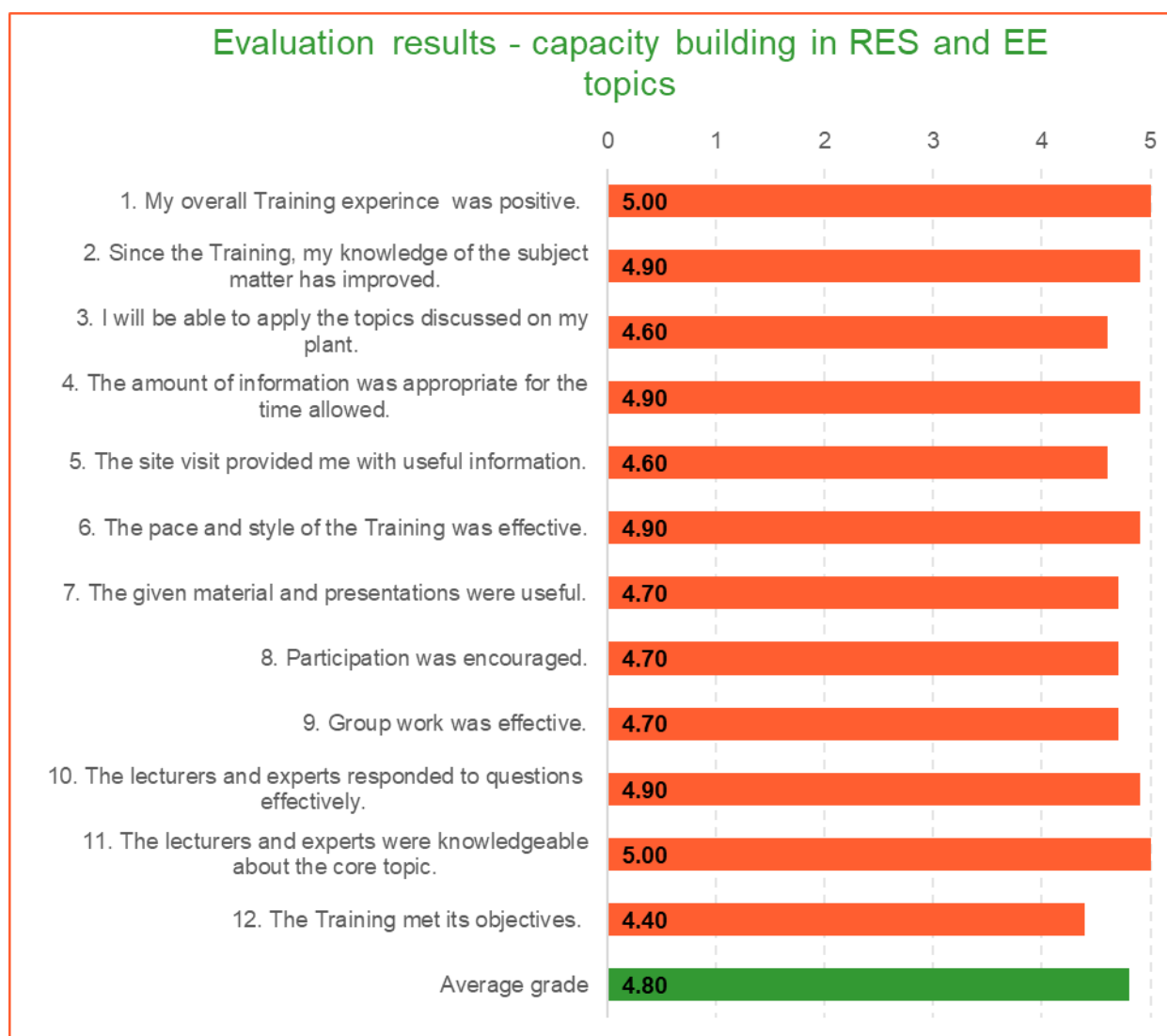


Figure 17. Evaluation results of capacity building in RES and EE topics in Ukraine

Some aspects stroke participants as interesting, new and meaningful such as:

- experience with the construction of new biomass-fired facilities
- equipment for heat generation using biomass and operation of cogeneration units
- environmental protection aspects during biomass boiler operation

Also, participants noted the following changes that they will make in their practice or one idea that they will put into practice, because of this training:

- start learning more about the use of biomass in district heating systems
- participate in a project foreseeing biomass power plant construction
- propose to consider a change in the design of a project planned to be financed by EBRD with the introduction of a biomass CHP unit instead of a biomass boiler.

