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1 Introduction

The Danube Region represents one fifth of the European Union's total area and covers 9 EU (Austria, Bulgaria, Croatia, Czech Republic, Germany, Hungary, Romania, Slovakia, Slovenia) and 5 non-EU countries (Bosnia and Herzegovina, Moldova, Montenegro, Serbia, Ukraine). The countries show significant regional disparities in economic and social development. In order to foster growth and strengthen cooperation at a macro-regional level, the European Union established the Danube Region Strategy (COM(2010) 715), endorsed by the European Council in June 2011.

The renewed action plan of the Priority Area 2 'Sustainable Energy' of the EU Strategy for Danube Region and the DTP-PAC2-PA2 project, which define the tasks of the priority area, both prioritize the acceleration of the spread of green district heating in the Danube Region and the decarbonisation objectives of the EU and the EUSDR. **Hungary has significant experience in the use of geothermal energy for district heating in both the EU27 and the Danube Region**. After Turkey, Iceland, France and Germany, **Hungary has the most operating and under development geothermal district heating systems**, where the utilization of geothermal energy for district heating purposes is approx. **530 GWh/ year**, the total installed capacity is approx. **180 MW**. The aim is to **transfer** the Hungarian experience and **knowledge** of geothermal energy utilization opportunities for district heating in a series of events to be implemented later to those EUSDR countries that have adequate geothermal potential, heat market and district heating supply, but such developments are lagging behind. Based on preliminary knowledge, the examined countries are Bosnia and Herzegovina, Croatia, Romania, Serbia, Slovakia and Slovenia.

The successful expansion of the geothermal market, already having mature technologies requires three basic conditions:

- available geothermal resources (supply side) and their in-depth geoscientific knowledge;
- available heat markets (demand side)
- an investment-friendly political and economic environment (supportive national strategic frameworks, transparent regulatory system, easy licensing procedures, available financial incentives, social acceptance, etc.).

2 Geothermal energy potential and district heating overview in the target countries

2.1 Bosnia and Herzegovina

2.1.1 Geothermal resources and current utilization

Within the Alpine orogeny Bosnia and Herzegovina belongs to the Dinaric tectonic unit and has a very complex geology. About 50% of the country's territory has various geothermal potential arranged into 9 hydrogeothermal zones located north of the Bihać – Konjic – Foča line, where the main reservoirs are Middle and Upper Triassic carbonates at a depth of 1500 m and below. Heat flow and subsurface temperatures increase from central to the northern parts of country. The largest positive geothermal anomalies are in the Pannonian Basin.

Geothermal utilization[1] is based on direct use from 26 production wells and 4 springs at 25 locations. Thermal and thermomineral waters with temperatures from 18 to 75 °C are used in balneology and recreation, then for the space heating and heating of water in swimming pools, industrial processes and as sanitary water. The use of geothermal energy for buildings (including heating waters in swimming pools) and sanitary waters was 43.64 GWhth /yr in 2021. Individual space heating is implemented at 13 locations out of which 8 sites have heat exchangers (Gata, Slatina-Banjaluka, Kulaši, Dvorovi, Terme Ozren, Ilidža Termalna rivijera, Ilidža Terme and Slobomir), and at 5 locations (spas) are in use heat pumps with water temperature t > 20 °C (Laktaši, Sanska Ilidža, Gradačac, Višegradska Banja, Olovo and Fojnica). There is no larger scale (i.e. district heating) usage of geothermal resources at the moment.

2.1.2 District heating situation in Bosnia and Herzegovina in 2019

2.1.2.1 Key Figures

Net DH sales to customers: 1,499 GWh

Total installed DH capacity: - MW_{th}

Trench length in km for transport and distribution network (one way): 450 km

Number of DH systems: 32 (in operation)

[1] Samardzic et al (2022): Geothermal Energy Use, Country Update for Bosnia and Herzegovina - European Geothermal Congress 2022, Berlin, Germany

2.1.2.2 Fuel use for district heating over the last ten years

The district heating system in urban areas in Bosnia and Herzegovina (BiH) was a common way of heating over the last decades. Namely, most urban environments were dependent on heat from district heating systems. The endeavor for society was to show its organization in that domain, and for the engineers to show how it was possible to heat more efficiently and to be more environmentally friendly than with individual furnaces. In conclusions there was a tradition of using district heating systems to provide heating in cities.

District heating systems can be divided into three groups:

- District heating systems in urban areas;
- District heating systems from thermal power plants – cogeneration; and
- Local heating systems from a local factory.

Almost all district heating systems aim to expand the district heating network to maximize the use of available capacity.

Considering the type of fuel, Sarajevo and Zvornik are the only DHS using natural gas, these two cities are located on the natural gas pipeline route. Prijedor and Banja Luka were using fuel oil in heating plants, however, in 2015 and 2017, respectively, these two district heating systems switched to wood chips as the primary energy source, while fuel oil plants remained an alternative option. In 2018, fuel oil is still being used as a primary energy source only in heat power plants in Vogošća and East Sarajevo. Ultimately, most DHS in BiH use coal as their primary energy source (Travnik, Zavidovici, Doboj, Tesanj, Bijeljina, etc.). Some of them are looking into the possibility of switching to wood biomass – following the trend of switching from coal to biomass due to the environmental aspect on the one hand, and prices on the other, as the wood biomass market is gradually evolving, with costs of biomass often lower than coal costs.

2.1.2.3 Energy supply composition of district heat generated

Energy supply composition of DH generated in BiH		
	2017 In GWh	2017 In %
Cogeneration		
Fossil		
Coal and coal products	**386**	**25,7**
Renewables		
Solid biomass	**53**	**3,5**
Heat only		
Fossil		
Coal and coal products	**364**	**24,3**
Oil and petroleum products	**15**	**1**
Natural gas	**435**	**29**
Renewables		
Solid biomass	**247**	**16,5**
Total	**1 500**	**100**

Figure 1 Energy supply composition of district heat generated in BiH 2017

2.1.2.4 DH market summary

In Bosnia and Herzegovina (BiH), in 2017, a total of 35 companies were identified in the field of DHSs, of which 3 were out of operation while there are 32 DHSs in operation. Of these, 22 are in the Federation of BiH (FBiH), while the remaining 13 are in the Republika Srpska (RS). Some of the 32 operating companies are involved in the production and delivery of heat, while some are only in the delivery.

In 2017, the total annual heat production from DHS in BiH amounted to 1,499,571 MWh, of which a total of 1,103,534 MWh of thermal energy was produced in the FBiH heat power plants, while 396,036 MWh of thermal energy was produced in the RS. At the BiH level, 50% of thermal energy is obtained from coal, while 29% of energy is obtained from natural gas and 20% from wood biomass. Fuel oil accounts for only 1% of heat produced.

The total heated area of all DHSs at the BiH level is 10,048,516 m^2. Most DHSs pay for the heat supply service in a combination, i.e. flat rate per heated area (BAM/m^2)* and according to actual consumption (BAM/MWh). The average rate of charge for all analyzed DH companies involved in the supply of thermal energy is 86.3%.

