



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

Deliverable N°2.1.

Training needs assessment and training plan

WP N° 2 Capacity Building of DHS operators

Horizon 2020 (H2020-EE-2017-PPI)

Project N°784966



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List of Abbreviations

AT	Austria
CEE	Central and Eastern Europe
CoM	Covenant of Mayors for Climate and Energy
CZ	Czech Republic
DHS	District heating system
GHG	Greenhouse gas
HR	Croatia
LV	Latvia
RES	Renewable energy source
SI	Slovenia
SRB	Serbia
UKR	Ukraine

Summary of the project

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

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

Project objectives

KeepWarm’s specific objectives are:

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

KeepWarm consortium partners

Logo	Partner name	Short name	Country
	Deutsche Gesellschaft für internationale Zusammenarbeit (GIZ) GmbH	GIZ	Germany
	University of Zagreb Faculty of Mechanical Engineering and Naval Architecture	UNIZAG FSB	Croatia
	Landeskammer für Land- und Fortwirtschaft in Steiermark	LWK	Austria
	Regionalna Energetska Agencija Sjeverozapadne Hrvatske	REGEA	Croatia
	Jožef Stefan Institute Energy Efficiency Centre	JSI	Slovenia
	ICLEI European Secretariat GmbH	ICLEI	Germany
	Teplarenske Sdruzeni České Republiky	TSCR	Czech Republic
	Biedriba Zemgales Regionāla Energetikas Agentūra	ZREA	Latvia
	Zavod Energetska Agencija za Savinjsko Salesko in Korosko	KSSENA	Slovenia
	LLC KT-Energy	KTE	Ukraine
	Institut za Nuklearne Nauke Vinca	VINCA	Serbia

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Executive summary

The Project “Improving the performance of district heating systems in East 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 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 reaching these goals is capacity building. The report D2.1 Training needs assessment and training plan summarizes the input given by DHS operators and presents conclusions and recommendations for the next steps towards the training of DHS operators.

The main objective of the capacity building of the DHS operators is to design and organise the tailor-made training programs to address the specific objectives and capacities of the target groups. The development of training programme and implementation will ensure that DHS operators and others, like public authorities or development and energy agencies, have increased their capacity on technical, organizational, financial and managerial concerns, especially those which are most relevant for the renovation and improvement of selected DHS in seven countries.

The tailor-made approach based on the real necessities of the DHS operators, which were learned from questionnaires, was used due to differences among selected DHS. In total, 52 DHSs participated in the training needs assessment among the seven partner countries. Proposed training topics were clustered in five groups:

- Capacity development on technical concerns
- Capacity development on the utilization of RES, waste and excess heat
- Organizational capacity development
- Financial concerns and
- Managerial concerns.

The following topics were raised in almost all partner countries and DHS operators:

- Reduction of energy losses – Assessment of energy losses in the district heating grid and determination of actions to improve grids and make them smart by using remote metering systems and metering standards.
- Demand-oriented service schemes – Identification of measures for increasing the attractiveness of DHS for end-consumers, in close interaction with end-consumers and public authorities.
- Integration of RES – The inclusion of RES in DHS (solar thermal, biomass, geothermal, heat pumps, etc.).

Preference survey to organise suitable and complementary training has shown that all partners would like to have training in form of lectures and workshops in combination with field trips. Almost all interviewed DHS operators would like to have a training organised for 8-hour daily slots. Online learning materials like presentations, exercises and scripts have been the preferred option for learning material. When it comes to the participating personnel the most common answer was that they would send engineers or managers, but this depends again on the specific training topic. Almost all DHS operators would like to involve also

representatives of local and/ or regional public authorities and representatives of development and/ or energy agencies in the training.

The training will be in general organised during the period from September 2018 until April 2019 and the lecturers will be recognised as a national expert in the field as well as researchers, representatives of DHS, etc. The evaluation of the training efficiency will be done through anonymous questionnaires and signed participant lists. Expected competences of participants vary according to the training topic but are broadly the same, e.g. increase knowledge and expertise of employees in the specific topic's groups, ability to adapt learnings and best practices to the own DHSs and to draw conclusions on DHS economic factors/ efficiency, energy losses and involvement of new energy sources. In most cases, however, experiences and some basic knowledge about DHS are required from participants to be able to join the training.

1. Introduction

1.1 The KeepWarm project

The Project “Improving the performance of district heating systems in East 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 modernized. Considering that the predominant energy sources used are still fossil fuels (oil, gas or coal) makes interventions 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 modernized.

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 the case of large-scale DH systems that are mostly found in Eastern Europe. Likewise, it is important to ensure that existing DHS that run on renewables do not switch back to fossil fuels.

The main objective of the capacity building of the DHS operators is to design and organise the tailor-made training programs to address the specific objectives and capacities of the target groups. The development of training programme and implementation will ensure that DHS operators and others, like public authorities or development and energy agencies, have increased their capacity on technical, organizational, financial and managerial concerns, especially those which are most relevant for the renovation and improvement of selected DHS in seven countries.

The tailor-made approach based on the real necessities of the DHS operators, which were learned from questionnaires, was used due to differences among selected DHS. They differ on the public perception in country, types and scale, usage of renewables, coverage of heat demand, efficiency, etc. Some of the characteristics of DHS in countries like Austria and Latvia are:

- The long history of (high-efficiency) DHS;
- High connection rates generally well received by consumers;
- Conducive policy framework stimulating investment;
- Adding functions beyond heat-provision is still a challenge;

For Croatia, Czech Republic and Slovenia:

- The high share of heat from DHS, though need to overcome inefficient (state-run) systems;
- Considerable room for improvement of efficiency and share of RES;
- Benefits of DHS are understood by national governments and ambitious targets in this regard can be found in national strategies and action plans;

And for Serbia and Ukraine:

- Often very inefficient DHS, heavily reliant on (imported) fossil fuels, with little RES;
- Limited trust by end-consumers;
- Policy frameworks are not conducive and little investment is seen;
- Strive for energy independence and national governments are ambitious to comply with EU standards.

1.2 Objectives and scope of training needs analysis and training plan

The first step towards the capacity building of the district heating system (DHS) operators in Austria, Croatia, Czech Republic, Latvia, Serbia, Slovenia, and Ukraine is a detailed training needs assessment involving DHS operators in these countries. The objective is to assess the training needs of DHS operators and propose suitable training measures. This will lead to the definition of a training plan for each of the seven countries. Proposed training topics were clustered in the following major groups:

- Technical concerns,
- The utilisation of renewable energy sources, waste and excess heat,
- Organisational capacity development,
- Financial concerns,
- And managerial concerns.

The main instrument for the training needs assessment are two questionnaires, which are - in the English version - included in the annex of this deliverable. The first questionnaire focuses on the identification of training topics, which are of highest interest to DHS operators. The second questionnaire asks for the DHS operators' preferences regarding the type, timing, organisation, etc. of specific training measures.

Interviewed DHS operators were asked to rate the priority for each proposed topic from their points of view (1 being lowest and 5 the highest priority).

The importance of topics to DHS operators are considered as followed:

- >4 very important (> 81%)

- 3,7 – 4 important (74% -80%)
- 3,3 – 3,7 *rather lightly important* (66% - 73%)

The main training focus lies on the identified topics, which gained more than 74% by the DHS operators. If none of the subthemes in the topic groups could reach the (highly) importance lightly important topics will be identified and will partially be included in the training.

The report summarizes the input given by DHS operators and presents conclusions and recommendations for the next steps towards the training of DHS operators.

2. Training needs assessment

2.1 List of training topics proposed to DHS operators

The training topics proposed to the DHS operators were clustered in five groups as listed here:

Table 1: Training topics proposed to DHS operators

Training topics proposed to DHS operators		
Topic n° and a short description		Full topic description
1. Technical topics	1.1 Reduction of energy losses	Optimisation of heat networks energy audits and surveillance
	1.2 Control of heat generation and storage	Automation of boiler house/substation and heat storage optimisation
	1.3 System temperatures	Optimising temperatures of supply/return pipes
	1.4 Energy audits and surveillance	Optimisation of heat networks energy audits and surveillance
	1.5 Adaptation to reduced heat demand	Modelling of DHS after energy retrofitting of connected buildings (consumers) – Building retrofit reduced heat demand, so DHS often needs to be adjusted to new heat demand
	1.6. DH vs. decentralised solutions	Technical evaluation and comparison of the municipal heating system development options, including a comparison of DHS with decentralised solutions in municipalities with reduced heat load density
	1.7 Cost-effective optimisation	Identification of cost-effective approaches to optimize DHS
	1.8 GIS applications	Use of GIS-based tools (Heat demand assessment, DH network

		development, mapping of excess heat sources)
	2.1 Integration of RES	The inclusion of RES in DHS (solar thermal, biomass, geothermal, heat pumps, etc.)
2. RES and EE topics	2.2 Industrial waste heat	The utilisation of waste heat in an urban environment and from industrial sites
	2.3 Feasibility of fuel switch	Feasibility analysis of switching from fossil fuel to renewable energy or waste heat sources and feasibility analysis of using different RES/waste heat
	2.4 Biomass supply	Sustainability of biomass supply (increasing capacity of plant operators and their fuel/biomass suppliers, estimation of biomass potential)
	2.5 Biomass quality	Assessment of the biomass quality
3. Organisation topics	3.1 Organization of DH networks	Identification of measures and processes for improving the organization management of DH&C networks (comprising energy generation, distribution and consumption)
	3.2 Operation of boiler houses	The increase of the organisational qualifications of boiler house operators
	3.3 Corporate organization	Different possibilities to organise DH companies according to national law
4. Financing topics	4.1 Viability of RES and waste heat	Assessment of the economic and financial viability of using RES and waste heat in DHS plants
	4.2 Innovative financing	Development of innovative financing mechanisms (on-bill, public-private, the inclusion of consumers/citizens...)
	4.3 Economic feasibility analysis	Tools for economic/financial viability analysis
	4.4 Financial support and funding sources	Financial support schemes and funding sources for DHS retrofits and decarbonisation
	4.5 Business planning	Business plans development
5. Management topics	5.1 Demand-oriented service schemes	Identification of measures for increasing the attractiveness of DHS for end-consumers, in close interaction with end-consumers and public authorities
	5.2 Public relations	Training on PR and user engagement towards new and existing consumers
	5.3 Assessment of user behaviour	How to assess user behaviour
	5.4 Individual billing	Identification of options for individual billing in multi-apartment buildings equipped with building heat meters
	5.5 Rewarding energy savings	Increasing transparency of information about bill structure and available energy services to reduce heat consumption

	5.6 Retrofitting DH networks	Contractual arrangements needed to ensure a smooth retrofit of the DH network
	5.7 Ensuring biomass supply	Contractual arrangements needed to ensure a smooth biomass supply

The order of the following detailed training is a proposal but will be adapted according to the implementation and request during the implementation of the DHS operators. However, the mentioned topics per country won't change and will be covered by the training. All trainings and their efficiency will be evaluated by using a standardized evaluation form developed for the KeepWarm project. The attendance of participants will be monitored through signed participants list for each training day. The whole training package per country will last at least 100 hours. In some cases, the training time could raise up.