Finally, capacity building in RES and EE topics received excellent grades, and the participants recognised changes and ideas that can be put into practice in their DHS, so in conclusion, the capacity building successfully reached planned objectives.

Capacity building in Organisation topics

Capacity building in organisational topics for managerial, administrative and supporting staff was organised as a 2.5-day workshop in Kyiv, in which organisational and managerial topics were combined. The training objective was to enhance the capacity of DHS operators in organisational aspects.

The training was organised by KT-Energy with the involvement of local experts such as a representative from the Bioenergy Association of Ukraine and state carbon and financing experts. Individuals participating in the training were engineers in planning and economic units, investment analysts, leading engineers, development department employees etc.



After the introductory part, organisational barriers for the development of DHSs in Ukraine and potential solutions were discussed. Furthermore, issues dealing with the organisation of DH networks such as legal framework and GHG emissions were also addressed in this capacity building.

Training evaluation

The training lasted for 11 hours and 20 individuals employed in DHSs participated. They provided positive feedback about the training organisation, the content of the presentations and the presenters. The average evaluation of the training ranged from 4.1 to 5.0, with an average grade of 4.8. In average, all training aspect were given more than 4.5, so training experience was excellent. Figure 18 shows the results of the training evaluation questionnaire.

Among many training aspects, the trainees emphasised several as very useful such as:

- active discussion of common problems and approaches to solve them, exchange of experience with colleagues;
- participation of the representatives of the key state authorities regulating and managing the district heating sector (State Agency on Energy Efficiency and Energy Savings; Reforms Support Office of the Ministry of Regional Development, Construction, and Utilities Sectors; National Commission on Regulation of Energy and Utilities Sector (the Regulator, etc.)
- clarification of the provisions of new regulatory and legislative acts covering the district heating sector from experienced experts
- clear and up-to-date information on the problems of the district heating sector and professional speakers
- communication with colleagues from other regions

