SMALL, MODULAR AND RENEWABLE DISTRICT HEATING & COOLING GRIDS FOR COMMUNITIES IN SOUTH-EASTERN EUROPE

Dominik Rutz[1], Rainer Janssen[1], JuanManuel Ugalde[1],
Morten Hofmeister[2], Per Alex Soerensen[2], Linn Laurberg Jensen[2], Christian Doczekal[3], Richard Zweiler[3], Tomislav Puksec[4], Neven Duic[4], Borna Doracic[4], Rok Sunko[5], Blaž Sunko[5], Natasa Markovska[6], Meri Karanfilovska[6], Nikola Rajkovic[7], Ilija Batas Bjelic[7], Anes Kazagic[8], Alma Ademovic-Tahirovic[8], Izet Smajevic[8], Slobodan Jerotic[9], Bojana Mladenović[9], Emir Fejzovic[10], Amra Babić[10], Milada Mataradzija[10], Mitja Kolbl[11], Tomi Zrinski[11]
[1]WIP – Renewable Energies, Sylvensteinstr. 2, D - 81369 Munich, Germany
Tel. +49 89 720 12743, Fax +49 89 720 12791
E-Mail: dominik.rutz@wip-munich.de, rita.mergner@wip-munich.de
Internet: www.wip-munich.de, www.coolheating.eu, https://www.facebook.com/groups/CoolHeating/, https://www.linkedin.com/groups/8471804/profile
[2]PlanEnergi, Denmark, [3]Güssing Energy Technologies GmbH, Austria, [4]University of Zagreb, Croatia, [5]Skupina fabrikad.o.o., Slovenia, [6]International Centre for Sustainable Development of Energy, Water and Environment Systems Zagreb - Affiliate Skopje, Macedonia, [7]School of Electrical Engineering and Computer Science, Serbia, [8]Elektroprivreda, Bosnia and Herzegovina, [9]Municipality of ofSabac, Serbia, [10] Municipality of Visoko, Bosnia and Herzegovina, [11]Municipality of Ljutomer, Slovenia

ABSTRACT: Small modular district heating/cooling grids can be fed by different heat sources, including solar collectors, biomass systems and surplus heat sources (e.g. heat from industrial processes or biogas plants that is not yet used). Especially the combination of solar heating and biomass heating is a very promising strategy for smaller rural communities due to its contribution to security of supply, price stability, local economic development, local employment, etc. On the one hand, solar heating requires no fuel and on the other hand biomass heating can store energy and release it during winter when there is less solar heat available. Thereby, heat storage (buffer tanks for short-term storage and seasonal tanks/basins for long-term storage) needs to be integrated. With increasing shares of fluctuating renewable electricity production (PV, wind), the Power-to-Heat conversion through heat pumps can furthermore help to balance the power grid. The objective of the CoolHeating project, funded by the EU's Horizon2020 programme, is to support the implementation of "small modular renewable heating and cooling grids" for communities in South-Eastern Europe.
Keywords: heating, cooling, heating grids, solar thermal, biomass

1 INTRODUCTION

The heating and cooling demand in Europe accounts for around half of the EU's final energy consumption. Renewable energy policies often mainly focus on the electricity market, whereas policies for renewable heating and cooling are usually much weaker and less discussed in the overall energy debate. Therefore, it is important to support and promote renewable heating and cooling concepts, the core aim of the CoolHeating project (Figure 2).

The objective of the CoolHeating project, funded by the EU's Horizon2020 programme, is to support the implementation of "small modular renewable heating and cooling grids" for communities in South-Eastern Europe. This is achieved through knowledge transfer and mutual activities of partners in countries where renewable district heating and cooling examples exist (Austria, Denmark, Germany) and in countries which have less development (Croatia, Slovenia, Macedonia, Serbia, Bosnia-Herzegovina) (Figure 1). Core activities, besides techno-economical assessments, include measures to stimulate the interest of communities and citizens to set-up renewable district heating systems as well as the capacity building about financing and business models. The outcome is the initiation of new small renewable district heating and cooling grids in 5 target communities up to the investment stage. These lighthouse projects will have a long-term impact on the development of "small modular renewable heating and cooling grids" at the national levels in the target countries.