2.2 The result of the training needs assessment per country

Austria

a) Interviewed DHS operators

A total of 24 DHS operators provided their input to the training needs assessment. Most of them are relatively small systems, only 4 (16.6%) are larger than 5 MW thermal, and they hardly have more than one employee (see Figure 1).

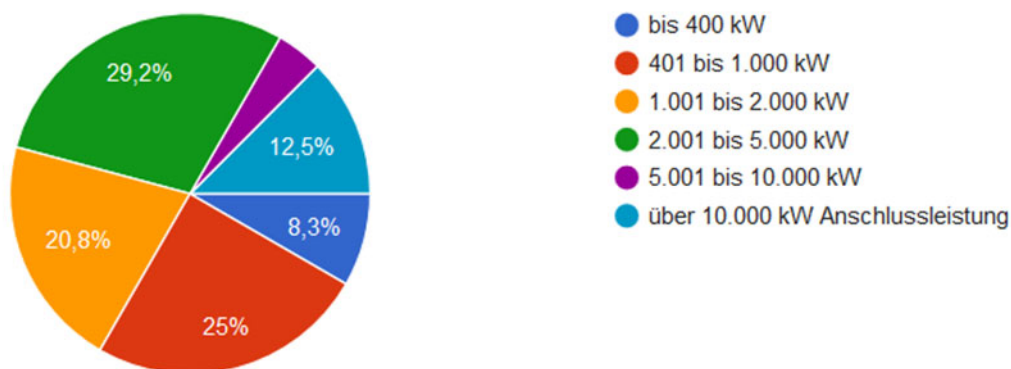


Figure 1: Size of the interviewed DHS

For 90% of the systems, the most important heat source is biomass. For the remaining 10%, it is photovoltaics. In addition, DHS use a wide mix of energy sources including oil (mostly for covering peak demand), natural gas, solar thermal, energy from waste, excess heat and biogas. 50% of the interviewed DHS operators are planning optimisation and renovation actions for their DHS systems and want to implement these actions during the next two years.

b) Rating of proposed training topics

The ratings of proposed training topics are shown in Figure 2

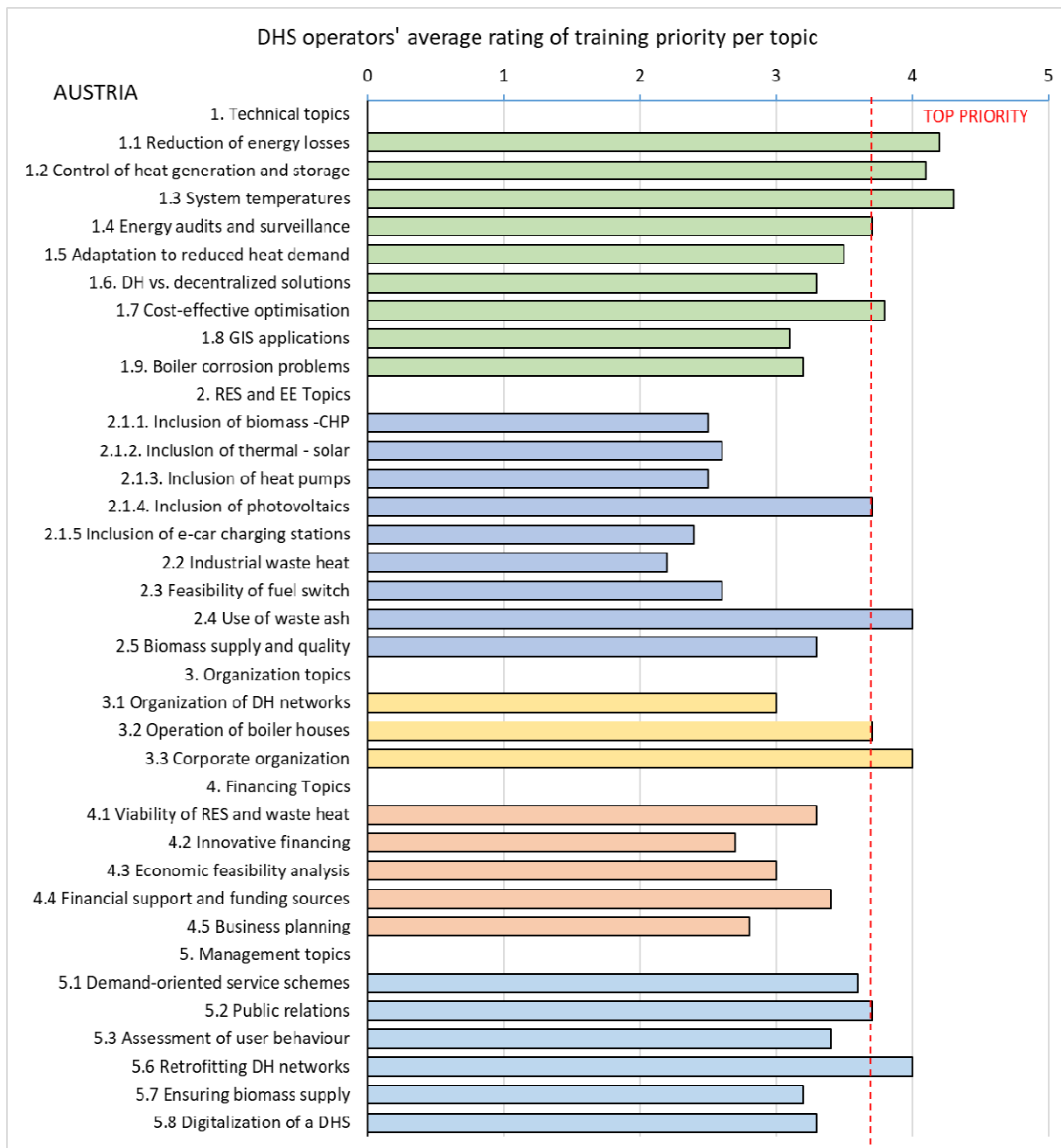


Figure 2: Prioritisation of training topics for DHS operators in Austria

The highest priority has been given to the technical group of topics, with three topics rated higher than 4 points. These topics are:

- System temperatures (4,3)
- Reduction of energy losses (4,2)
- Control of heat generation and storage (4,1)

Other technical topics which are considered as a top priority are cost-effective optimisation (3,8) and energy audits and surveillance (3,7). From the RES and EE topic group inclusion of photovoltaic (3,7) and use of waste ash (4,0) has been considered as important. In the organisation topics group, corporate organisation (4,0) and operation of boiler houses were considered very important. Financing topics are in general not highest priority for DHS operators in Austria, nevertheless, the viability of RES and waste heat, and financial support

and funding sources should at least be included in the training plan. In the management group of topics, three topics are considered highly important and shall be included in the training plan. Demand-oriented service schemes (3,7), public relations (3,8) and retrofitting DH networks (4,0).

c) Additional training topics proposed by DHS operators

Austrian DHS operators proposed a number of additional topics for which they see a need for training. Most of these additional topics are related to technical issues. The economic viability of solar heat in DHS is an additional financing topic which should be included in the training programme for Austria, as well as the issue of digitalization in DHS operations.

Table 2: Training topics proposed by Austrian DHS operators

Additional training topics proposed by DHS operators in Austria	
Topic n° and a short description	Full topic description
1. Technical topics	Efficient combustion technologies
	Adjustment and optimisation of grid pumps
	Adjustment (optimization) of the boiler regarding emissions
	Combustion technology: right boiler settings
	Increasing the lifespan of the boiler
	Comparison between different boilers, pipes, both including different manufacturers, different technical planners and plumbers.
2. RES and EE topics	Flue gas condensation
	Internal heat recovery
	Dust collection for the combustion of biomass fuels.
3. Organization topics	-
4. Financing topics	The economic viability of thermal solar in DHSs
5. Management topics	Digitalisation in the operation of a DHS
	Education on project creation and subsidy processing

d) Training preferences

More than 80% of the DHS that participated in the survey chose lectures as a preferred type of training. Also, more than 80% of DHS operators would prefer that the training will be organised in 8 hours daily slots, while 30% would be fine with 4 hours slots and training series with 1-day full training held every month. Other options that were also preferred are field trips, workshops and individual training. One of the interviewed DHS operators also

suggested that Working Teams, which are quite a common method in Austrian agricultural sector, could be adjusted and use here as well.

When it comes to the learning material which could be used, two methods of distribution are preferred, either printed scripts or online materials like presentations, exercises and scripts. The type of personnel which would be sent to these workshops hasn't been asked since most of the systems are quite small. Regarding the inclusion of external stakeholders, most of the DHS operators would like to include additional DHS operators, ESCO companies, DHS lobbying groups, technical DHS planners, local and regional public authorities, development and/or energy agencies.

DHS operators expect to gain deeper knowledge about the state-of-the-art technologies, subsidies and the legal framework, to learn to operate with small tools which are useful for the DHS operation and to get information and tips including options, how to optimize the DHS. Their goal is to become more efficient and more economical after getting the knowledge from the training. When it comes to including bioenergy in the energy sector lobbying actions and awareness raising are seen as very important to obtain the expected outcomes: optimisation of operation; cost savings; exchange of experience with other DHS operators; new laws; new technical developments and improvement of DHS.

e) Training organisation

LKW Steiermark will organize the training in Austria and focus on the identified topics. They identify suitable lectures among DHS lobbying groups, technical planners, public authorities, energy agencies, ESCO companies and DHS operators to support expertise and technology transfer, to promote most profound management skills and the establishment of business contacts.

Training will start with basic lectures and gradually proceed to more and deeper details. At the end of training, each DHS operator shall know how to optimize their own DHS with cost-effective tools. They shall know what the current state-of-the-art is and which modern technologies are available. They shall be part of a network of persons (DHS lobby group, public authorities, other DHS operators, etc.) which they can ask for additional questions.

f) Training plan

The training plan was developed considering the responses on the topic and training preferences from the DHS operators. LKW Steiermark plans to conduct training as 1 day 8 hours slots with a combination of lectures, workshops and field trip.