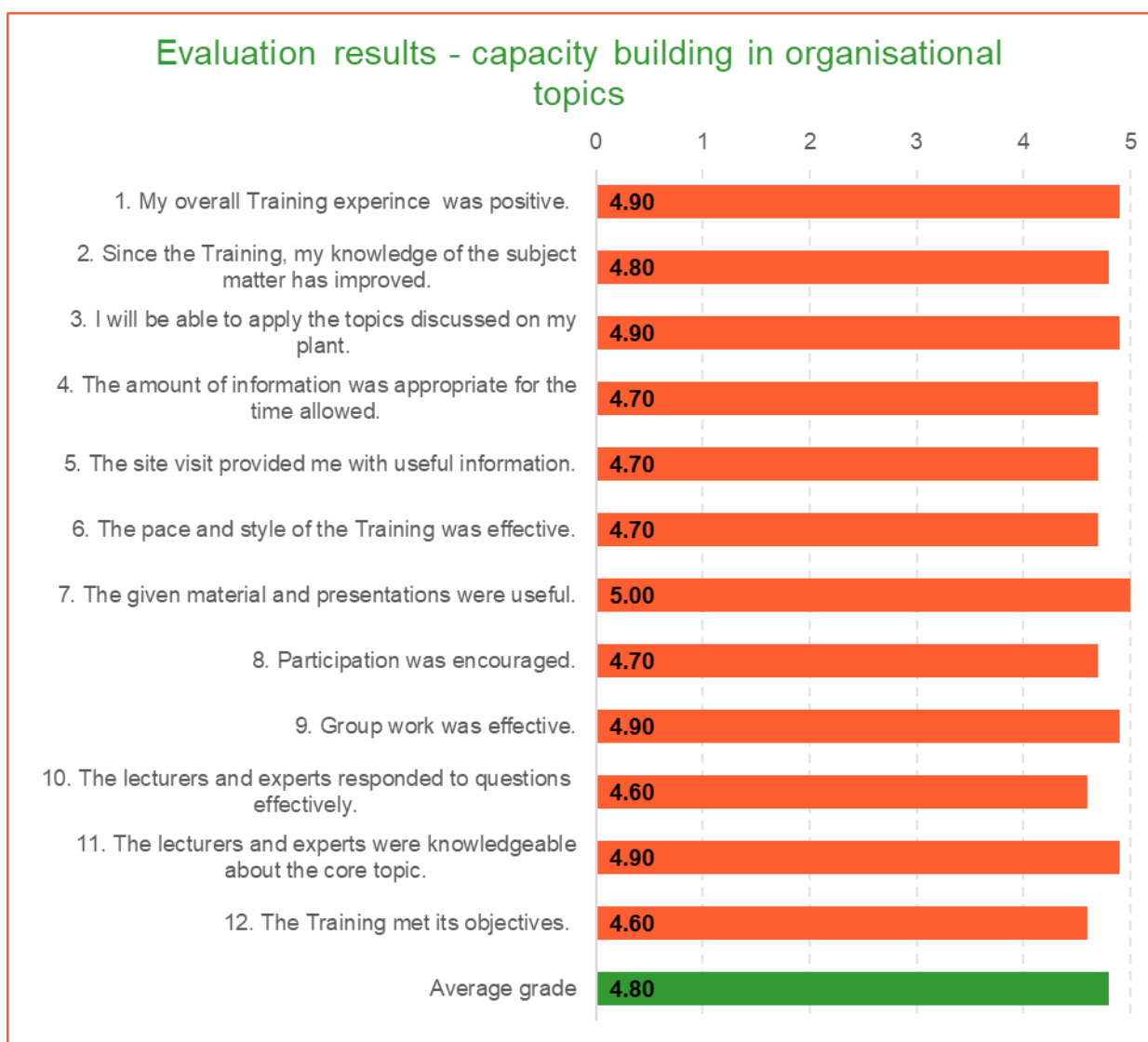


Figure 18. Evaluation results of capacity building in organisational topics in Ukraine

Furthermore, they mentioned that additional representatives from relevant departments of the Ministry of Regional Development, Construction and Utilities sector should also be invited. According to the participants' feedback, some training aspects stroke them as interesting and/or meaningful:

- overview of emission trading system operation and greenhouse gases emissions monitoring requirements
- discussion on organisational problems in the district heating sector in Ukraine

The participants additionally noted that they would be able to implement the following ideas and knowledge into practice;

- calculate GHG volumes considering the potential introduction of MRV requirements and emission trading system, including pilot preparation of monitoring documentation using simplified procedures
- contribute to the submission of recommendations on exemption of biomass-based heat energy generation from carbon taxation to the relevant state authorities

In conclusion, the capacity building achieved its objective, successfully increased DHS operator's capacity in the organisational topic and enabled the participants to apply gained knowledge in practice.

Capacity building in Financing topics

Capacity building in financing topics in Ukraine was organised as a 2.5-day workshop in Kyiv. The objective of the training was to enhance the expertise of DHS operators in financial planning, investment projects development and implementation.

Lecturers were state agency representatives, KT-Energy LLC employees, DHS managers, local government representatives etc. Participants were engineers employed in investment projects and implementation services, investment analysts, employees in charge of commercial aspects, sales etc.

Training in financing topics was organised to cover all relevant financing issues, so all KeepWarm topics from financing topics group were addressed. First of all, training was focused on the analysis of current condition in DHSs such as financial state, debt, subsidies and legislative framework. Furthermore, topics like management of investment projects, cooperation with financial institutions and opportunities for investment in the DH sector were presented. To enable DHS operators to prepare their business plans training in financial modelling, business analysis, business planning and barrier analysis was also carried out.



Training evaluation

Training in financial topics lasted for 20 hours, and 16 trainees participated. Training mostly consisted of presentations and slots dedicated to discussion. Training participants provided

positive feedback with grades ranging from 4.3 to 5.0. The training was graded with an average grade of 4.7. Results for training aspects are available in Figure 19.