Figure 1: Countries involved in the CoolHeating project and target villages (red dots)

Figure 2: CoolHeating logo

2 SMALL RENEWABLE MODULAR HEATING AND COOLING GRIDS

Small modular district heating/cooling grids are local concepts to supply households and/or small and medium industries with renewable heat and/or cooling. In some cases, they may be combined with large-scale district heating (DH) grids, but the general concept is to have an individual piping grid which connects a relatively small number of consumers. Often, these concepts are implemented for villages or towns. They can be fed by different heat sources, including solar collectors, biomass systems and surplus heat sources (e.g. heat from industrial processes or biogas plants that is not yet used). A scheme of these grids is presented in Figure 3.

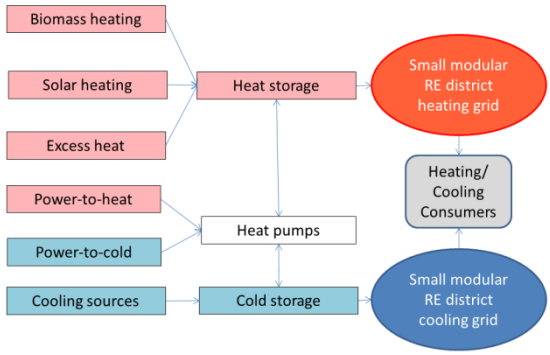

Figure 3: Concept of small modular renewable heating & cooling grids

Especially the combination of solar heating and biomass heating is a very promising strategy for smaller rural communities due to its contribution to security of supply, price stability, local economic development, local employment, etc. On the one hand, solar heating requires no fuel and on the other hand biomass heating can store energy and release it during winter when there is less solar heat available. Thereby, heat storage (buffer tanks for short-term storage and seasonal tanks/basins for long-term storage) needs to be integrated. A scheme of a typical seasonal demand and supply of a combined small heating grid is presented in Figure 4. The main advantages of a biomass/solar heating concept are:

- Reduced demand for biomass
- Reduced heat storage capacity
- Lower maintenance needs of biomass boilers

With increasing shares of fluctuating renewable electricity production (PV, wind), the Power-to-Heat conversion through heat pumps can furthermore help to balance the power grid.

If the planning process is done in a sustainable way, small modular district heating/cooling grids have the advantage, that at the beginning only one part of the system can be realised and additional heat sources and consumers can be added later. This modularity requires well planning and appropriate dimensioning of the equipment (e.g. pipes). It reduces the initial demand for investment and can grow steadily.

Besides small district heating, also small district cooling is an important technology with multiple benefits. With increased temperatures due to global warming, the demand for cooling gets higher, especially in southern Europe in which the target countries are located. In contrast to energy demanding conventional air conditioners, district cooling is a good and sustainable alternative, especially for larger building complexes. However, experiences and technologies are much less applied than for district heating. The CoolHeating includes both, heating and cooling in its planning process.

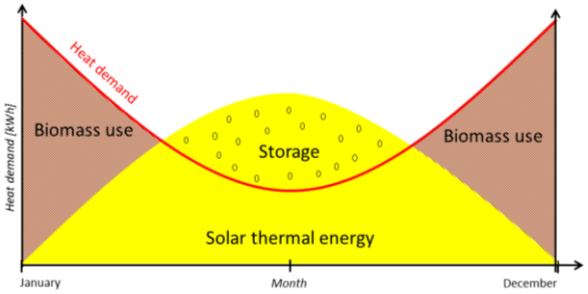

Figure 4: Scheme of the seasonal heat demand and supply from solar and biomass sources in Europe

The CoolHeating target countries in south-eastern Europe have high solar irradiation which can be used both for heating and cooling. The combination of small district heating and cooling in the same planning step saves cost and efforts, even if some consumers will demand only either heating or cooling. Thereby, also technical synergies are created (piping, the use of heat pumps). CoolHeating will develop business plans for the target communities with the following characteristics:

- Seasonal storage
- Diurnal storage
- Renewable heating (e.g. with a solar thermal plant and a biomass boiler)
- Thermal cooling
- Utilization of the waste heat from thermal cooling for heating (e.g. hot water supply)

Small modular district heating/cooling grids have several benefits. They contribute to increase the local economy due to local value chains of local biomass supply. Local employment is enhanced as well as security of supply. The comfort for the connected household is higher as only the heat exchanger is needed in the basement of the buildings and no fuel purchase has to be organised. Due to all these benefits, the objective of the CoolHeating project is to support the implementation of small modular renewable heating and cooling grids for communities (municipalities and smaller cities) in South-Eastern Europe.