2.1.2.5 Existing driving forces and/or opportunities that favor an expansion of DH

- Based on researches and different assessments there is a significant energy potential in biomass residue from agriculture, forestry and wood-processing (technical energy potential is estimated at 13.75 PJ or 3,820 GWh).
- There is also a growing interest in the use of solar collectors as well, especially in the public sector (7,000 m^2 installed collectors estimated, with an annual increase close to 28%).
- There is a significant potential in geothermal energy, mainly in the central and northern parts of the country (estimated at 9.25 MW_{th} available at 42 different sites).
- More than 1,100 public buildings have been included in an Energy Management Information System (EMIS), for monitoring, comparison, etc.
- A typology of residential buildings is currently being establishing for BiH, covering data on size, age and energy consumption level.

2.1.2.6 Existing barriers to the expansion of DH

- Due to complex administrative structures in BiH and a high degree of decentralization, there is a multitude of legal acts, regulated by different regulatory authorities.
- The legal framework in the DH sector is incomplete, there is no DH Sectoral Strategy, and a more coherent framework regulating the operation and key principles of the DH sector would need to be established.
- The heating sector is currently not regulated. Otherwise, a separate Law on Heat Energy market is adopted by the end of 2019 in the Federation of Bosnia and Herzegovina (FBiH).
- The general problem with most district heating systems built by the end of the 1990s is over-size. The plants are designed for a much larger number of customers than they currently supply. In addition, the thermal needs calculation method was such that the system could heat the buildings adequately at extremely low outside temperatures. Since all systems only provide heat for space heating (not for domestic hot water), their annual utilization is around 20%.
- An additional problem is the low energy efficiency of about 80% of facilities connected to district heating systems.
- The rules applying to district heating companies are defined by the local community (municipality, city or canton). As a result it is often the case in BiH that social policy is overruling and the beneficiaries of such social services are residentals who are not in a state of social support at all. As a result, citizens supported by local politics do not have an adequate attitude

towards an energy efficient use of district heating systems. Also the tariff rules applicable are more than 30 years old etc.

- The price ratios of individual energy products on the BiH market are irregular and create misconceptions among the population about the actual price of heating. A particular problem is the price of electricity for the population, which is not affordable. In such a situation, citizens very often make incorrect price comparisons and are directed in misleadingly wrong direction. In general, in BiH, irregular energy price ratios are the basis for making poor investment decisions in the area of district heating and energy sector. For example, in Canton Sarajevo, as much as 100,000 MWh of electricity is consumed for heating during one heating season.
- A heating and energy regulator should be established to ensure a fair relationship between customers, distributors and heat producers.

An example of this is the Sarajevo Canton, whose Government established an Independent Expert Body in 2017, with the task of monitoring changes in energy prices on the market and other costs significantly affecting the price of heat and set accordingly the price of heat. The work of the Independent Expert Body and adherence to the recommendations of that body by the Government of the Canton of Sarajevo have brought positive results.

Proper energy statistics are missing and though there are statistical data on electricity, heat (lump sum) and fossil fuel supply and consumption, there are no reports on renewable energy sources published by the BiH or statistics body.

2.1.2.7 Emerging Technologies

Potential for the use of renewable energy in district heating systems (DHSs) was analyzed in 2018 for Bosnia and Herzegovina. The total technical potential of wood biomass for high-efficiency cogeneration and district heating in BiH is 1,971,553 t / year, which is the energy equivalent of 28.51 PJ. Furthermore, it is possible to produce a total of 328,357 MWh / year of thermal energy, or 31,524 MWh / year of cooling energy, from geothermal sources explored in BiH so far. Data for BiH for solar energy show that the average duration of insolation is about 2,071 hours, with about 70% being generated from April to September. In BiH, the solar energy utilization potential is 70.5 million GWh of total solar radiation per year.

An analysis of the potential for the expansion of district heating systems in selected areas was made. For the purpose of determining the economic potential of the expansion of DHSs, a levelized energy production cost (LCOH) was determined, which included the calculation of investment costs,

maintenance costs, operating costs and fuel costs. The LCOH at the boiler threshold and the LCOH at the consumer threshold were calculated for a total of 45 cities / municipalities in BiH, ranging from 38-107 KM / MWh and 55-134 KM / MWh respectively. The differences in LCOH height depend to a large extent on energy sources, population density, and existing infrastructure.

2.2 Croatia

2.2.1 Geothermal resources and current utilization

Croatia can be divided into two significantly different geothermal regions: the Dinaric and the Pannonian. The Dinaric region is characterized by low heat flow and temperature gradient, while the northern Pannonian part has favourable geothermal conditions: the average heat flow is 76 mW/m^2, the geothermal gradient is 49 °C/km

In the northern part of Croatia (part of the Pannonian Basin - Mura, Drava, Sava and Slavonija-Srijem depressions) there are multiple sandstone aquifers in Miocene and Pliocene formations, as well as in Triassic dolomite and Paleozoic metamorphic aquifers at greater depth. In accordance with the depth, the waters also have higher temperatures (50 – 200 °C). A great number of wells drilled for hydrocarbon exploration were unsuccessful for the production of oil and gas, however discovered significant geothermal reservoirs, outlining ten geothermal fields, classified in two categories, medium temperature reservoirs with water between 100 and 200°C, and low temperature ones, producing water with temperatures between 65 and 100°C.

In spite of the considerable geothermal potential, the rate of direct heat utilization is low[2]. In 2021, 252.7 TJ (70.3 GWhth) of heat was produced from geothermal sources. Geothermal district heating is available only at 3 sites (Topusko, Zagreb, Bizovac) with a total installed capacity of 43,3 MW and a heat production of 21,1 1 GWh/y. The rest is used in balneology and in a few greenhouses.

[2] Zivkovic et al (2022): Geothermal Energy Use, Country Update for Croatia - European Geothermal Congress 2022, Berlin, Germany

2.2.2 District heating situation in Croatia in 2019

2.2.2.1 Key Figures

Total installed DH capacity: 2,221 MWth

Trench length in km for transport and distribution network (one way): 436 km

Number of DH systems: no data available

Number of citizens served by DH in 2017: 435,870

2.2.2.2 Fuel use for district heating over the last ten year

The fuels used for District heating in Croatia are natural gas, renewables, oil and petroleum products (light heating oil and fuel oil) which are used both in cogeneration plants and local boiler plants. In the past ten years, the percentage of each fuel used has fluctuated from year to year. However, the percentage of natural gas used to generate District heating in the last decade has generally risen while the percentage of oil and petroleum products has fallen. Figure 2 shows these trends and the percentage of fuels used (for 2019: natural gas 71.5%, oil and petroleum products 1.13%, renewables 27.32%).