Main training topics will be:

- Assessment of energy losses in the district heating grid and determination of actions to improve grids and make them smart, remote metering systems, Metering standards
- Automatization of boiler house/substation and heat storage optimization
- Optimizing temperatures of supply/return pipes
- Identification of cost-effective approaches to optimize DHS
- Inclusion of Photovoltaics
- Optimized use of wood ash

- The increase of the organisational qualifications of boiler house operators and information about business succession
- Financial support schemes and funding resources
- Identification of measures for increasing the attractiveness of DHS for end-consumers, in close interaction with end-consumers and public authorities
- Training on PR and user engagement towards new and existing consumers

Learning materials will be provided to the participants in electronic and printed format. The training will be conducted during the period from September 2018 until April 2019.

Croatia

a) Interviewed DHS operators

Training needs assessment in Croatia was done for three smaller cities, for which the DHS operator is HEP Toplinarstvo Ltd. This is part of the state-owned company, which is the biggest distributor of heat in Croatia. The company is also the biggest electricity producer and supplier and it is also in charge of the electricity distribution. The cities for which operators gave their answers are Velika Gorica, Zaprešić and Samobor. This report presents the main findings of the training needs assessment based on the information provided by the local DHS operators.

b) Rating of proposed training topics

All proposed topics and their ratings are shown in Figure 3.

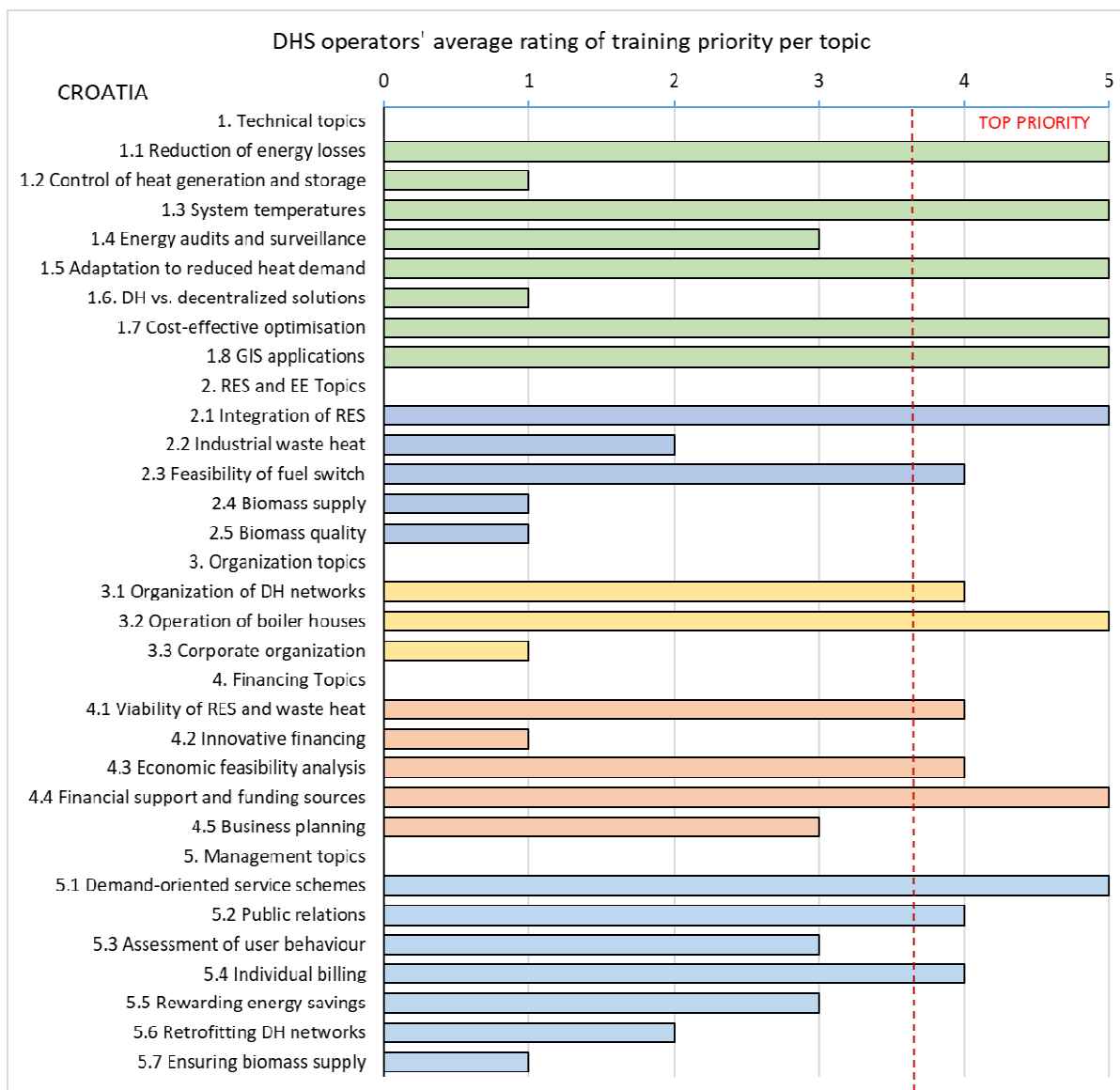


Figure 3: Prioritisation of training topics for DHS operators in Croatia

Although the highest priority was given to technical topics (5), top priority topics were also identified in all other groups. Very important topics rated with 5 points are:

Technical topics;

- Reduction of energy losses
- System temperatures
- Adaptation to reduced heat demand
- Cost-effective optimisation
- GIS applications

RES and EE topics;

- Integration of RES
- Operation of boiler houses

Financing topics;

- Financial support and funding sources

Management topics;

- Demand-oriented system schemes

There are additional six important topics rated with 4 points. Feasibility of fuel switch and organization of DH networks were recognised as important from RES and EE topics and organizational topics, respectively. From financing topics, the viability of RES and waste heat and economic feasibility analysis are also considered important. Management topics rated with four points are an assessment of user behaviour and individual billing.

c) Training preferences

As a preferred option for the organisation of training the combination of lectures, workshops and software training was selected. When it comes to training duration and slots the most preferred option are two-hour slots and the training for each topic group will be scheduled for two weeks. When it comes to the type of learning materials online distribution of the training material, like lectures, presentations and exercises would be preferred in combination with field trips. The staff that would be sent on training are financial officers, operation and maintenance workers and engineers depending on the training topic. They would also like to involve development and energy agencies in the training.

As an outcome of the 100-hour training, the DHS operators would like to have better trained and more educated employees on the topics of inclusion of RES in the existing DHSs and that they are able to implement learned optimisation techniques for the existing DHS. In addition, obtaining knowledge on how to approach existing and new consumers more effectively to promote DHS is also desired. The main outcome of the training process shall be DHS operator's improved skills on how to develop business plans.

d) Training organisation

In Croatia, training will be organised by the North-West Croatia Regional Energy Agency with help from the UNIZAG FSB. The lecturers will be found among university professors and employees of the energy agency, which have specific knowledge of the technical, financial and managerial areas.

The necessary competencies and expertise that is necessary for the participation in the training will be divided according to the group of topics. Technical training will be aimed at DHS operators, which have at least high school or higher education in the technical area, financial training is aimed at employees, which have a diploma in economy or finance. The topics covering optimisation of systems and inclusion of RES are aimed at engineers.

The outcomes of the training shall be to increase the capacity of DHS operators' employees in all 5 planned areas, education of multipliers who may facilitate and pass their knowledge to other employees, an increase in the technical, managerial and economic management capacities of the DHS operators.

e) Training plan

REGEA, together with the UNIZAG FSB, plans to conduct two-week training of 2 hours of training per day with a combination of lectures, workshops and software training. A field trip to nearby facilities, which can help with the inclusion of RES in the DHS is also planned.

The main topics covered by the training will be:

- The inclusion of RES in DHS
- Optimisation of operation of DHS
- Comparison between direct and indirect heating substations
- Learning on the alternative financing mechanisms – EU funds, PPP, etc.
- Acquiring knowledge in cost-benefit analysis tools
- Promotion of DHS towards existing and new consumers
- Obtain knowledge in individual metering schemes
- Increase in bill transparency
- Learn how to calculate profitability and how to finance projects
- Implementation of national laws

Czech Republic

a) Interviewed DHS operators

The interviewed DHS operators represent 3 district heating systems in Czech cities (Teplarny Brno, Teplarna Ceske Budejovice and Teplarna Pisek).

b) Rating of proposed training topics

Rating of the proposed training is shown in Figure 4.