3 THE COOLHEATING TARGET COUNTRIES AND COMMUNITIES

CoolHeating activities will have impact at tree levels: on national level, on target community level, and on "follower" community level. Core actions will be focussed on the target communities. Follower communities have the opportunity to learn from the project activities in the target communities. The following chapters will describe the current situation on renewable heating and cooling at these levels.

3.1 Bosnia-Herzegovina

Large district heating systems exist in Bosnia and Herzegovina in larger cities. There are also a number of small district heating grids, built in smaller cities and towns for schools, buildings or blocks of buildings. However, these systems are often old (more than 30 years) and operate mainly on fossil fuels. Many consumers have individual solutions for heating as well, using fossil fuels or wood in their own household boilers, or electricity for heating.

On the other hand, there are several other examples of district heating systems as well, such as those based on waste woody biomass that have recently been constructed and put into operation, like in Livno, Gracanica and other cities. In addition, many cities and towns have plans for the construction of such heating systems, to eliminate pollution and improve the cost-effectiveness of the heating solutions (Visoko, Zivinice, Gorazde and many others). Some current examples of good practice are described below.

3.1.1 Biomass Heating - Eko-Toplane, Gracanica

Eko-Toplane (http://www.eko-toplane.ba) was put into operation in 2008. The plant is operated on biomass and is adjusted to meet the needs of local communities for the supply of heat, both in industrial plants and in private residences. The heat is produced in a biomass boiler with a capacity of 6,000 kW. As an alternative for peak load operation a fuel oil boiler is installed as well. The network of the heating system has a length of about 14.5 km with a tendency of further expansion. The heated surface area currently amounts to approximately 55,000 m^2.

3.1.2 Biomass Heating - IEE Toplane, Gradiska

IEE ToplaneGradiskawas put into operation in 2014 (http://www.ieegroup.net/projekti.html). The plant is operated on biomass and provides heat both for private residences and office spaces. The heat is produced in two biomass boilers with a total capacity of 12,000 kW. The heated surface area currently amounts to approximately 120,000 m^2.

3.1.3 Hybrid Solar Collector/ Biomass Heating - Sports Hall “DaliborPerkovic - Dali”, Livno

The project of the reconstruction of the Sports Hall “DaliborPerkovic - Dali” was selected as one of ten USAID 3E projects. The letter of intent for its implementation was signed in November 2011 and the project inaugurated in November 2013. The sports hall was connected to an existing district heating network based on biomass boilers. Solar thermal panels were installed on the roof for domestic hot water heating. To reduce heat loss, new windows and doors were installed, parts of roof covering replaced, and the facade additionally thermally insulated. The installation of a Monitoring and Verification System for heat consumption should additionally contribute to improving the energy efficiency of the building. (http://www.sustainable-energybih.org/27-11-2013-sports-hall-inauguration-in-livno?lang=en; http://pdf.usaid.gov/pdf_docs/PA00K5JZ.pdf)

3.1.4 Hybrid Solar Collector/ Biomass Heating - Student Centre, Mostar

The Student Centre Mostar introduced the project of solar collector heating in 2012. Besides the solar collectors, the Student Centre uses pellet stoves as well, activated at times when the solar collectors are not operated. The students are herewith supplied with 24-hour hot water and heating. The overall aim of the project was to reduce power consumption and improve the student standard. Given the number of tenants (550 students during the academic year), the project provided substantial savings. Previous costs associated to average annual energy consumption amounted up to 500 KM per person, while today they are reduced down to 185 KM per person, with the aim of further reduction. (http://scm.pogled.ba/clanak/veliki-rezultati-projekata-ustede-elektricne-energije-u-studentskom-centru-mostar/38387)

CoolHeating will overall aim at helping facilitate cost efficient solutions and positively affect the environmental impact of existing heating solutions in many cities and towns in Bosnia-Herzegovina. It will directly have an impact on the reduction of harmful emissions and offer opportunities for new job creation, improving the social situation in the municipalities. By comprising environmental, economic and social aspect, CoolHeating will contribute to the overall sustainability in the field. At the end, all mentioned benefits should help the national governments in fulfilling requirements of increasingthe share of Renewable Energy Sources in final energy consumption and improving energy efficiency.