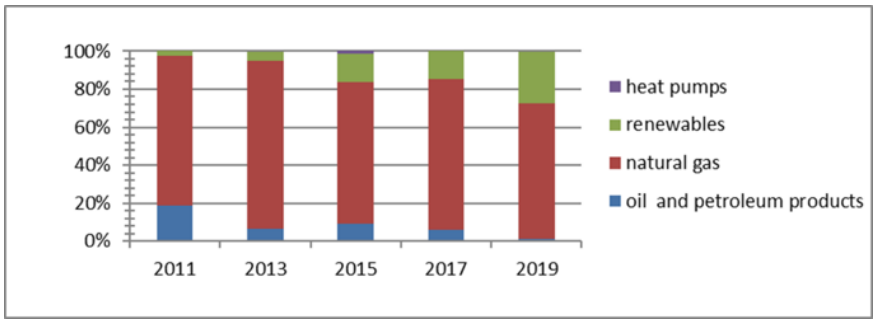

Figure 2 Fuels used in DH in Croatia (2019)

2.2.2.3 DH market summary

There has been no expansion of District heating in the last fifteen years in Croatia and there is a considerable need for refurbishment of existing networks to increase customer confidence, energy efficiency and profitability.

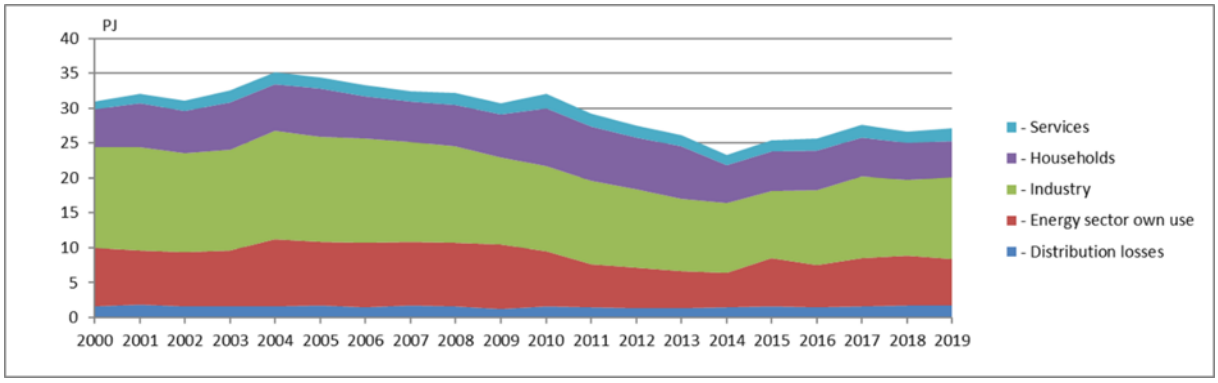

Figure 3 DH market composition

Three of the largest networks are operated by the largest DH distribution company in Croatia, HEP Toplinarstvo d.o.o. These are located in the cities of Zagreb, Osijek and Sisak.

Main market data of the three largest DH companies

	Network length	Number of customers			Share of renewable energy
	km	households	business premises	total	%
Zagreb	284	99 289	4 750	104 039	0
Osijek	57	10 499	1 292	11 791	29
Sisak	30	4 066	83	4 149	42

Figure 4 Main data of the three largest DH companies

2.2.2.4 Existing driving forces and/or opportunities that favor an expansion of DH

The refurbishment of the existing and the connection of new pipeline sections to the district heating systems in large cities will increase efficiency and reduce heat loss. By connecting technologically diverse energy sources and heat accumulators, the competitiveness of district heating systems will increase for the future resolution of combined heating and cooling with low temperature return in large cities. The energy refurbishment of buildings will significantly contribute to the overall efficiency of district heating systems as well as the application of advanced information-communication systems and meters in the operation of district heating systems.

The application of distributed heat production, the development of heat storage, the efficiency of district heating systems operation in conjunction with high efficiency cogeneration, will affect the competitiveness of supply of district heating and cooling of new and existing district heating customers.

Energy efficiency is a fundamental component of energy developments that will be reflected in the technological development of production, transport/transmission, distribution, and energy

consumption, and will include state measures, system organization and support programs. The level of financial support will directly affect the speed and scope of the reconstruction of the building stock.

The main opportunity for the development of District heating in Croatia is seen as being through improved energy efficiency and an increase in reliability and security of supply of District heating systems through the application of new technologies. These may include options such as biomass and geothermal energy, the replacement of old networks with preinsulated pipes, improved regulation of District heating systems at all levels (including demand side management).

It may still be too early for the development of large District Cooling schemes in Croatia, but this will certainly depend on new technologies and their widespread application as well as acceptable investment and operating costs that are competitive in comparison with current traditional methods of cooling. Cooling undoubtedly has potential but how it will take off remains to be seen in the years to come.

2.2.2.5 Existing barriers to the expansion of DH

- The existing District heating systems in Croatia require substantial investment to revitalise and modernise them to increase the reliability and security of heat supply.
- A lack of energy planning. The final phase of the District heating Strategy, which has been postponed, is expected to provide the final guidelines that should facilitate cooperation between state administration offices in the counties responsible for energy affairs and representative bodies of local governments when physical planning documents are being developed.
- Natural gas, which is district heating's main competitor, is seen by district heating companies as being favored by political and local communities and in terms of price. In the view of the current gas crisis emerging from the Russian-Ukrainaien war this will be changed.
- The major challenge is to raise more awareness about District heating and to create conditions for it to become profitable by allowing price levels to facilitate development. The implementation of the Energy Development Strategy through an Energy Strategy Action Plan is also a challenge as it will determine measures, activities, and implementation dynamics of the energy policy for the upcoming years. The image of District heating also needs to be improved, especially among those who do not currently use it, through information and education campaigns.

2.2.2.6 Emerging Technologies

It is expected that the construction of distributed energy infrastructure to complement large energy systems will be stimulated as well as the application of renewable energies for heating, primarily biomass/biogas, geothermal energy and solar thermal will be introduced as well as heat pumps due to their high efficiency and lower environmental impact.

Heat pumps are used in low-temperature heating and are as such not compatible with the existing heating infrastructure. With higher energy prices and government incentives they are becoming competitive and therefore low-temperature heating is expected to grow in the years to come. In the Green Book of the Energy Strategy, it is estimated that by 2030, 9% of the total heated surface of residential, services and other sectors will use heat pumps for heating and cooling, and that the figure will rise to 22% by 2050.

HEP Toplinarstvo d.o.o. has begun its mission to decarbonize its district heating by installing two biomass cogeneration plants in Osijek and Sisak. In parallel, HEP-Toplinarstvo implements large investment projects co-financed by grants from the European Union through the European Regional Development Fund. Firstly, the project of revitalization of the distribution network in the city of Zagreb - the total value of the project is 700 million HRK, of which 421.5 million HRK is from non-refundable EU funds, which makes it one of the largest projects in Croatia co-financed by EU funds. In the period from 2021 to 2023, it is planned to replace almost a third of the obsolete Zagreb distribution network, which will increase the reliability and security of the heat supply to customers.

The second project is the replacement of the connecting pipeline from TE-TO Osijek to the Osijek Heating Plant - the total value of the project is HRK 78 million, of which HRK 46 million are from non-refundable EU funds. The goals of the project are greater energy efficiency of the system, continuation of a reliable supply of heat to customers and reduction of emissions of harmful substances into the environment.

2.3 Romania

2.3.1 Geothermal resources and current utilization

The best well known geothermal resources in Romania are the geothermal aquifers in the Pannonian Plain, where the main geothermal aquifers are found either in the in the Miocene, Pliocene porous and permeable multi-layered sandstones and siltstones, or in the basement Triassic limestones and dolomites at depths of 2200 to 3000 m, which produce thermal waters up to 80-100 C (e.g. near Oradea, Bors, Beius).