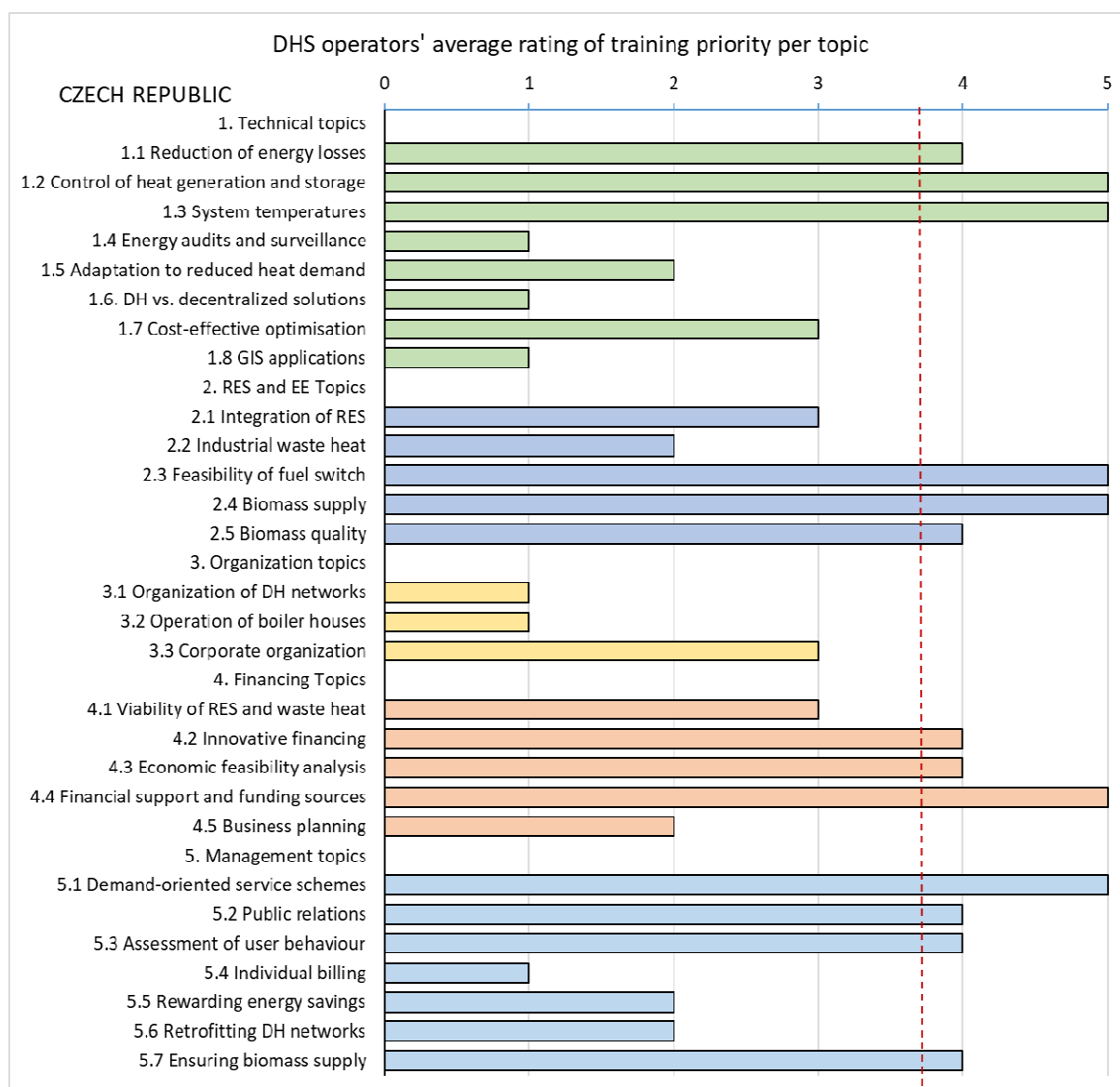


Figure 4: Prioritisation of training topics for DHS operators in the Czech Republic

Interviewed operators in the Czech Republic recognized top priority topics in four out of five subgroups. Two topics from technical and RES and EE subgroups and one topic from financing and management subgroups were rated with 5 points:

Technical topics;

- Control of heat generation and storage
- System temperatures

RES and EE topics;

- Feasibility of fuel switch
- Biomass supply

Financing topics;

- Financial support and funding sources

Management topics;

- Demand-oriented service schemes

Other important topics rated with 4 points are: reduction of energy losses (technical topics), biomass quality (RES and EE topics), innovative financing and economic feasibility analysis (financing topics), public relations, assessment of user behaviour and ensuring biomass supply (management topics).

c) Additional training topics proposed by DHS operators

Czech DHS operators proposed a number of additional topics for training.

Table 3: Training topics proposed by DHS operators in the Czech Republic

Additional training topics proposed by DHS operators in the Czech Republic	
Topic n° and a short description	Full topic description
1. Technical topics	Electric boilers and their use
	Accumulation of heat and heat storage
	Efficient use of CHP technology
	Provision of system services to electricity grid both with CHP and electric boilers
2. RES and EE topics	EU + national legislation on renewable energy – expected developments (new directive on RES)
	Waste to energy technology and corresponding issues
	Development of relevant waste legislation (EU + national)
	Ability to switch between different fuels – boiler flexibility
3. Organisation topics	Relations and cooperation with municipalities
	Building code/regulations
	Environmental requirements and cooperation with local/regional authorities when planning/preparing/implementing DH network refurbishment
4. Financing topics	Usage of EPC concept – potential benefits and best practice
	Heat price regulation/heat price formation and implications for investment
5. Management topics	Suitable pricing models for DH
	Models of investment cost-sharing when connecting new customers

d) Training preferences

The preferred type of training for DHS operators in the Czech Republic are lectures and workshops in combination with field trips. They would prefer that the training is organised as one- or two-day full-time seminars per topic. From the learning materials, they have selected the combination of online materials (lectures, presentation, exercises) and printed scripts. Depending on the training topic, the personnel attending the training would be middle managers, financial officers or engineers. They would like to include personnel from local and regional public authorities in the training.

The desired outcomes of the training are described as:

- Increasing the qualifications of employees in the technical, organizational, financial and managerial spheres.
- Getting acquainted with modern technologies and procedures. (Brainstorming during the training will be useful - description of the current state of operations and procedures, detection of weaknesses and definition of measures to optimize and increase the efficiency of operation, suggestions for novel solutions and improvements. Discussion of the barriers and the benefits of innovative solutions.)
- Transfer of experience from successful projects, best practice and lessons learned from mistakes.

e) Training organisation

In the Czech Republic, the training will be organised by Teplarenske Sdruzeni Ceske Republiky (TSCR), which is the association of DHS operators. Members and employees of TSCR, university specialists, experts from energy companies and institutions, will provide the training. The trainers will have appropriate qualification and years of experience in the specific field. There is no specific profile requested from trainees, as long as they are employees of heating plants and local/ regional officials who work in the energy field and are competent to design and implement changes.

The main learning outcomes of the training shall be:

- Increased knowledge of innovative technologies, financial mechanisms, organizational arrangements, managerial procedures and adopting new ways of approaches for employees of heating plants.
- Conclusions from discussions with experts in the energy field, their perception of the current conditions in the heating sector, the opportunity to point out the problems they are facing, to find an appropriate solution and to cooperate with regional authorities.
- Better knowledge of handling customer and DH network refurbishments.

f) Training plan

Training events will take the form of workshops, lessons and field trips. Experts on energy and heating sector issues will be invited to present current trends, technologies and rules according to the selected topic and to help to assess the current state of the individual operations and procedures. The training events will be attended by competent employees to design and implement changes as well as enforce new production methods and working

procedures. Participants will have the opportunity to discuss possibilities for improvement in the participating heating plants. They will share their experiences with each other. Site visits are considered as an appropriate form of practical training. Each participant will receive study materials and specialized publications in printed or online form. For an effective training in the Czech Republic, the number of participants in interactive workshops will be limited to 30. Participants prefer one or two-day training sessions. The training will be conducted during the period from September 2018 until April 2019.

Latvia

a) Interviewed DHS operators

Training needs assessment was performed among the partners representing three district heating systems in Latvian cities based on the provided questionnaires. Interviewed district heating systems are: “Ozolnieku KSDU”, Ltd. from Ozolnieki county, “Auces komunālie pakalpojumi”, Ltd. from Auce county, “Jēkabpils siltums”, Ltd. from Jēkabpils city. Questionnaires were distributed by Zemgale Regional Energy Agency (ZREA), possible training topics were discussed with pilot DHSs during their visits.

b) Rating of proposed training topics

Prioritisation of training topics according to DHS operators' ratings is shown in Figure 5.

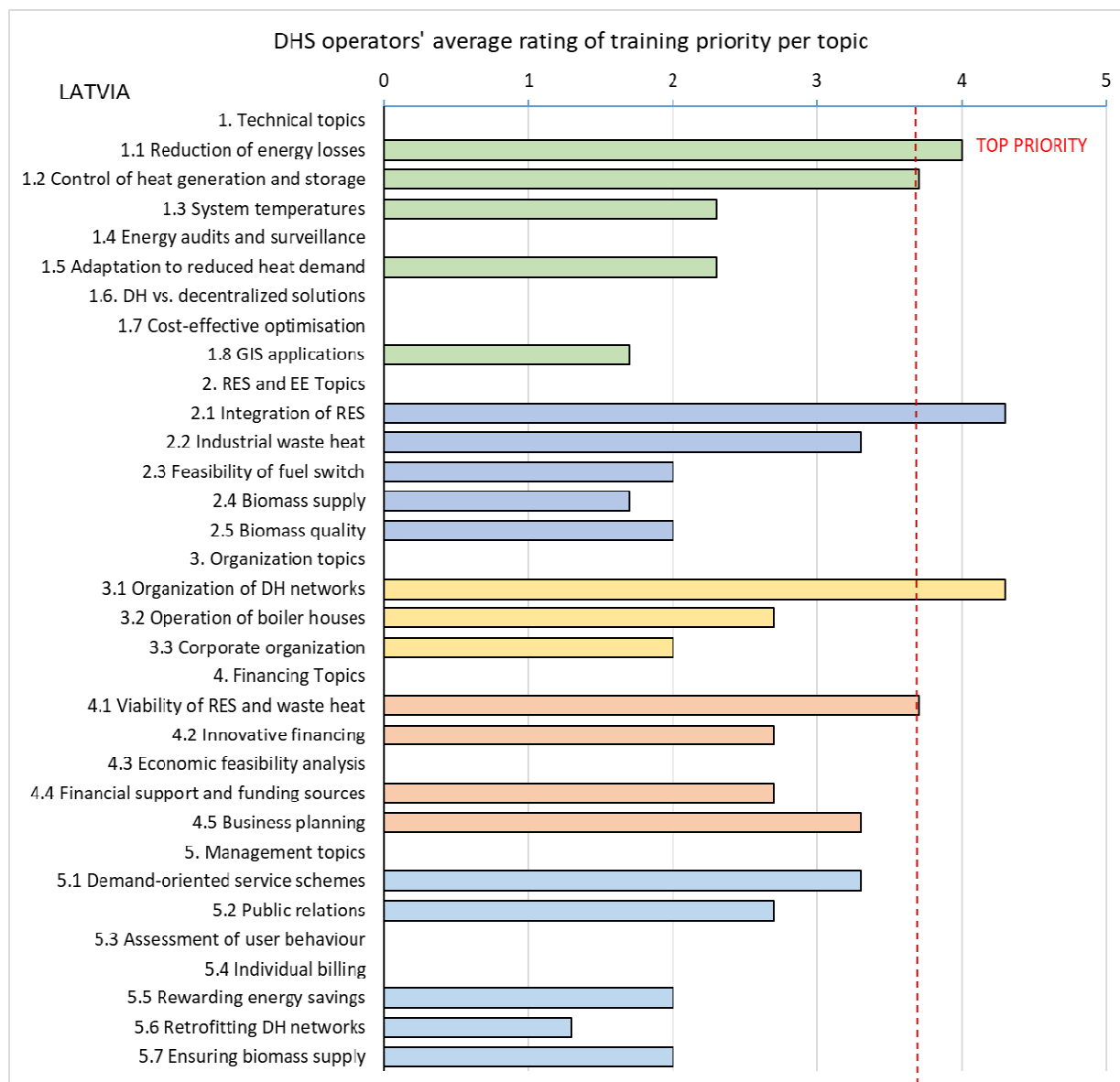


Figure 5: Prioritisation of training topics for DHS operators in Latvia

Highest priority was put on two topics from RES and EE topics group and organization topics group. Topics below were rated with more than 4 points:

Technical topics:

- Integration of RES (4,3)

Organization topics:

- Organization of DH networks (4,3)

Furthermore, reduction of energy losses (technical topics) is also included in top priority topics rated with 4,0 points.