The major strengths and most useful aspects noted by training participants included the following:

- discussion on interesting and important questions such as approval of the new state strategy on the heating energy sector
- involvement of the participants in discussions and collective work
- qualification of lecturers and good presentation style
- participation of the industry association representatives and state authorities

The participants mentioned the following aspects of the training that could be improved:

- the more frequent organisation of the training
- invitation of the representatives of the Ministry of Construction and Regional Development
- allowing speaking for each training participant

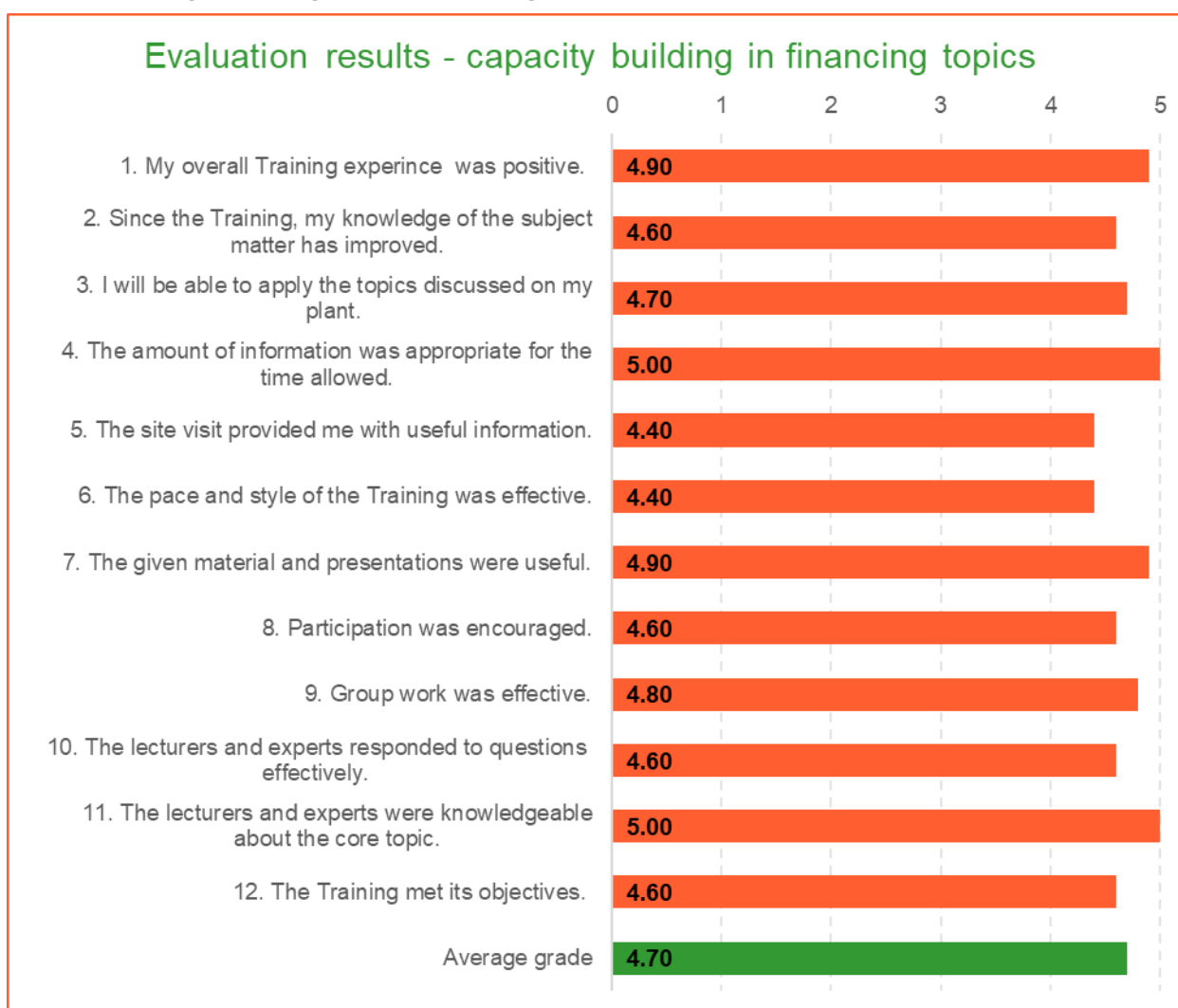


Figure 19. Evaluation results of capacity building in financing topics in Ukraine