3.1.5 Target community: Municipality of Visoko

The Municipality of Visoko (41,352 inhabitants) is situated on the crossroads of the Sarajevo-Zenica industrial region. It is a settlement with an important cultural and historical past. The convenient geographic location, favourable climate conditions, plenty of woods and current waters were the reasons why this area was inhabited ever since the ancient times. The oldest traces of human life here date back to the younger Stone Age, while on the fertile river terraces of Bosna and its tributaries many Neolithic sites were found. Having such convenient geographic and economic conditions, the Visoko basin developed into one of the main political, economic and cultural centres of the medieval Bosnia state. Visoko has a status of a royal town, while its name was first mentioned in the 1355 charter issued to the merchants of Dubrovnik by ban Tvrtko I.

Today it has a well-developed business environment and contains several business zones: Ozrakovici, Cekrekcije, Dobrinje, and Topuzovopolje.

The Municipality of Visoko is strongly interested in developing a district heating system and finding a more sustainable solution for heating. As a source of heat, bio-waste as well as waste heat from the power plant Kakanj, which can operate in co-firing (coal-biomass) regimes and is situated 9 km from the town, is considered. At the moment part of the town is covered by a gas distribution system, so natural gas is used for heating to a certain degree. The rest of the Municipality uses coal or wood in individual small household boilers, or electricity for heating. Moreover, many consumers turn to individual solutions for heating (wood, coal or electricity), because of the price of natural gas.

The proportion of the population heated by natural gas compared to other fuels (wood, electricity, pellets and other fuels) is 10:90. Most inhabitants use wood for heating, which has an effect on increased deforestation. This project will directly contribute to raising awareness and educating the community about the benefits of

alternative solutions. The project will have a direct impact on the reduction of harmful emissions, reducing air pollution and providing a healthier environment.

3.1.6 Cooperation with Follower communities

In Bosnia-Herzegovina, the following two follower communities are involved:Municipality of Zivinice and Municipality of Gorazde.

3.2 Croatia

District heating represents approximately 14% of the overall heat supply in Croatia with 14 companies operating district heating plants in 19 cities and towns. By far the biggest district heating operator with a share of about 85% is HEP – Toplinarstvo, a publicly owned sister company of the national power company, HEP group. The majority of systems present in Croatia could be classified under the so called second generation category due to the fact that the heat networks use pressurised hot water with supply temperatures well above 100 °C as a heat carrier. This is still necessary due to the condition of the building stock in the country. The most common energy source in Croatia for district heating purposes is natural gas, approximately 80-85% depending on the season, followed by heat oil and a negligible amount of renewables in the form of one geothermal and one biomass plant. Three district heating plants utilize cogeneration, two plants in Zagreb and one in Osijek, while the rest are heat only. Most of the consumers in all of the cities are households. District cooling as such does not exist in Croatia yet.

The biggest issues facing the district heating sector in Croatia are the average age of the system, gas prices for households and, most crucially, the condition of the building stock in the country. Since most of the building stock does not have adequate heating insulation, usually resulting in a heat demand of 150-250 kWh/m^2 annually, the supply temperature in the system has to be kept at higher levels, well above 100 °C. This coupled with an old supply system results in fairly high energy loses and, in cases where domestic hot water is supplied, much higher differences in summer and winter operation than necessary. Due to all of this and the very low gas prices for households, district heating is perceived as expensive and inefficient by the general public.

3.2.1 Target community: City of Ozalj

The town of Ozalj is situated in the north-west part of the Karlovac County, and it occupies an area of 179.4 km^2 where numerous picturesque villages and hamlets are located, home to 6,837 inhabitants (2011 census). The Ozalj area is located along the lower course of the Kupa River and its right confluent, the Dobra River. It is characterized by an interesting geographical diversity – picturesque regions of south spurs of Žumberakmountains, smooth hills of the Vivodina-Vrhovac vineyards, wide and fertile plains near the Kupa River and 9 Šljunčara lakes full of fish. The highest peaks in the area are Vodenica (537m) and Sveta Gera (1,178 m).