Some of the proposed topics were not at all rated as relevant.

c) Training preferences

DHS operators in Latvia have chosen several types of training. All of them opted for a different combination of offered types in the questionnaire. The result shows that all types of

training are fine for them, so ZREA will decide on the type of training depending on the topic. When it comes to the training slots and duration, most requested was 3 full-day training with 8-hour slots. They are also fine with using all the suggested learning materials like online materials, scripts, books and field trips. Depending on the topic, they will send training managers, financial officers, boiler operators, operation and maintenance workers, engineers, legal and personnel officers to participate in the training. They are also keen on the integrating external stakeholders into training, e.g. local and regional public authorities, development and energy agencies and potential investors/banks.

The main outcome of the training shall be:

- Increased knowledge about the use of RES, about the allocation and use of finances, improvement of organizational skills, application of theoretical knowledge in practice, exchange of experience.
- Development of real pilot project, knowledge about project elaboration from A to Z, promotion of project implementation.
- Increased capacity of the personnel, which would allow being more competitive and capable to attract more funds for the modernization of the DHS plants.
- The performed training should positively influence the future development of DHS systems, especially by a better utilizing of waste.

d) Training organisation

ZREA will attract suitable professionals as lecturers and organize the training. This includes high-level specialists with long-term practical knowledge in the heating sector (specialists from District Heating Association of Latvia, front-runners - different energy companies: for example, "Balteneko", Ltd., "Bek-Konsult". Ltd., "Salaspils siltums", Ltd., "Ekodoma", Ltd.) as well as academic professionals (for example, from Riga Technical University, Department of Thermal power systems; Technical faculty of University of Life Sciences and Technology;). The main requirement for participation in the planned training would be the participants' involvement in the daily work of DHSs, and the approval of the DHS head. Nevertheless, some basic knowledge in the field of the specific training topic would be good to have in advance. Expected learning outcomes will be to improve the capacity of DHS personnel in order to be able to work together with project partner organizations in the assessment of their DHSs and in the elaboration of business plans/ pilot projects.

e) Training plan

The most preferred type of training is 3-day training (8 hours a day) – in practice, this could be 5 field trips, according to 5 training blocks. Each field trip would last 3 days (at least 20 training hours), organized in various places, where according to the topic, trainees could have practical insight on e.g. modern boiler houses, modern equipment and technologies or RES or waste as fuel and exchange experience parallel within technical and theoretical lectures/workshops. There is also the idea of organizing one digital training to test the software AutoCAD – as part of one field trip.

Currently, the preliminary schedule of training is the following:

- 1st block (September/October 2018);
- 2nd block (November 2018);

- 3rd block (January 2019);
- 4th block (February 2019);
- 5th block (March 2019).

Serbia

a) Interviewed DHS operators

Training needs assessment was performed among the partners representing seven district heating systems in Serbian cities based on the provided questionnaires. Interviewed district heating systems are Bajina Bašta, Šabac, Priboj, Majdanpek, Pirot, Nova Varoš and Valjevo.

b) Rating of proposed training topics

Prioritisation of training topics for DHS operators in Serbia is shown in Figure 6.

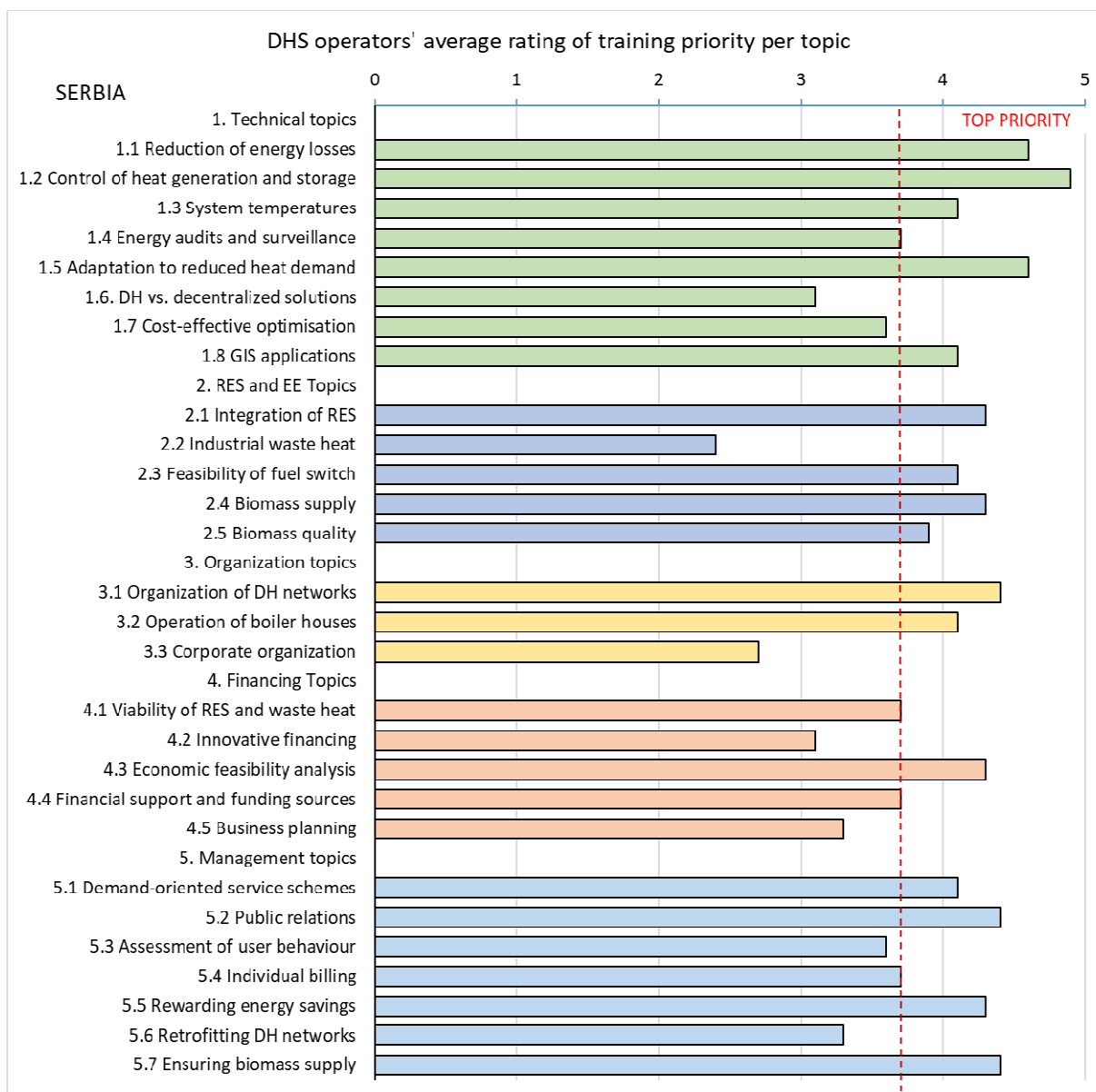


Figure 6: Prioritisation of training topics for DHS operators in Serbia

Highest priority is given to technical and management topics. In general, all of the proposed topics were given relatively high grades, as compared to the situation in the other countries. This means that all proposed topics would be interesting to the DHS operators in Serbia. Topics rated with more than 4,0 points are given below:

Technical topics;

- Reduction of energy losses (4,6)
- Control of heat generation and storage (4,9)
- System temperatures (4,1)
- Adaptation to reduced heat demand (4,6)
- GIS applications (4,1)

RES and EE topics;

- Integration of RES (4,3)
- Feasibility of fuel switch (4,1)
- Biomass supply (4,3)

Organization topics;

- Organization of DH networks (4,4)

Financing topics;

- Economic feasibility analysis (4,3)

Management topics;

- Demand-oriented service schemes (4,1)
- Public relations (4,4)
- Rewarding energy savings (4,3)
- Ensuring biomass supply (4,4)

Topic biomass quality (RES and EE topics) rated with 3,9 points is considered important and will be included in the training.

c) Additional training topics proposed by DHS operators

Serbian DHS operators proposed a long list of additional topics to be included in the training.

Table 4: Training topics proposed by DHS operators in Serbia

Additional training topics proposed by DHS operators in Serbia	
Topic n° and a short description	Full topic description
1. Technical topics	Building retrofit reduced heat demand, so DHS often needs to be adjusted to new heat demand
	Installation of the filters and meeting the parameters of the emission limit values of the harmful substances in the atmosphere

2. RES and EE topics	The DHS operator would like to focus on the good practice examples of the inclusion of wastewater heat, heat pumps, geothermal energy and biomass
	The development of the biomass market
	Logistics of biomass supply and biomass suppliers
	Agro biomass in suburban settlements.
	Solar energy and the influence of municipal strategy and development documents as well as energy policy
3. Organisation topics	Quality standards
	Improvement of written procedures
	Open dialogue with end consumers
	Surveys – analysis of service quality – actions to improve energy services
	Improvement of the heat production and distribution
	Training in SCADA software and smart grids
4. Financing topics	Getting acquainted with cost-saving analysis software
	Heat price analysis in DHS grids that use fossil fuel and renewable energy
	Procurement of excess and waste heat energy
5. Management topics	Improvement of the communication on the distributor-end customer relationship

d) Training preferences

The DHS operators in Serbia prefer workshops when it comes to the type of training. Six out of seven DHS operators opted for this option. Only 3 out of the 7 would also see lectures and field trips as suitable. When it comes to the training duration most of the DHS opted for blocks of 1-3 days, offering 8 hours of training per day. DHS operators prefer online materials and field trips to best practice examples. Personnel, who will be sent to training are mainly engineers and managers, but some DHS want also their operators of boilers and grid to be trained. From the external stakeholders, they would prefer local and regional public authorities and development and/or energy agencies to participate in the training.

The main outcome shall be:

- More information on how to create a biomass supply chain with training on how to control biomass quality.
- A technical concept and business model of a DHS with several renewable heat sources for base load and natural gas for peak load.