Another area with geothermal waters is in the central and southern parts of the country between the Dambovita Valley and Olt Valley.

Geothermal district heating[3] and individual space heating exists at 10 locations (mostly in the W-ern part of the country) with a total installed capacity of 109 MWt and a heat production of 158 GWh/y. A minor part of the geothermal resources (8MW) is used in the agriculture and industry and in balneology (10 MW).

2.3.2 District heating situation in Romania in 2017

2.3.2.1 Key Figures

Total installed DH capacity: 9,962 MW_{th}

Trench length in km for transport and distribution network (one way): -

Number of DH systems: 61

2.3.2.2 Fuel use for district heating over the last ten years

The shares of the different types of energy resources used in the SACET (Romanian district heating systems ensuring heat generation, transport and distribution, as well as supply to end users in a centralised manner) in 2015 are:

- Natural gas 80.18 %;
- Coal 17.67 %;
- Other resources (combustible waste, etc.) 1.06 %;
- Renewable energy sources (plant and wood biomass, geothermal energy, sun energy) 0.64 %;
- Black oil 0.45 %.

The following may be pointed out with regard to the consumption of energy resources used in the 59 cogeneration plants with electricity input in the National Electronic Energy System:

- 45 cogeneration plants, with a total installed electric capacity of 1,067 MWe use natural gas;
- 12 cogeneration plants, with a total installed electric capacity of 678 MWe use coal;
- 2 cogeneration plants, with a total installed electric capacity of 28 MWe use other fuels.

[3] Gavriliuc et al (2022): Geothermal Energy Use, Country Update for Romania - European Geothermal Congress 2022, Berlin, Germany

2.3.2.3 Energy supply composition of district heat generated

Energy supply composition of DH generated in Romania		
	2013 In GWh	2013 In %
Cogeneration		
Fossil		
Coal and coal products	**72 384**	**38,39**
Oil and petroleum products	**6 221**	**3,3**
Natural gas	**101 225**	**53,6**
Nuclear	**19**	**0,01**
Heat only		
Fossil		
Renewables		
Solid biomass	**3 770**	**2**
Others	**5 090**	**2,7**
Total	**188 709**	**100**

Figure 5 Energy supply composition of district heat generated in Romania 2013

2.3.2.4 DH market summary

The district heating sector is in obvious and worrying decline in Romania.

In 1989, there were 315 cities that owned a district heating network; in 1997, there were 308, the number decreasing considerably to 188 in 2003, 121 in 2009 and 110 in 2011. (source: Ministry of Regional Development and Public Administration & Ministry of Energy Report 2015)

Today, only 61 district heating systems exist, mainly in big cities. Unfortunately, the majority of these systems are confronted with severe economic issues. Actually, in the absence of a coherent national energy strategy, decision powers have been transferred to the local administrations. Moreover, the district heating installations have not been adapted to the real needs, which have decreased after the 1990s, most of all because of the decline of the industrial sector.

The reasons for this decline are numerous: they are linked to institutional, legal, technical, administrative, financial, social and investment issues, as well as to an atypical gas price policy. Disconnections from the district heating system by encouraging individual heating solutions were generated by the misunderstanding of this field both at central and local level.

During the last 25 years, a technical legacy of high energy losses and a modest living standard led inevitably to this situation, as there were no financial resources for technical rehabilitation of heat pipelines.

In Romania, district heating can be split in two categories:

- The municipality took the responsibility of the district heating service and gave it in concession to an operator – which administrates the entire system;

- Heat is supplied by the heat network operator, but producers are not yet integrated in the system.

Four ministries have been responsible for the production, transport, distribution and supply of heat. Two National Authorities are in charge with the heat supply regulation (ANRE – National Regulatory Authority in the field of Energy and ANRSC – National Regulatory Authority in the field of public services).

Due to the fact that heat was not within the responsibility of a single ministry, it has not been introduced in the Romanian Energy Strategy until recently. In order to comply with the EU Strategy on Heating and Cooling, producers are now promoting new support schemes for cogeneration and renewables.

The way in which the district heating systems have been operated had a negative effect on the overall treatment of these systems. Heating fuel subsidies amounted up to 45% and social grants are available for end consumers. The abolition of fuel subsidies, considered state aid, had an impact on consumer bills by up to 30-50%.

Given the importance of district heating systems for the population's standard of living the following measures are necessary:

- An efficient institutional and legislative framework, with clear responsibilities on the promotion of efficient cogeneration and modern district heating systems; a single regulator, a ministry responsible for public services, including district heating;
- Responsibilisation of local authorities in order for them to obtain investment funds to modernize the cogeneration installations, together with the operator, using efficient cogeneration bonus as collateral;
- The use of the binomial tariff for heat as a recognition of economic realities and a better monthly expenditure for the district heating operators;
- Building compliance with the energy efficiency laws; and discouraging the disconnection from district heating;
- Priority use of renewables, building knowledge and compliance with the investors' terms in this area;
- VAT reduction on works aiming to increase energy efficiency;
- Solutions to restructure existing systems through a concession to experienced private operators;

- Improving the quality of the district heating service as an argument for consumers to reconnect to the district heating system.

The energy sources for the large cities should include energy recovered from waste, as an important part of non-hazardous solid waste management. Transforming solid, compostable or recyclable waste into electricity and heat in high efficiency cogeneration plant is considered as an effective method of using local energy sources and at the same time, of reducing the methane production in waste storage. This final waste of such cogeneration facilities represent almost 10% of the initial waste, contributing substantially to reducing the amount of landfill materials. The first project of this kind, which is underway in Timisoara, should be an example to be followed by other major municipalities in Romania. During the 2014-2020 programming period, funds should have been granted without discrimination for investment projects involving large companies in the public and as well the private sector. Also, in general, there should be equal eligibility of projects (public and private) provided that they comply with the EU 2020 strategy. In this context, it is recommended that European subsidies should be available also for providers of high environmental and energy efficiency services. These grants would be used, on the one hand, to develop projects in line with EU objectives and targets set by Romania (energy efficiency, cogeneration, using waste as an energy source) and, secondly, to limit the impact of increased costs due to new standards of environmental requirements on the end-users (e.g. the Directive on industrial emissions and hazardous waste management laws).

2.3.2.5 Existing driving forces and/or opportunities that favor an expansion of district heating

Law 121 / 2014 acknowledges the advantages of heat networks and cogeneration: possibility to recover lost industrial heat, massive use of renewable energy (biomass), efficient production (according to the scheme), better air quality and safety in comparison with individual heating solutions. The application of article 14 (promotion of heat and cold efficiency) of the Energy Efficiency Directive will allow for a mapping of networks depending on the future demographic development and on heat demand.

It will offer the basis for a national strategy that must establish the cornerstone of sustainable management of such networks resuming refurbishing and development of cogeneration plants included in the SACET or as industrial applications, as well as investment in network refurbishment.

2.3.2.6 Existing barriers to the expansion of district heating

The existing support scheme for promoting high efficiency cogeneration units will end in 2023 and does not supply enough incentives for investors to develop new projects.