The town of Ozalj has a great interest in improving their energy situation, in order to make it more efficient. This could be achieved by improving public city lights or the heating system for public buildings or private homes.

In the last few years there have been a few initiatives for biomass district heating systems that would be used to heat public buildings, private homes and a part of the industrial zone. Unfortunately, until now these initiatives have not yet been followed through. In that context, the CoolHeating project gives an additional mechanism to optimize the ideal fuel and technology mix for the future district heating options in Ozalj.

3.2.2Cooperation with Follower communities

In Croatia, the following two follower communities are involved:City of Osijek and City of VelikaGorica.

3.3 Macedonia

Macedonia has some 550,000 dwellings. The average energy intensity of the existing Macedonian building stock is roughly estimated at 220 kWh/m²/year. Electricity is the dominating heating source: In 2011, 52% of households' total final consumption was made up by electricity. Biomass e.g. fuel wood has the second biggest share, 31%, whereas heat provided by District Heating (DH) services only 6.7% and oil products 8%. This is a reflection of the findings in a household survey1, according to which 74% of all households are heated by stoves using solid fuels and 14% are heated by stoves using electricity, whereas only 6.2% have central heating (based on DH), and 5.5% have central heating (with private installations).

District heating only exist in three locations in Macedonia: Skopje, Bitola and Kamenica. The last two systems have been out of operation for several years. Only the DH network in Skopje is of important magnitude. Deliveries to the end users are measured at sub-stations or individual houses. Within apartment blocks the heating costs are divided according to heated area of the individual apartments. There is no individual metering per household. The system was expanded during 1990-2000 because many new apartment blocks were constructed and suitable for DH connections. In recent years the connections to the DH system have slowed down and even decreased. The Skopje DH system is characterised by outdated boilers (for fuel oil and natural gas) and considerable technical losses in distribution. The new cogeneration plants are of a better quality. There are plans to convert two electricity production plants to cogeneration plants and utilise the heat for district heating in the City of Bitola.

To date, almost two decades after the introduction of natural gas, it has not been possible for Macedonia to achieve significant development and expansion in the use of gas, not even in the greater Skopje area, which – owing to its population density and large industrial base – would represent one of the most likely geographical candidates for increasing the use of gas. Nevertheless, according to the gasification plan, gas consumption in the households, tertiary and industry sectors combined is projected to increase substantially, as the new gas network is projected to expand into more than 50 municipalities.

Small renewable district heating grids, as well as district cooling systems do not exist in the country, and are not explicitly addressed in the relevant strategic and planning documents. There is a wide spectrum of barriers for deployment of these technologies - starting from lack of technical knowledge and capacities, through enabling legislative/regulatory frameworks and financing schemes for mobilising investments, to lack of capacity of the local governments for planning and designing such projects.

3.3.1 Target community: Municipality of Karposh

The municipality of Karposh (population: 60,000; surface area 35 km^2) is located in the northwest Macedonia, central-west part of the City of Skopje. It is one of the ten Skopje municipalities with 12 urban and 2 rural units, and is mostly covered by the Skopje DH network.

Karposh is the only municipality in Macedonia which has subsidised the energy efficiency in buildings and the renewable energy use for heating and cooling, covering 15% and 20% of the communal tax for the respective buildings. Out of 244 buildings, constructed over the period 2012-2015, 117 buildings are of A+, A and B classes, and 68 of them have installed heat pumps for heating and cooling. Furthermore, as per the Development Strategy until 2019 and Energy Efficiency Programs (2008-2012 and 2013-2016), all the reconstructed buildings under the municipal jurisdiction (in total 20 schools and kindergartens, 14 fully reconstructed) should replace the oil boilers with renewable energy based heating by the end of 2018. So far, three buildings have installed renewable energy based heating – two with heat pumps and one with biomass wood chips (under construction). Also, under the Program for renovation of the facades of the collective housing buildings (166 buildings by 2019), facades of 13 buildings have been reconstructed with thermal insulation and new carpentry.