- Trained managers, engineers and operator of boilers for the management of plants using wood chips as fuel. As a result, cheap and safe heating for the citizens of Priboj municipality, as well as a huge ecological effect and green jobs.

e) Training organisation

The training lecturers will be research and academic professionals, with expertise and insights in the design, operation, and maintenance of DHSs. All lecturers have experience in giving lectures and presentations, as well as organizing courses. For participating in the training, it is required that everyone has at least a high school diploma and work experience in DHS and/or local energy management. Necessary knowledge and information will be provided to the participants and enable them to actively take part in introducing RES, increasing energy efficiency, and reducing emissions in their DHSs.

f) Training plan

DHS partners from Serbia expressed their preferences for:

- Type of training: workshop (86%), lectures (43%) and field trips (43%);
- Training duration: one day (57%) and 3 days (43%);
- Learning material: online (71%), field trip (57%) and scripts (29%).
- Type of personnel that attend the training: engineers (100%), managers (86%), plant operators (43%), and financial (29%) and legal staff (29%).
- They also expressed the wish to include following external stockholders: local authorities (71%) and development and energy agencies (43%).

The 1-3-day training will mostly/probably take place in the conference room of Institute Vinca. They will include lectures and workshops. Field trips will be organized and learning materials will be distributed among training participants in electronic form. The training will be conducted during the period from September 2018 to April 2019.

Slovenia

a) Interviewed DHS operators

The training needs assessment was performed among the partners representing seven district heating systems in Slovenian cities: KP Velenje / PE Energetika, Public Services Ptuj, Energetika Ljubljana, Komunala Slovenj Gradec, Komunala Trbovlje, Petrol d.d./OE Ravne na Kor. and Energetika Maribor.

b) Rating of proposed training topics

Rating of the training topics for DHS operators in Slovenia is shown in Figure 7.

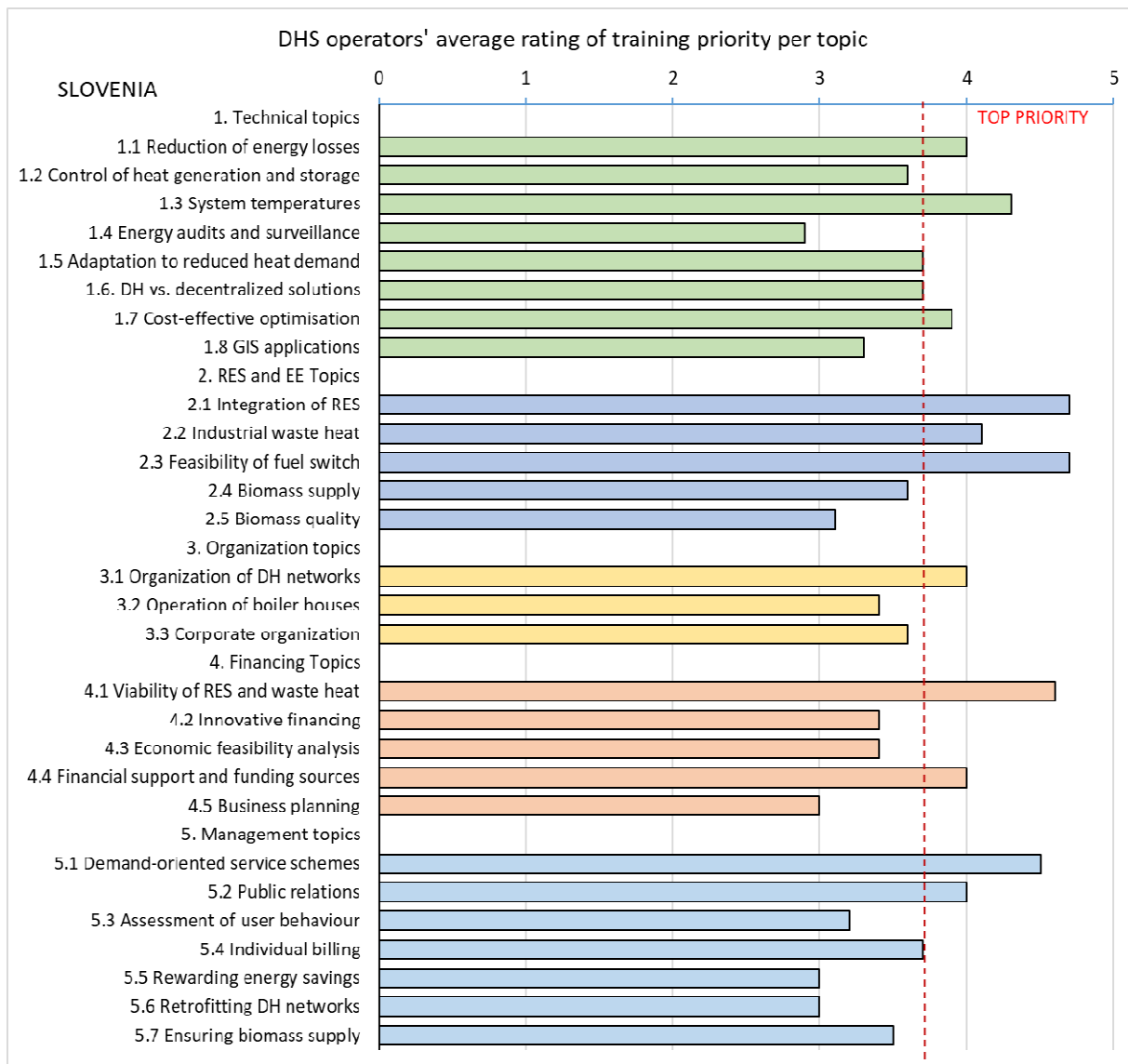


Figure 7: Prioritisation of training topics for DHS operators in Slovenia

The highest rating was given to the topics which are dealing with the integration of RES in the DHS. For Slovenia, it can also be stated that all topics received relatively high ratings. Topics rated with more than 4,0 points are given below:

Technical topics;

- System temperatures (4,3)

RES and EE topics;

- Integration of RES (4,7)
- Industrial waste heat (4,1)
- Feasibility of fuel switch (4,7)

Financial topics;

- The viability of RES and waste heat (4,6)

Management topics;

- Demand-oriented service schemes (4,5)

Other topics from technical subgroup considered top priorities are a reduction of energy losses and cost-effective optimization with 4,0 and 3,9 points, respectively. From organization topics, an organization of DH network was given 4 points. Financial support and funding sources from financing topics and public relations from management topics were both given 4,0 points and are also considered a top priority.

c) Training preferences

As a preferred type of training almost all DHS operators selected lectures, while field trips and workshops were also highly rated. When it comes to the training duration in days the opinions on how many days in a row would be perfect differ between one and several days nevertheless for time slots they all confirmed that they would like to conduct whole day training (8 hours). Besides that, most of the operators prefer online materials (lectures, presentations, exercise) and scripts as the training material. DHS operators will send engineers and managers to the training and, in addition, they would like to invite external stakeholders, like local and/ or regional public authorities and development and/or energy agencies to participate in training activities.

d) Training organisation

KSSENA will organize the training with the support of IJS in Slovenia. The lecturers will be found among employees and contractual partners of IJS and KSSENA if necessary other professionals which have specific knowledge in the technical, financial and managerial areas will be included. KSSENA considers that training in smaller groups are more efficient than larger events so the majority of topics will be covered by a smaller workshop like training at the locations of pilot DHSs.

The main requirement for participating in the planned training is to be actively involved in the daily work and processes of DHSs. The technical topics are meant for DHS professionals with the technical background and that they have at least a high school diploma. Training on economics and financial topics are aimed at employees, which have a deeper education on economy or finance topics. The topics covering optimisation of systems and inclusion of RES are meant for engineers and researchers.

Expected outcomes are the improvement of the capacity of DHS personnel in order to be able to assess their DHSs, in the elaboration of a business plan and pilot projects. Moreover, the outcomes of the training should influence the day to day work of DHS employees in all planned areas positively and increase the capacity of training participants to pass their knowledge on to other employees and to facilitate internal training with the focus on technical, managerial and economic operations of the DHS.

e) Training plan

The preliminary training plan for Slovenia commences with a major one-day training for a wider audience where we plan to invite the majority of Slovenian DHS operators. In this training general technical and organizational topic will be covered. The second part of the training program will be individual on-site training for pilot DHS. In specific cases, KSSENA might join training for different pilot DHS with similar requested training topics/needs. These training are planned for the end of 2018 or at the beginning of 2019. If necessary, another major one-day training for a wider audience will be organized in spring 2019.

Ukraine

a) Interviewed DHS operators

The training needs assessment was performed among the partners representing five district heating systems in Ukrainian cities: Khmelnytskyi (two municipal district heating companies), Zhytomyr, Ternopil, Bila Tserkva and Kalush. Questionnaires were translated into Ukrainian, distributed among the partners via email and discussed during meetings and phone calls.

b) Rating of proposed training topics

The ratings of the proposed training topics according to the summarized answers from Ukrainian DHS operators are shown in Figure 8.