Investors expect that a new support scheme will be defined.

Today, the Romanian energy sector faces an over-capacity, due to the proportion of renewable electricity installed (the support scheme was very attractive, more than 4,000 MW_e were installed) and to the decrease in consumption.

2.4 Serbia

2.4.1 Geothermal resources and current utilization

The territory of Serbia has favorable geothermal characteristics with more than 80 hydrogeothermal systems arranged into four geothermal provinces. According to the recent data[4] in Serbia in 2021 546.27 GWth was produced from geothermal sources with a total capacity of 161.85 MWth, where 429.38 GWth was in geothermal direct use with a thermal capacity of 109.26 MWth. In Serbia nowadays, thermal water is being used for balneology, sport and recreation at over 50 locations. Geothermal energy utilization for heating, as well as in agriculture and industrial processes is present, but only in few locations. Geothermal energy utilization for heating is usually connected with systems used for spas and balneology, while district heating systems based on geothermal energy exist only in Bogatic.

2.4.2 District heating situation in Serbia in 2019

2.4.2.1 Key Figures

Total installed DH capacity: 5,821 MW_{th}

Trench length in km for transport and distribution network (one way): 2,354

Number of DH systems: 59

2.4.2.2 Fuel use for district heating over the last ten years

In the production of heat energy, the percentage of natural gas has increased, fuel oil and coal have decreased, but on the other hand, the use of renewable energy sources is growing very slowly. The fossil generated district heat is produced in heat-only thermal plants. Waste heat recovered from industry accounts for 14.3% of the heat supplied to DH networks.

[4] Oudec and Djokic (2022): Geothermal Energy Use, Country Update for Serbia - European Geothermal Congress 2022, Berlin, Germany

2.4.2.3 Energy supply composition of district heat generated

Energy supply composition of DH generated in Serbia		
	2019 In GWh	2019 In %
Cogeneration		
Fossil		
Natural gas	**98**	**1,4**
Heat only		
Fossil		
Coal and coal products	**505**	**7,4**
Oil and petroleum products	**616**	**9,1**
Natural gas	**4609**	**67,8**
Renewables		
Industrial waste heat	**974**	**14,3**
Total	**6 802**	**100**

Figure 6 Energy supply composition of district heat generated in Serbia 2019

2.4.2.4 DH market summary

A small decrease in the DH market has been observed in recent years with a reduction in both the overall number of networks and the level of investment, while CO2 emissions have increased. The length of the distribution network has increased and there is potential to connect more customers.

The largest DH systems are:

Belgrade network: 732 km in length, 317,200 households connected

Novi Sad network: 224 km in length, 98,937 households connected

Kragujevac network: 86 km in length

Nis network: 26,855 households connected.

Of these four district heating systems, only Belgrade uses renewable energy (0.15% wood pellets) in relation to its own energy produced.

2.4.2.5 Driving forces and/or opportunities that favor an expansion of district heating

Currently, local governments issue regulations on how to expand the district heating system. The measures taken vary greatly by municipality / city.

It is necessary to harmonize this practice in order to improve local air quality by eliminating individual heating solutions (furnaces, boilers) through equal financial, technical and tax treatment, to mitigate the impact of competition in all municipalities / cities. The new Energy Law (adopted in 2021) creates such opportunities in the coming period.

2.4.2.6 Existing barriers to the expansion of district heating

The main barrier to the expansion of the district heating system is the low price of electricity. The number of households heated directly using electricity is almost the same as the number served by district heating systems. There are no major political, administrative or technical issues, but tax relief and harmonization of accession practices with favorable financial conditions would certainly contribute to the improvement of the current situation.

It is necessary to improve communication channels and repair the image of district heating with future potential buyers of thermal energy, at the local and national level.

2.4.2.7 Emerging Technologies

The Law on the Use of Renewable Energy Sources (adopted in 2021) has created the possibility to purchase energy generation technologies relevant for the district heating sector through state subsidies. The priority will likely be the use of heat pumps, solar thermal plants, biomass and waste heat recovery in the case of the largest district heating system in Belgrade.

2.5 Slovakia

2.5.1 Geothermal resources and current utilization

Within the variable geological setting of Slovakia encompassing parts of the Carpathian Mountains and the Pannonian basin altogether 27 hydrogeothermal areas or structures have been identified representing a great variety of geological settings and reservoir types. Recently[5] 121 wells are active at 76 localities representing an installed capacity of 230 MWth. The yearly production reached 1,684 TJ of heat and a 470 $GW_{th}h$ of geothermal energy.

Altogether 10 wells at 10 sites provide heat of a geothermal resource for individual heating of administration buildings or resorts with an overall installed capacity of 33.4 MWth. Four DH plants exist in Slovakia (Sereď, Šaľa, Veľký Meder and Galanta) with a total installed capacity of 20.6 MWth. Each is, however, a hybrid system, combining geothermal energy supporting natural gas boilers.

[5] Fricovsky et al (2022): Geothermal Energy Use, Country Update for Slovakia - European Geothermal Congress 2022, Berlin, Germany

2.5.2 District heating situation in Slovakia in 2015

2.5.2.1 Key Figures

Total installed DH capacity: 15,793 MW_{th} (2013)

Trench length in km for transport and distribution network (one way): no data available

Number of DH systems: no data available

2.5.2.2 Fuel use for district heating over the last ten years

As regards the structure of the fuels and energy used to produce heat, natural gas is the dominant fuel. The production of heat and the structure of fuels is used in centralised heat supply systems with the greatest potential for application of high-efficiency cogeneration.

The share of fuels was the following: coal 15,82%, natural gas 43,82%, nuclear energy 4,43%, wood and wood waste 16,09%, other fuels[6] 19,80% (2014). The declining consumption of fossil fuels is largely due to the reduction in their use for the production of heat, in particular in the case of natural gas. The share of biomass in the production of heat has increased by more than 100% over the last few years. The production of heat from other fuels (oil and petroleum products, waste incineration, metallurgical gases, useful heat from chemical production, etc.) has been at an almost constant level. during the monitored period. This heat is used mainly in the industrial sector for technological purposes.

The climatic conditions during heating seasons have a major impact on heat consumption. The remarkably mild weather in 2014 was reflected strongly in absolutely the lowest heat production during the monitored period.

The structure of fuel consumption is expected to remain largely unchanged over the next few years, with natural gas being the most commonly used fuel.

In 2015, the share of types of fuel used in heat production remained largely unchanged compared to the previous year. The most frequently used types include natural gas (55%) and biomass (27%). Approximately 110 biogas power plants, of which 36 produce heat in addition to electricity, were built in Slovakia over the past two years. The share of heat generated from biogas is 2% of the total heat supplied.

2.5.2.3 DH market summary

Slovakia has an extensive centralised heat supply system covering more than 54% of the overall demand for heat.

[6] Oil and petroleum products, waste incineration, lyes, metallurgic gases, useful heat from chemical production.

The district heating systems showed a significant development from the 1950s to the 1990s, that was related, in addition to the extensive development of the industrial production, also to the construction of housing estates and amenities.