Several aspects stroke them as new, interesting and very useful such as:

- Commercial Metering Law and its impact on financial operations of enterprises
- incentive-based tariff mechanisms in the heat supply sector
- experiences from DHS modernisation projects
- discussion with other DHS operators and other stakeholders

After the training, the participants also stated that they would be able to:

- use of the knowledge gained during the implementation of the projects under the support of international financial institutions and managing DHS modernisation projects
- implement changes in the enterprise due to the discussed legislative changes

In conclusion, training in financing topics successfully increased trainees' capacity in training topics important for DHS operators and prepared them to use gained knowledge in practice.

Capacity building in Management topics

Capacity building for managerial, administrative and supporting staff in management topics was joined with organisational topics. General information about training location, lecturers and participants can be seen above, under the capacity building in organisational topics.

The main training objective in Management topics was to increase the capacity of DHS operators in managerial aspects.

In this capacity building focus was put on public relations, individual billing, retrofitting DH networks and ensuring biomass supply. One of the more important topics covered in this capacity building was individual billing. Based on the first successful case of individual heat metering in Ukraine, a detailed analysis of the methodology on heat allocation in the multi-apartment building was carried out. Furthermore, retrofitting DHS networks and ensuring biomass supply were discussed from the legislative perspective. Regarding public relations, effective communication tools, social media management and press releases were presented since they are vital for effective communication with end-users.

Training evaluation

Capacity building in management topics lasted for 9 hours and gathered 20 participants. Training in management topics has been evaluated together with training in the organisational aspect, and individual grades for certain training aspects can be seen under training evaluation in organisation topics chapter. Additionally, answers on questions 13-17 in training evaluation questionnaire are given below.

According to the participants feedback several training aspects stroke them as interesting and/or meaningful;

- individual metering of heat energy consumption in multi-apartment buildings
- discussion of the Law of Ukraine On Commercial Metering

- legislative changes in tariff setting procedures and requirements
- communication tools for DHSs operators

Participants additionally noted that they would be able to implement the following ideas and knowledge into practice:

- communicate with the customers about potential projects on individual metering in multi-apartment buildings;
- conduct more intensive awareness activities and stakeholder consultations (including customers and members of city councils) to secure DHS modernisation projects support
- implement new tools for communication with customers (using bills as an information and advertisement tool), implement changes concerning websites performance, improve communication policy of the enterprise to ensure more efficient communication with the customers
- detailed analysis of the new Laws of Ukraine On Commercial Metering and On Utility Sector and improve the procedures to monitor and analyse new legislative changes

In conclusion, training in managerial aspects reached its objective and successfully enabled DHS operators to implement gained knowledge.

Summary of capacity building in Ukraine

The goal in Ukraine was to build the capacity of at least 20 individuals representing partnering DHS operators. According to the *Training needs assessment*, the partners expected participants to gain new skills, knowledge and experience, which can be practically applied during the modernisation of DHSs.

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 where DHSs prioritised technical topics over organisational and managerial. Besides that, the training organisation went according to the previously defined training plan, and all topics considered top priority were discussed. Furthermore, many other topics which received higher grades during the assessment phase were also covered alongside several topics proposed by DHS operators themselves.

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. Table 16 shows the summarised numbers regarding training duration and the number of participants in Ukraine per training topics.

General impressions towards the training were positive, and the participants recognised the effort, complemented the lectures, emphasised many positive training aspects and managed to acquire the knowledge which can be applied in practice. They also proposed

additional improvements to increase training effectiveness and improve the discussion.

Table 16. Summary of capacity building in Ukraine

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	100/100	46/20	6	52

In conclusion, capacity development in Ukraine successfully reached planned objectives regarding the content, training duration and the number of participants who will be able to apply gained knowledge in practice to increase the efficiency of their systems and implement changes that will have a positive impact on their DHSs.

Capacity building conclusions

The goal of the KeepWarm project was to increase the capacity of at least 150 employees of DHS operators in five main KeepWarm topics. In the end, capacity building in seven countries reached 617 individuals employed in DHSs and additional 196 external stakeholders, which adds up to 813 individuals in total. The number of participants exceeded the expectations and capacity building was received exceptionally well.