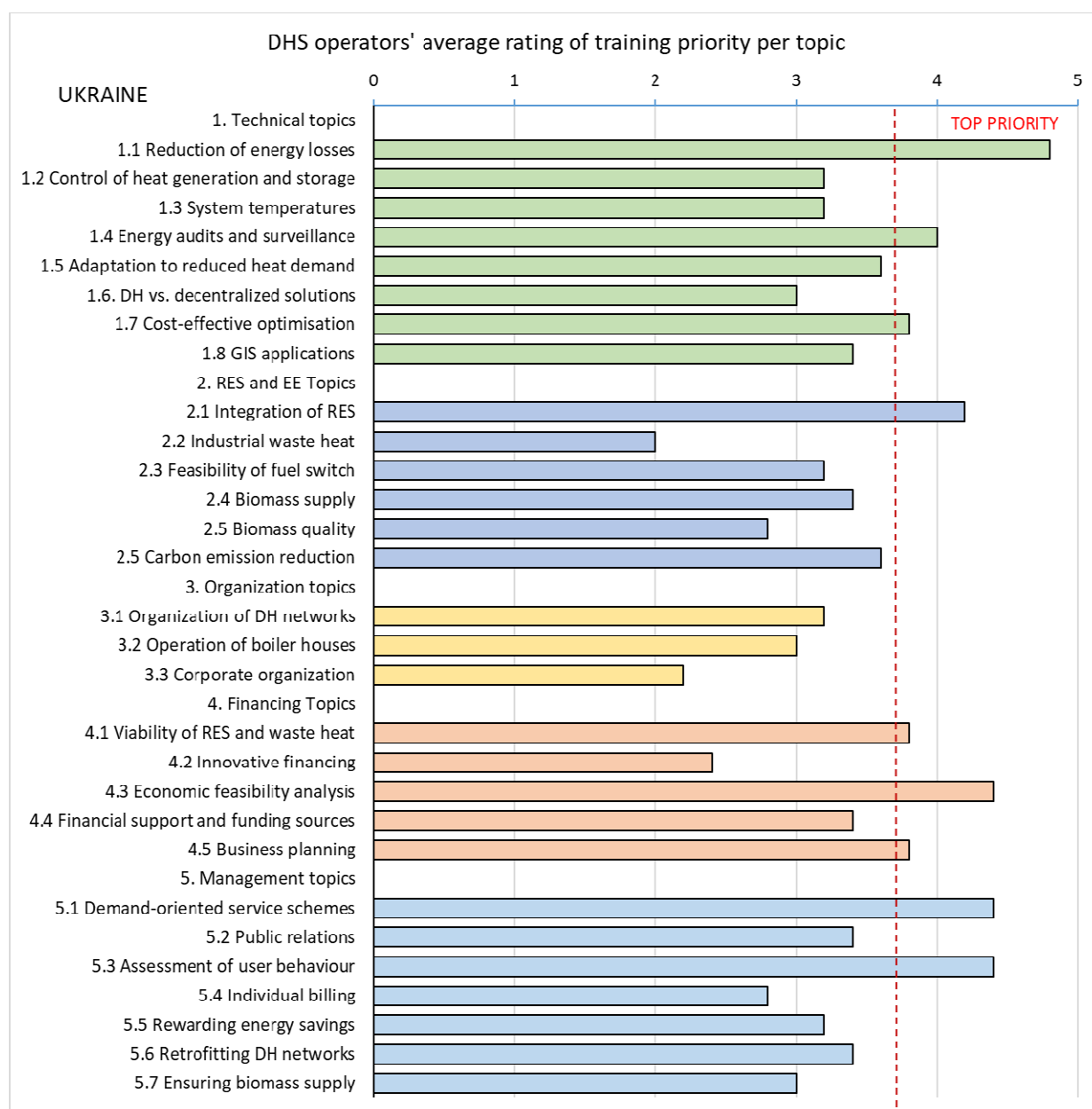


Figure 8: Prioritisation of training topics for DHS operators in Ukraine

The highest priorities were thereby given to the technical, financial and managerial topics. Topics rated with more than four points are given below:

Technical topics;

- Reduction of energy losses (4,8)

RES and EE topics;

- Integration of RES (4,2)

Financing topics;

- Economic feasibility analysis (4,4)

Management topics;

- Demand-oriented service schemes (4,4)
- Assessment of user behaviour (4,4)

Four additional topics rated more than 3,7 points are considered important. Energy audits and surveillance and cost-effective optimization from technical subgroup were given 4,0 and 3,8 points, respectively. The viability of RES and waste heat and business planning were both given 3,8 points.

None of the suggested topics from organisational subgroup has been rated as a top priority.

c) Additional training topics proposed by DHS operators

Ukrainian DHS operators proposed a long list of additional topics to be included in the training.

Table 5: Training topics proposed by DHS operators in Ukraine

Additional training topics proposed by DHS operators in Ukraine	
Topic n° and a short description	Full topic description
1. Technical topics	Energy losses assessment during the summer period (hot water supply)
	Using digital technologies for remote identification of leakages, and estimation of energy losses
	Specifics of heat energy transportation with under the condition of unstable heat demand
	Centralisation of heat energy generation
	Benefits and economic feasibility of quality and quantity control of heat energy supply
	Development of temperature schedules for different heat energy generation sources
2. RES and EE topics	Practical examples of financial analysis for diverse types of renewable energy projects

	Options for renewable energy use in the districts with dense construction
	Heat pumps
	Practical aspects of biomass quality assessment
	Estimation of carbon emission reduction from modernization projects
3. Organisation topics	Analysis of the benefits and disadvantages of different organizational structures (one company for all or different companies) based on specific examples
4. Financing topics	Practical skills to analyse the financial feasibility of different projects and development strategies, as well as the analysis of the internal potential of the enterprises
5. Management topics	Establishing feedback mechanisms with the customers, communication strategies, examples of information campaigns, best practices and experiences of other companies in billing
	Exploitation of automation systems (capacity development on technical concerns)
	Optimization of an enterprise's organizational structure (organizational capacity needed)
	Innovative mechanisms for dealing with customers debts for district heating services (managerial capacity)

d) Training preferences

Workshops were mentioned as a preferred type of training by all project partners. With respect to training duration, project partners gave preferences to 2 or 3-day training with 8 or 4 hours of training per day. Field trips are seen as suitable and complementary training material in addition to online materials, like lectures, presentations and exercises.

Managers and engineers are the expected target groups for participation in the training. Most of the partners also mentioned operation and maintenance workers and financial officers among potential training participants. And they are willing to invite also local and/or regional public authorities to participate in the training. Some of them also mentioned representatives of development and/or energy agencies, potential investors/banks and ESCO companies as potential training participants.

Most of the partners expect that their employees gain new skills, knowledge and experience during the training, which can be practically applied during the implementation of modernization projects in the DHS.

Main areas of interest include:

- Preparation of business plans for DHS modernization projects;
- Best practices of DHS modernization projects;

- Improved communication with customers and attraction of new consumers to DHS.

e) Training organisation

KT-Energy LLC will organize the Training in Ukraine with the involvement of local experts e.g. in the field of energy efficiency, renewable energy, financial analysis and public relations. KT-Energy LLC will also involve the representatives of DHS operators participating in the project in presenting their best practices and experience during the training.

KT-Energy LLC plans to consult with international organizations and projects, which are actively involved in the change process in Ukraine (USAID, NEFCO, EBRD, WB, DemoUkraine-DH, etc.) in order to discuss potential cooperation concerning training sessions and field trips. The lectures providing training in Ukraine will have higher education in the relevant field and at least 3 years of practical experience. Experience in participating in international projects and/or in projects financed by international organizations will be considered as an additional asset.

No specific requirements are set out concerning competences or expertise to participate in the planned training. Participants will be chosen by project partners (DHS operators) based on training themes and programs. Expected learning outcomes of the planned training: at least 20 individuals representing the partnering DHS operators participated in the training.

f) Training plan

The training plan was developed by considering the responses on the topic and training preferences from the DHS operators. KT-Energy LLC plans to conduct 5 training sessions, each 2.5 days (i.e. 20 hours). Each session will include 1.5-2 days of lectures and workshops, and 0.5-1-day field trips.

The first and second training session will be devoted to technical topics. They will include presentations and discussions on the topics prioritized by project partners and a field trip to one of the partnering DHSs. Representatives of local and/ or regional public authorities, including energy agencies will be also be invited.

The third training will be devoted to the utilization of RES, waste, and excess heat. The training will include presentations and discussions on the topics prioritized by project partners and a field trip to one of the partnering DHSs. Representatives of local and/ or regional public authorities, including energy agencies will also be invited.

The fourth training will be devoted to financial topics. The training will include presentations and discussions on the topics prioritized by project partners and a field trip to one of the partnering DHSs. Representatives of local and/or regional public authorities, IFIs and other donors active in Ukraine, and, potentially, ESCO companies will also be invited.

The fifth training will be devoted to managerial and organizational topics. The training will include presentations and discussions on the topics prioritized by project partners and a field trip to one of the partnering DHSs.

The proposed training plan is tentative and may be updated/adapted to needs on the basis of consultations with DHS operators, with experts involved in the training sessions and with project partners while conducting the training. Learning material will be provided to

participants in electronic format. The training will be conducted during the period from September 2018 until April 2019.

3. Summary

In total, 52 DHSs participated in the training needs assessment among the seven partner countries. As mentioned at the beginning of the report the proposed training topics were clustered in five groups:

- Capacity development on technical concerns
- Capacity development on the utilization of RES, waste and excess heat
- Organizational capacity development
- Financial concerns and
- Managerial concerns.

In addition, the following topics were raised in almost all partner countries and DHS operators:

- Reduction of energy losses – Assessment of energy losses in the district heating grid and determination of actions to improve grids and make them smart by using remote metering systems and metering standards.
- Demand-oriented service schemes – Identification of measures for increasing the attractiveness of DHS for end-consumers, in close interaction with end-consumers and public authorities.
- Integration of RES – The inclusion of RES in DHS (solar thermal, biomass, geothermal, heat pumps, etc.).

The distribution per number of countries and topic can be seen in the following Figure 9.