Karposh, as the Macedonian pioneering municipality in the area of local sustainable energy development, has a strong interest to assess the technical, non-technical and economic aspects and to promote the concept of small district heating and cooling systems at selected sites. Those sites could include some of the settlements that are not connected to the DH network and contain hundreds of houses which currently use electricity or biomass for heating, i.e. Zhdanec and Bardovci, and/or the military building complex "Ilinden", which has high energy consumption for heating and sanitary hot water, and extremely high energy expenses.

3.3.2 Cooperation with Follower communities

In Macedonia, the following three follower communities are involved:Municipality of KiselaVoda, Municipality of Chair, and Municipality of Strumica.

3.4 Slovenia

Slovenia has high renewable energy potentials, especially in terms of biomass, sun and geothermal resources. The current use of biomass for individual heating is high, especially in small cities and rural areas, but the biomass is used mainly in inefficient individual heating systems. Most district heating is based on large scale fossil driven district heating networks. Although there are only few renewable energy driven small-scale district heating networks in Slovenia today, the development of small scale district heating networks is a part of the Slovenian national energy plans and strategies. It is supported in a range of national tools like DOLB subsidies and supports schemes for small scale cogeneration plants. The main barriers are low awareness of positive impacts of centralised small scale DH (especially higher efficiency and less pollution with hard particles) of the general population, problematic legislation for above 1 MW district heating networks, existing use of biomass or individual heating, low price of heating oil and natural gas.

Practically no small scale district cooling or district heating projects in Slovenia exist. There are mainly large scale district heating systems in larger cities. Only a hand full of small scale district heating systems in Slovenia is using renewable energies.

The target community and the follower communities are located within the rural area of north eastern Slovenia. As such they have especially high renewable energy potentials. The communities are aware of the potential of small scale renewable energy DH projects and there are numerous small settlements where such projects would be highly important (replacing inefficient biomass heating and expensive heating oil heating).

3.4.1 Target community: Municipality of Ljutomer

The target community of Ljutomer includes almost 12,000 inhabitants in more than 40 settlements. The municipality represents a typical community in Slovenia. With one larger city of Ljutomer (almost 3,500 inhabitants) and a set of smaller dislocated communities. The municipality has large agricultural areas and rich forests. The predominant heating sources in the municipality are wood (used in predominantly old and ineffective individual stoves in rural areas), heating oil (used in individual heating, heating of larger objects and heating of larger residential buildings) and natural gas (being used in newer buildings, replacing especially heating oil). There are no district heating and/or cooling networks in the municipality. Whereas the concept of small district heating/cooling is very important for the municipality as it can represent an economic, green solution for replacing many existing (individual) heating devices which are becoming outdated and will have to be replaced in the following years. One of the target areas of the CoolHeating project in the Municipality of Ljutomer is a relatively developed village of Cven.

Cven is a village in the Municipality of Ljutomer in eastern Slovenia. The area traditionally belonged to the Styria region and is now included in the Mura Statistical Region. It has 589 inhabitants, 226 houses and 43 businesses. Potsherds and human remains from antiquity have been found in the settlement, testifying to early settlement in the area. The village was sacked during a peasant uprising in 1704, and the castle was also burned and never rebuilt. Cven Castle was surrounded by a meander in the Murica River on three sides and protected by a moat on the fourth side. Cven was known for horse breeding from the mid-19th century until the Second World War. Horse races were held as early as 1850 along the road from Ljutomer to KriževcipriLjutomeru, and a horse racing society was established in 1875, which also set up a racetrack in Cven.

3.4.2 Cooperation with Follower communities:

In Slovenia, the following two follower communities are involved:Municipality of Križevci and Municipality of GornjaRadgona.

3.5 Serbia

Currently, the district heating in Serbia is dominantly fuelled by fossil fuels: natural gas, lignite/coal and fuel oil. They will be replaced with biomass for cooling and heating. Basic data related to district heating in Serbia are as follows (Journal of District Heating in Serbia, issued by Association of Serbian District Heating Utilities; http://www.mre.gov.rs/doc/efikasnost-izvori/EnergyLaw.doc):

- Average consumption of fuels – coal 200,550 t/a, fuel oil (mazut) 87,441 t/a, 490,104,000 Sm3/a, fuel oil (light) 361,070, wood briquette 929 t/a, wood pellets 1,635 t/a, sunflower shell 29,500 MWh/a (energy equivalent), wood logs 4,910 t/a
- Approximately 320,000 MWh/a of thermal energy are supplied from power plants
- Total number of dwelling connected to DH system 608,767
- Total heated area 36,227,261 m^2
- Heating demand 6,185 MW
- Iinstalled capacity (without power plants) 6,432 MW
- Total length of DH networks 1,929,157 m
- Average age heating networks is 23 years
- Total number of heating substations 23,393