In seven partner countries, 746 hours of training were held divided into 68 training sessions, and the goal of 700 hours of training was exceeded by 46 hours. Since DHS operators provided inputs that training in technical topics was a priority, 213.5 hours of capacity building in technical topics were held, and the number of individuals benefiting from the training peaked at 565 persons. On the other hand, training in organisational topics lasted 105 hours since DHS operators showed weaker interest in topics from this group. Table 17 summarises the number of participants and training duration per five KeepWarm topics in all partner countries.

Table 17. Summary of capacity building in all partner countries

TOPIC	TRAINING HOURS	DHS EMPLOYEES	OTHER STAKEHOLDERS	TOTAL INDIVIDUALS
1. Technical topics	213.5	441	124	565
2. RES and EE topics	160.5	393	144	537
3. Organization topics	105	315	36	351
4. Financing topics	150.75	260	40	300
5. Management topics	114.25	256	20	276
Total	746/700	617/150	196	813

Regarding the content, topics considered top priority from all five topics group were addressed in all countries, with Croatia being the exception by cancelling training in organisational topics. Furthermore, many other topics, considered important but not top priority by the DHS operators, were also presented and discussed. Training topics defined within the project are presented in Table 18 on the next page, and topics addressed in particular country are marked with ✓. As can be seen from the table, several topics were addressed in all countries. Topics reduction of energy losses and integration of energy losses from technical and RES and EE topics group were addressed in all countries since they are necessary for increasing systems' efficiency and reducing operating expenses. Furthermore, financial topics such as economic feasibility analysis, financial support and funding sources were also covered in all countries, to enable DHSs to understand financial statements and prepare and finance projects for improving DHSs. Although initially not considered top priority topics, retrofitting of DH networks was addressed in all countries since most of the DHS require continuous network rehabilitation.

Table 18. Summary of addressed training topics

TOPIC N° AND A SHORT DESCRIPTION	AUSTRIA	CROATIA	CZECH REPUBLI	LATVIA	SERBIA	SLOVENIA	UKRAINE
1. Technical topics							
1.1 Reduction of energy losses	✓	✓	✓	✓	✓	✓	✓
1.2 Control of heat generation and storage	✓		✓	✓	✓		
1.3 System temperatures	✓	✓	✓	✓	✓	✓	
1.4 Energy audits and surveillance	✓	✓			✓		✓
1.5 Adaptation to reduced heat demand		✓		✓	✓		✓
1.6. DH vs decentralised solutions			✓				
1.7 Cost-effective optimisation	✓	✓	✓	✓	✓	✓	✓
1.8 GIS applications		✓		✓	✗	✓	
2. RES and EE topics							
2.1 Integration of RES	✓	✓	✓	✓	✓	✓	✓
2.2 Industrial waste heat			✓	✓		✓	✓
2.3 Feasibility of fuel switch		✓	✓	✓	✓	✓	
2.4 Biomass supply	✓		✓	✓	✓	✓	✓
2.5 Biomass quality	✓		✓	✓	✓		✓
3. Organisation topics							
3.1 Organization of DH networks	✓	✗	✓	✓	✓		✓
3.2 Operation of boiler houses	✓	✗		✓	✓		
3.3 Corporate organisation	✓		✓	✓	✓	✓	
4. Financing topics							
4.1 Viability of RES and waste heat		✓	✓	✓	✓	✓	✓
4.2 Innovative financing	✓	✓	✓	✓	✓		✓
4.3 Economic feasibility analysis	✓	✓	✓	✓	✓	✓	✓
4.4 Financial support and funding sources	✓	✓	✓	✓	✓	✓	✓
4.5 Business planning	✓		✓	✓	✓	✓	✓

5. Management topics							
5.1 Demand-oriented service schemes	✓	✓	✓	✓	✓	✓	
5.2 Public relations		✓	✓	✓	✓	✓	✓
5.3 Assessment of user behaviour		✓	✓	✓			
5.4 Individual billing		✓		✓			✓
5.5 Rewarding energy savings			✓		✓		
5.6 Retrofitting DH networks	✓	✓	✓	✓	✓	✓	✓
5.7 Ensuring biomass supply	✓		✓	✓	✓		✓

As already mentioned, DHS operators and other training participants evaluated training using training evaluation forms. The results showed general satisfaction with training and positive feedback, supported by very good or excellent numerical grades for training sessions. Numerical grades for various training aspects varied but were generally, very good or excellent. Furthermore, participants' feedback was usually used for the improvement of upcoming training.