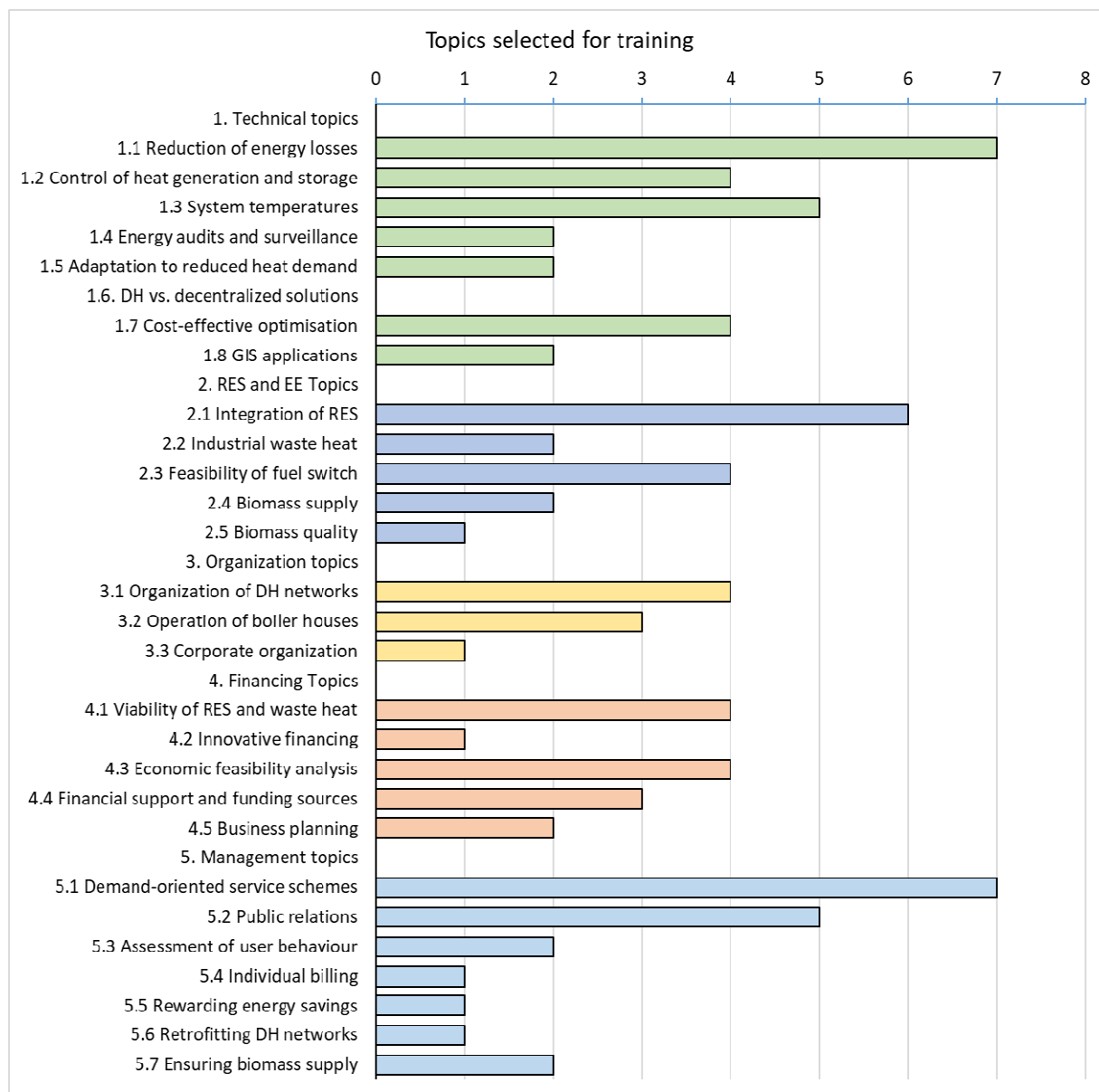


Figure 9: Topics selected for training

Survey on preference in order to organise suitable and complementary training has shown that all partners would like to have training in form of lectures and workshops in combination with field trips. Some of them have chosen lectures as the first option and other workshops but they will be satisfied with any of those formats. Field trips are mentioned as a value by all interviewed DHSs.

Almost all interviewed DHS operators would like to have a training organised for 8-hour daily slots and depending on the topic they would like that the specific topic is covered by one or more training days. Online learning materials like presentations, exercises and scripts have been the preferred option for learning material. In addition, DHS operators opted for printed scripts. When it comes to the participating personnel, the most common answer was that they would send engineers or managers, but this depends again on the specific training topic. Other personnel, which could be sent to training are financial officers, boiler house and grid operators, operation and maintenance workers, etc. Almost all DHS operators would like to involve also representatives of local and/or regional public authorities and representatives of development and/or energy agencies in the training.

The training will be in general organised during the period from September 2018 until April 2019 and the lecturers will be recognised as a national expert in the field as well as researchers, representatives of DHS, etc. The evaluation of the training efficiency will be done through anonymous questionnaires and signed participant lists. Expected competences of participants vary according to the training topic but are broadly the same, e.g. increase knowledge and expertise of employees in the specific topic groups, ability to adapt learnings and best practices to the own DHSs and to draw conclusions on DHS economic factors/ efficiency, energy losses and involvement of new energy sources. In most cases, however, experiences and some basic knowledge about DHS are required from participants to be able to join the training.

Table 6: Training topics distribution per countries

Training topics							
Topic n° and a short description	Austria	Croatia	Czech Republic	Latvia	Serbia	Slovenia	Ukraine
1. Technical topics							
1.1 Reduction of energy losses	X	X	X	X	X	X	X
1.2 Control of heat generation and storage	X		X	X	X		
1.3 System temperatures	X	X	X		X	X	
1.4 Energy audits and surveillance	X						X
1.5 Adaptation to reduced heat demand		X			X		
1.6. DH vs. decentralised solutions							
1.7 Cost-effective optimisation	X	X				X	X
1.8 GIS applications		X			X		
2. RES and EE topics							
2.1 Integration of RES	X	X		X	X	X	X
2.2 Industrial waste heat				X		X	
2.3 Feasibility of fuel switch		X	X		X	X	
2.4 Biomass supply			X		X		
2.5 Biomass quality			X				
3. Organization topics							
3.1 Organisation of DH networks		X		X	X		X

3.2 Operation of boiler houses	X	X			X		
3.3 Corporate organization	X						
4. Financing topics							
4.1 Viability of RES and waste heat		X		X		X	X
4.2 Innovative financing			X				
4.3 Economic feasibility analysis		X	X		X		X
4.4 Financial support and funding sources		X	X			X	
4.5 Business planning				X			X
5. Management topics							
5.1 Demand-oriented service schemes	X	X	X	X	X	X	X
5.2 Public relations	X	X	X		X	X	
5.3 Assessment of user behaviour			X				X
5.4 Individual billing		X					
5.5 Rewarding energy savings					X		
5.6 Retrofitting DH networks	X						
5.7 Ensuring biomass supply			X		X		

Annexes

Training needs topic questionnaire

Name of the project partner:

Name of the DHS operator/City:

T1 Capacity development on technical concerns

Name of the topic	Give priority to the training topic (1 = lowest, 5 = highest priority)					Insert a few keywords on why you prioritised this topic so high/low
Assessment of energy losses in the district heating grid and determination of actions to improve grids and make them smart, remote metering systems, Metering standards	1	2	3	4	5	
Automatisation of boiler house/substation and heat storage optimization	1	2	3	4	5	
Optimising temperatures of supply/return pipes. Optimizing temperatures of supply/return pipes	1	2	3	4	5	
Optimisation of heat networks energy audits and surveillance	1	2	3	4	5	
Modelling of DHS after energy retrofitting of connected buildings (consumers) – Building retrofit reduced heat demand, so DHS often needs to be adjusted to new heat demand	1	2	3	4	5	
Technical evaluation and comparison of the municipal heating system development options, including a comparison of DHS with decentralised solutions in municipalities with reduced heat load density	1	2	3	4	5	
Identification of cost-effective approaches to optimize DHS	1	2	3	4	5	
Use of GIS-based tools (Heat demand assessment, DH network development, mapping of excess heat sources)	1	2	3	4	5	
Suggest other possible topics for training in your country						

T2 Capacity development on the utilisation of RES, waste and excess heat

Name of the topic	Give priority to the training topic (1 = lowest, 5 = highest priority)					Insert a few keywords on why you prioritised this topic so high/low
The inclusion of RES in DHS (solar thermal, biomass, geothermal, heat pumps, ...)	1	2	3	4	5	
Sustainability of biomass supply (increasing capacity of plant operators and their fuel/biomass suppliers, estimation of biomass potential)	1	2	3	4	5	
The utilisation of waste heat in an urban environment and from industrial sites	1	2	3	4	5	
Feasibility analysis of switching from fossil fuel to renewable energy or waste heat sources and feasibility analysis of using different RES/waste heat	1	2	3	4	5	
Assessment of the biomass quality	1	2	3	4	5	

Suggest other possible topics for training in your country	1	2	3	4	5	
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T3 Organisational capacity needed

Name of the topic	Give priority to the training topic (1 = lowest, 5 = highest priority)					Insert a few keywords on why you prioritised this topic so high/low
Identification of measures and processes for improving the organization management of DH&C networks (comprising energy generation, distribution and consumption)	1	2	3	4	5	
The increase of the organisational qualifications of boiler house operators	1	2	3	4	5	
Different possibilities to organise DH companies according to national law	1	2	3	4	5	
Suggest other possible topics for training in your country	1	2	3	4	5	

T4 Financial concerns

Name of the topic	Give priority to the training topic (1 = lowest, 5 = highest priority)					Insert a few keywords on why you prioritised this topic so high/low
Assessment of the economic and financial viability of using RES and waste heat in DHS plants	1	2	3	4	5	
Development of innovative financing mechanisms (on-bill, public-private, inclusion of consumers/citizens...)	1	2	3	4	5	
Tools for economic/financial viability analysis	1	2	3	4	5	
Financial support schemes and funding resources for DHS retrofits and decarbonisation	1	2	3	4	5	
Business plans development	1	2	3	4	5	
Suggest other possible topics for training in your country	1	2	3	4	5	

T5 Managerial concerns

Name of the topic	Give priority to the training topic (1 = lowest, 5 = highest priority)					Insert a few keywords on why you prioritised this topic so high/low
Identification of measures for increasing the attractiveness of DHS for end-consumers, in close interaction with end-consumers and public authorities	1	2	3	4	5	
Training on PR and user engagement towards new and existing consumers	1	2	3	4	5	
How to assess user behaviour	1	2	3	4	5	
Identification of options for individual billing in multi-apartment buildings equipped with building heat meters	1	2	3	4	5	

Increasing transparency of information about bill structure and available energy services to reduce heat consumption	1	2	3	4	5	
Contractual arrangements needed to ensure a smooth retrofit of the DH network	1	2	3	4	5	
Contractual arrangements needed to ensure a smooth biomass supply	1	2	3	4	5	
Suggest other possible topics for training in your country	1	2	3	4	5	

Questionnaire on the training preferences

Name of the project partner:

Name of the DHS operator/City:

PART A: Questions for DHS operators:

1. What is your preferred type of training?
 - a. Lectures
 - b. Workshops
 - c. Webinars
 - d. Software training
 - e. Field trip
 - f. Individual training (1 on 1 consultancy)
 - g. Combination of above mentioned, which?
 - h. Other
2. What type of training duration and slots would you prefer?

Example:

- 3 days full training with 8 hours slots
 - 2 weeks training with 2 hours per day slots
 - 1-day full training with 8 hours slot(s)
 - Other...
3. Type of learning materials that you would prefer?
 - a. Online material (lectures, presentations, exercises)
 - b. Scripts
 - c. Books
 - d. Field trip
 - e. Combination of above mentioned, which?
 - f. Other

4. What type of personnel would you send to the training?
 - a. Managers
 - b. Financial officers
 - c. Boiler operators
 - d. Operation and maintenance workers
 - e. Engineers
 - f. IT officers
 - g. Legal and personnel officers
 - h. Combination of above mentioned, which?
 - i. Others

5. Would you like to include any external stakeholders in the training?
 - a. Local and/or regional public authorities
 - b. Spatial development planners
 - c. Development and/or energy agencies
 - d. Potential investors/banks
 - e. Real estate developers
 - f. ESCO companies
 - g. Others
6. Describe what would be for you the desired outcome of the training?

PART B: Questions for training organisers:

1. Who will be the lecturers providing training in your country? Describe the necessary qualifications.
2. How will you prefer to evaluate training efficiency?
 - a. Signing sheet
 - b. Anonymous questionnaire
 - c. Combination of the above mentioned
 - d. Other
3. What will be the necessary competences and knowledge necessary to participate in and understand planned training?
4. What will be expected learning outcomes of the planned training?
5. Provide a 10-row description of the planned training? After you receive responses on the topic and training preferences from the DHS operators.