The following had an impact on the development of district heating systems since the 1990s until present times:

- Continuous liberalisation of fuel and energy prices, formation of competitive environment and arrival of foreign investors;
- Adoption of new environmental and energy acts related to the alignment of Slovakian legislation to the EU legislation;
- Availability of the most up-to-date technologies and facilities for heat generation, distribution, regulation and measuring.

Since then, the impacts indicated above have resulted in the stagnation of the construction of new district heating systems, respectively in the failure to complete the planned projects of the unfinished systems. However, this period was characterized by high intensification of the whole process starting with the production and ending with the final consumption of heat.

The heat generating installations are typical new elements, e.g. condensation and low-energy boilers, installations for biomass burning or co-burning, cogeneration units, installations of heat exchangers for the usage of the flue gases heat, etc. In the case of heat distribution, the following aspects can be noted: pre-insulated pipe systems, heat exchangers with high power density and compact heat exchanger stations for the households. On the side of heat consumption, it is the installation of heat measuring units for heating and hot water consumption, hydraulic regulation of heating installations, installation of thermoregulation valves.

The current period can be characterized as a period of making more sustainable (particularly in heat sources for heating) and rationalization of the existing DH systems.

The production of heat in DH systems using the benefits of cogeneration of electricity and heat is most common, with a 54% share. The remaining production is secured mostly by district heating sources (boiler houses, heating plants) with external heat distribution units within the relevant assigned territory supplied by heat.

Over the last 20 years, the production and supply of heat from centralized heat supply systems has reduced significantly mainly due to the enforced energy efficiency policy in the housing and municipal sectors, in services and in industry.

Heat consumption for heating and hot water in residential properties supplied with heat from district heating systems decreased by 26% between 2004 and 2014. The average nominal annual heat consumption for heating dropped from 85.8 kWh/m^2 to 61.5 kWh/m^2.

Heat consumption for heating fell by 8.5% from 2014 to 2020. The above-mentioned reduction in consumption has been achieved mainly by the continued thermal insulation of residential buildings.

Climatic conditions in recent years, building insulation and disconnection of customers from a centralized heating system have led to a gradual yearly decrease in heat supply by 3-5%. The particularly warm year of 2014, when the actual supply of heat dropped by 10.5%, marked an exception to this trend. The decline was mainly reported in the housing sector in which the volume of heat produced is directly dependent on the climatic conditions. Improving thermal and technological characteristics of residential and public buildings also has a significant impact on reduction of heat supply. Although a large portion of residential buildings have already been insulated or fully renovated, a further decline in heat demand is expected in the coming years.

2.5.2.4 Existing driving forces and/or opportunities that favor an expansion of district heating

The basic document that deals with the development and direction of the Slovak energy sector including the heat management sector, is the Energy Policy of the Slovak Republic worked out by the Ministry of Economy of the Slovak Republic:

- Targets in the field of thermal energy: Sustainable heat supplies, i.e. secure, reliable, affordable, effective and environmentally sustainable heat supplies by the district heating systems as a priority;
- Increasing the share of heat from locally available renewable energy sources;
- Increasing the effectivity of heat production and distribution;
- Development of efficient district heating systems.

Measures to be taken in order to achieve the targets:

- To support economically efficient use of RES, particularly the locally available biomass and waste including the support for the multi-fuel systems;
- To support efficient district heating systems with heat supplies from RES, waste heat from industrial processes;
- To apply the system a compulsory evaluation of the energy demand of heat supplies by means of energy audit executed regularly;

- To decrease the administrative burden in the field of heat supplies by means of centralizing data in the monitoring system of energy use efficiency;
- To update on a regular level the concepts of the development of municipalities in thermal energy;
- To work out and implement supplementary mechanisms for construction and reconstruction of heat distribution units;
- To work out the thermal map in order to consider on a complex level the heat needs and to set up the potential of usage of highly efficient cogeneration, RES and waste;
- To continue creating a long-term stable and predictable regulatory framework;
- To evaluate the possibility to create conditions for using heat plants for energy supplies in emergency situations;
- To create conditions for reconstruction of existing and building new district heating systems while considering the development trends of heat and cold needs depending on the massive insulation of the buildings, replacement of windows, installation of solar collectors and requirements towards new buildings;
- To execute an analysis of the economic, environmental and social impacts of decentralization of heat supplies and to propose effective measures in order to remove unsystematic procedures.

Based on the measures indicated above it is necessary to:

- Prefer district heating systems with cogeneration of electricity and heat against power generation from fossil fuels without using heat and to secure their operation in a way that maximum advantages can be taken from their usage while supplying electricity;
- Utilize the infrastructure of the heating plants during construction of installations for energy recovery of municipal waste, respectively separated part of municipal solid waste (MSW) as fuel;
- Optimize the electric power in the heating sources in a way that support of power generation is minimized and the conversion efficiency reaches at least 70%.

2.5.2.5 Existing barriers to the expansion of district heating

Investments in infrastructure

Warm and hot-water distribution is predominant in district heating systems. Steam distribution is mostly used to supply heat to industrial consumers. A major part of heat distribution systems is 15 to 30 years old and this age is reflected in their technical condition.

A certain part of the primary heat distribution system has been operated at excess capacity due to the significant decrease in heat consumption over the last 15 years and this has resulted in an increase in relative distribution losses of heat. Distribution losses represent in average 16% while the EU average is 8-9%. Steam distribution systems are a problematic part of the primary heat distribution systems due to their extensive wear and tear and low cost-effectiveness.

Insufficient set-up of the legislative and regulatory measures

So far the practice shows the frequent absence of professional discussion with the concerned parties in the process of creation and adoption of strategic documents, which leads to insufficient predictability of legislation and of stability of the business environment.

The unstable regulatory environment creates uncertainty and jeopardizes the investments that have already been realized or are still planned. The regulatory policy is adopted for a 5-years term, however the conditions change significantly also during the regulatory period; and example is the introduction of a so called G-component for the producers of electricity from RES or co-generation.

The biggest barrier to the further development of district heating systems is particularly the over-regulation of heat prices on the "Cost + fee" principle that does not motivate sufficiently and from time to time even demotivates companies to implement energy-efficient solutions leading to decrease of costs. At the same time this regulation significantly limits the individual attitude towards individual clients, who could connect to the existing networks. Heat supplies from district heating systems are very often considered by the public as a monopoly action within the frame of which the consumers cannot choose their energy supplier.

Heat market evolution

The market for heat has demonstrated a decrease in the supply of heat through centralized heat supply systems over the last few years. This has been caused mainly by reduced demand for heat in residential buildings, due to thermal insulation and streamlining measures. The significant extent of the measures implemented in residential buildings throughout Slovakia suggests that the trend of the previous years may slow down over the following few years.

Customers disconnecting from centralized heat sources also had a negative impact on the size of the market for heat, but this trend is not expected to continue on a greater scale. In addition, the application of Directive 2012/27/EU (and its revision with ambitious objectives) on energy efficiency and its impact on reducing final energy consumption also must be considered.