The participants, in general, expressed satisfaction with the organisation of training, complimented the lecturers and proposed to conduct similar training in the future. They recognised many major training strengths and most useful aspects such as lecturers with work and life experience in specific areas, high-quality content, concrete problem identification, the inclusion of study visits, practical sessions and good practice examples. Besides from individual approach, workshops, software training, practical sessions and field trips, which are focused on the transfer of knowledge, the participants listed other useful training aspects such as networking and discussion with relevant stakeholders. They appreciated time for discussion because it enabled them to address current issues and work on the solutions with other DHS operators and other relevant stakeholders. Furthermore, the participants were thankful for the opportunity to meet relevant stakeholders such as representatives of government, energy agencies, companies in the energy sector etc. which can help them in improving their DHSs.

Since the participants prefer practical lectures and inputs over theoretical, they proposed including more practitioners, exercises, study visits and good practice examples to improve training. Additionally, they requested more time dedicated to the discussion and joint problem solving and proposed exhibiting posters, leaflets and other materials on the newest products, equipment and services related to DH.

Among many addressed topics the participants mentioned some as more interesting such as system temperature optimisation, use of solar thermal, biomass and heat pumps in DH, energy renovation of buildings and individual billing, European legislation in DH, current trends in DH industry, public relations and customer care.

The participants stated that training met the primary objective and effectively increased their capacity in relevant topics. They stated that they would be able to apply gained

knowledge in improving the efficiency of their systems, including RES and improving management of their organisations. In conclusion, training effectively increased the capacity of DHS operators. Besides providing positive inputs, participants' feedback also provided valuable lessons for future training of DHS operators.

The used training material will be available on the KeepWarm website to ensure sustainability and to enable further DHS to train themselves. The first set of material is available on KeepWarm learning centre (<http://www.keepwarmeurope.eu/learning-centre/>) and the respective country pages. All materials will be publicly available latest in October 2019.

Annex

Training evaluation form



This project has received funding from the European Union's Horizon 2020 research and innovation programme.

KeepWarm: Improving the performance of district heating systems in Central and Eastern Europe

Training evaluation form

Please respond to each of the following questions, they are intended to allow us to evaluate held and improve upcoming trainings. Please be as honest as possible to provide us with an accurate assessment of your experience. Thank you for taking the time to complete this.

Date, Location and Topic of Training:

Circle 1-5 with your evaluation.

	Strongly Disagree		Neutral		Strongly Agree	
1. My overall experience of the Training was positive.	1	2	3	4	5	
2. Since the Training, my knowledge of the subject matter has improved.	1	2	3	4	5	
3. I will be able to apply the topics discussed on my plant.	1	2	3	4	5	
4. The amount of information was appropriate for the time allowed.	1	2	3	4	5	
5. The introductory presentations/site visits provided me with useful information.	1	2	3	4	5	
6. The pace and style of the Training was effective.	1	2	3	4	5	
7. The given materials were useful.	1	2	3	4	5	
8. Participation was encouraged.	1	2	3	4	5	
9. Group work was effective.	1	2	3	4	5	
10. The facilitator responded to questions effectively.	1	2	3	4	5	
11. The facilitator(s) was knowledgeable about the core topic.	1	2	3	4	5	
12. The Training met its objectives.	1	2	3	4	5	

WP N°2



13. What were the major strengths of the Training? What did you find most useful?

14. What aspects of the Training could be improved and how?

15. Did anything strike you as interesting, new, provocative, or meaningful during the Training?

16. Can you identify one change that you will make in your practice, or one idea that you will put into practice, as a result of this Training?

Training evaluation form

2 / 3

WP N°2



17. What part of the Training format should be changed to improve discussion?

18. Any other comments?