Currently, there are approximately 1% renewable district heating grids in Serbia. By the Energy Law there is the interest for energy from renewable sources. According to Chapter 66, paragraph 8, the national plan should include measures to develop district heating and cooling from renewable energy sources. There are about 100 MW of biomass cogeneration with 640 GWh_{el}/a of electricity production envisaged with the National renewable energy action plan. According to this plan the envisaged share of biomass cogeneration in district heating and cooling amounts to 33% of heat energy produced from additionally commissioned facilities (2009-2020), or around 570 GWhth/a. According to the Law on privileged producer the feed-in tariffs (8.22-13.26 c€/KWh) are available for the electricity production from biomass, but nor for heat energy nor for cogeneration. The main barriers for development are the permitting procedures. Also, there is no sustainable system for financial support.

The CoolHeating project will increase of use of energy from renewable source of biomass by knowledge transfer to the municipalities. The existing procedures will be analysed and solutions for the real challenges will be proposed. Knowledge transfer is ensured by the project activities, while the real challenges, the permitting procedures, are addressed. The licence permits in heat production are in the responsibility of municipalities. Also, support schemes such as feed-in tariff for the renewable district heating and cooling lies on the responsibility of the municipalities. The technical parts of the binding agreement for the heat producers are in responsibility of the municipal district heating companies as well, according to the National plan. However, CoolHeating will have a positive economic impact for the rural communities. These communities will benefit from the localization of the heating and cooling supply chain, but also from the food industry that has significant demand for heating in the winter and cooling during summer months.

Although highly needed, there are no experiences with district cooling in Serbia. There was an intention for the district cooling project development in the City of Subotica.

3.5.1 Target community: Municipality of Sabac

The target community, the City of Sabac, has a district heating utility named "Toplana-Sabac" with a capacity of 72.3 MW (http://www.toplanasabac.rs). The heat production is manly based on natural gas (93% of capacity) and small part on fuel oil (7%). The system is consisted of 4 generators, 22 km of heating networks, 369 substations that are supplying the heat for about 6,700 customers in households and 600 in commercial sector (around 472,750 m^2). The average age of the heating network and substations is 20-25 years (Journal of District Heating in Serbia, issued by Association of Serbian District Heating Utilities). During 2014 and 2015, 110 substations were reconstructed and modernized. Also, in the flue gases tracts of three 14 MW gas boilers, recuperation units that increase efficiency for 3.5% of these boilers, were installed. These activities were financed by KfW 4 project. In 2016 the reconstruction of part of DH network, of the biggest heating plant and of the SCADA system is envisaged.

The CoolHeating study should include biomass district heating/cooling for around 250 households and 1,000 kW in other sectors.

3.5.2 Cooperation with Follower communities

In Serbia, information on the follower communities will be provided soon.

4 CONCLUSIONS

In the coming 2.5 years, the CoolHeating will work on a key challenge to make the energy supply in Europe more sustainable: it will support local actions in the target countries in south-eastern Europe in order to develop concepts for small renewable modular heating and cooling systems. Core technologies will be combinations of solar and biomass systems. Active involvement of target communities and the relevant stakeholders (e.g. citizens, utilities, installers) will be implemented by a large set of soft support measures, such as handbooks in local languages, working group meetings, surveys, consumer information and workshops.

5 ACKNOWLEDGEMENTS

The authors would like to thank the colleagues of WIP Renewable Energies as well as the CoolHeating partners for their contributions in the project:The authors would like to thank the European Commission and the Innovation and Networks Executive Agency (INEA) for the support of the CoolHeating project. CoolHeating has received funding from the European Union`s Horizon 2020 research and innovation programme under grant agreement No 691679. The project duration is January 2016 to December 2018.

Disclaimer: The sole responsibility for the content of this paper lies with the authors. It does not necessarily reflect the opinion of the European Union. Neither the INEA nor the European Commission are responsible for any use that may be made of the information contained therein.