Access of consumers and competition in the field of individual heating

The operators of district heating systems are, on the one hand, pushed towards innovations, investments, change to heat production from renewable sources and emissions reductions (which implies further increase of funds), on the other hand they become the target of criticism from suppliers, who mostly complain about constantly rising prices. Moreover, the price regulation in the set-up of thermal energy currently limits any investment, modernization and extension of the district heating systems (e.g. through the so called investment development factor).

2.5.2.6 Emerging Technologies

As the majority of district heating systems work on natural gas with installed power measured in units and dozens of MW_{th}, the most promising field is the installation of cogeneration technologies (gas engines). However, a transparent and stable legislative environment is needed for their further development.

With regards to the decreasing heat demand (insulation of buildings), a gradual switch to low-energy systems is possible to envisage, with the possibility to effectively implement heat pumps technologies at district level.

As to the construction of new waste incineration plants, it is expected that they will be connected to the existing district heating systems in the future. However, the construction of waste incineration plants is a long-term process, very often sensitively perceived by the public.

2.6 Slovenia

2.6.1 Geothermal resources and current utilization

The best geothermal conditions are found in NE-Slovenia, being part of the Pannonian Basin, where most production wells tap thermal water from the Miocene sand aquifers with temperatures of 54 to 62 °C. In the SE part of the country thermal water is mostly encountered in the Krško sedimentary basin along its southern edge in the Mesozoic carbonate rocks. Geothermal utilization of thermal water heat[7] in 2021 is based on direct use from 53 production wells plus 4 thermal springs, implemented at 31 localities. Direct use represents 60.70 MWth and 486.13 TJ/yr. Geothermal district heating exists at one location (Lendava). The future of geothermal DH in Murska Sobota and Benedikt remains uncertain. In addition there are 15 spas and/or thermal resorts with bathing/swimming pools and balneology facilities, where also space heating (and at four users also cooling) and snow melting (at three users) are accounted for. The total geothermal energy used for these DH plants is 356.73 TJ/yr (99.093 GWh/yr).

2.6.2 District heating situation in Slovenia in 2019

2.6.2.1 Key Figures

Total installed DH capacity: 2,132 MW_{th}

Trench length in km for transport and distribution network (one way): 908

Number of DH systems: 111

Number of DH operators: 53

2.6.2.2 Fuel use for district heating over the last ten years

The coal and coal products used in cogeneration are the dominant fuels, but it was decreasing in the last years. Natural gas used in cogeneration and in boilers is the second most common fuel, its use was increasing. The third-one is biomass used mainly in cogeneration, but in boilers as well (**Figure 7).**

[7] Rajver et al (2022):): Geothermal Energy Use, Country Update for Slovenia - European Geothermal Congress 2022, Berlin, Germany

2.6.2.3 Energy supply composition of generated DH

Energy supply composition of DH generated in Slovenia										
	2011 In GWh	2011 In %	2013 In GWh	2013 In %	2015 In GWh	2015 In %	2017 In GWh	2017 In %	2019 In GWh	2019 In %
Cogeneration										
Fossil										
Coal and coal products	1 186	61,51%	1 291	61,21%	1 353	59,87%	1 396	59,89%	1 088	48,88%
Oil and petroleum products	1	0,05%	2	0,09%	2	0,09%	2	0,09%	2	0,09%
Natural gas	251	13,02%	283	13,42%	319	14,12%	310	13,30%	467	20,98%
Renewables										
Solid biomass	156	8,09%	203	9,63%	209	9,25%	166	7,12%	277	12,44%
Other										
Non-biodegradable waste	36	1,87%	33	1,56%	36	1,59%	36	1,54%	34	1,53%
Heat only										
Fossil										
Oil and petroleum products	47	2,44%	26	1,23%	23	1,02%	33	1,42%	2	0,09%
Natural gas	174	9,02%	179	8,49%	212	9,38%	272	11,67%	202	9,07%
Renewables										
Solid biomass	73	3,79%	87	4,13%	101	4,47%	106	4,55%	114	5,12%
Geothermal	4	0,21%	5	0,24%	5	0,22%	5	0,21%	2	0,09%
Industrial waste heat	0	0,00%	0	0,00%	0	0,00%	5	0,21%	38	1,71%
Total	1 928	100,00%	2 109	100,00%	2 260	100,00%	2 331	100,00%	2 226	100,00%

Figure 7 Energy supply composition of district heat generated in Slovenia 2019

2.6.2.4 DH market summary

In 2020, 53 heat suppliers provided heat from district heating. Distribution was carried out in 68 municipalities from 111 distribution systems. Heat distributors supplied 2,215.3 GWh of heat for the heating of buildings, domestic hot water, and industrial steam processes, and delivered 1852.7 GWh of heat to 106,762 consumers. The difference represents losses amounting to 362.6 GWh of heat. Heat consumption for the supply of consumers on registered distribution systems was 1.6% lower compared to the year before, without taking into account own use of heat producers, and compared to 2018 it was 2.4% lower, which is a result of slightly higher outdoor temperatures during heating seasons in the last three years, and partially because of thermal insulation of single- and multi-apartment buildings. The number of heat consumers is almost 0.2% higher than in the previous year.

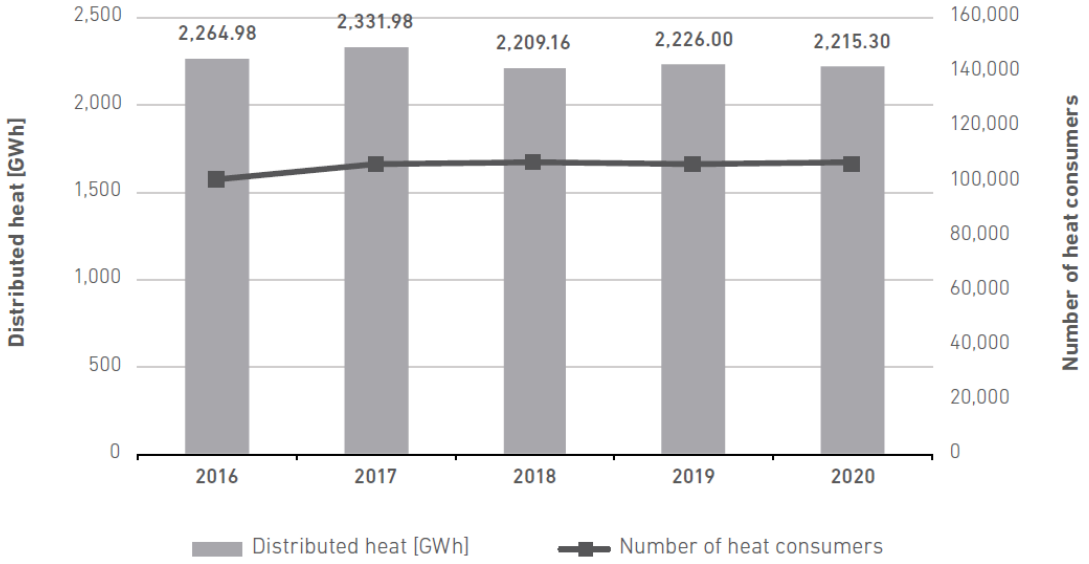

Figure 8 Distributed heat and number of consumers in the 2016-2020 period in Slovenia *(source: Report on the energy sector in Slovenia 2020)*

In 2020, a smaller but already existing distribution system for district cooling was recorded in the industrial area of the former Iskra in Ljubljana. The other two bigger distribution systems with a total installed capacity of 3.88 MW of refrigeration units mainly supplied business consumers in Velenje and industrial consumers in Kranj.

Heat distributors with own production and heat producers supplying distribution systems have produced 2390.2 GWh of useful heat for heating, the preparation of sanitary hot water, the supply of industrial processes, and their own needs. At the same time, 848.7 GWh of electricity or 759.3 GWh was produced at the threshold of cogeneration processes. The heat produced in cogeneration production processes accounted for 76.2% of all useful heat produced (for own use and distribution systems). The remaining 23.9% was produced in other technological processes (woody biomass boilers, natural gas, liquefied petroleum gas, heat recovery processes from geothermal wells, waste heat from industrial processes, incineration plants, etc.). In the share of heat supplied by distribution systems, heat from cogeneration sources was represented by 79%. The highest share of total useful heat produced, i.e. 37%, was delivered to 97,235 household consumers, 26.7% to 8,466 business consumers, and 14.3% to 1,061 industrial consumers. Average annual distribution losses were estimated at 15.2% of distributed heat and increased by around 1.2% compared to 2019, and the remaining 6.8% of the heat produced represent the difference between the heat produced and the

delivered heat used in the industrial processes of the heat producers or distributors, i.e. for own use. The heat consumption by type of consumers and their number is shown in **Figure 9.**

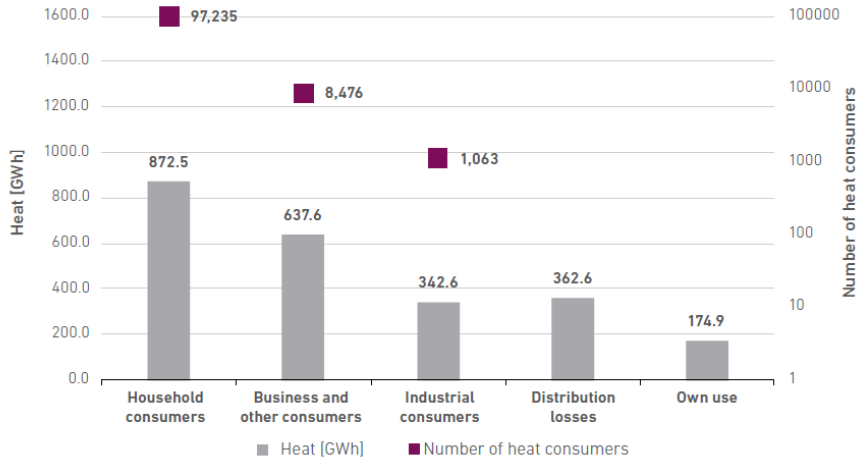

Figure 9 Heat consumption by the type of consumers and their number *(source: Report on the energy sector in Slovenia 2020)*

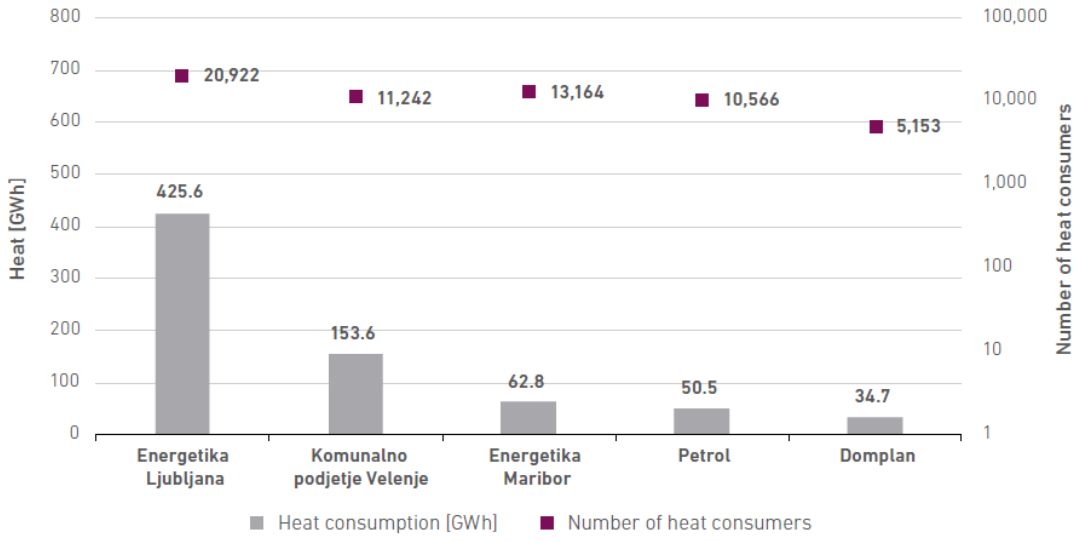

Figure 10 Heat consumption and the number of household consumers at the five largest heat distributors *(source: Report on the energy sector in Slovenia 2020)*

District heating networks are installed in 68 municipalities in total length of 908 km. 97% of the total network length is designed for hot water primary and secondary DH supply while 3% of the total network length is designed for steam DH supply.

DH systems with the longest networks:

- Municipality Ljubljana, (289 km)
- Municipality Velenjeand Šoštanj, (180 km)
- Municipality Maribor (61 km)

2.6.2.5 Driving forces and/or opportunities that favor an expansion of district heating

The driving forces for the expansion of district heating are the support schemes for biomass and CHP in district heating. Investors who expand existing district heating systems or build new housing with biomass boilers for an existing district heating network are eligible for the incentives. The total amount of financial incentives in the form of grants for the implementation of individual projects is determined in accordance with the rules of State aid, ranging from 30 to 50% of the eligible costs for each project. The Energy Law which implemented Directive 2012/27/EU supports the development of district heating systems producing heat mainly from renewable energy sources, CHP or waste heat. The contribution for "heat production from renewable energy sources" is not paid by the end customers if the heat is produced from renewable energy or efficient district heating and cooling systems. The government regulation determines the manner in which funds collected from the contribution of "heat production from renewable energy sources" are spent, and the way funds are used as incentives or subsidies for the construction of new facilities for the production of district heating and cooling.

2.6.2.6 Existing barriers to the expansion of district heating

There are also some obstacles related to the partial implementation of the State Energy Policy and Strategy. Some existing support schemes still compete against each other. There are examples where different support schemes for biomass and heat pumps trigger the exclusion of natural gas condensing boilers or exclude the use of district heating in areas where a district heating network already exists. Some users in peripheral areas migrate from district heating systems which use natural gas for heat production to individual biomass heating systems, without taking into account the environmental impact of air pollution (with PM10 particles). The bright side of DH policy in urban areas is that the support schemes for heat pumps are not assigned to end customers who live near a DH system.

2.6.2.7 Emerging technologies

It is expected that current space heating and domestic hot water technologies will become more efficient and environmentally friendly in the future. In Slovenia, larger urban areas have the potential to provide heat from waste and large-scale heat pumps in combination with other renewable energy sources. The heat or cold produced is then provided to end customers through district heating or district cooling systems (smart district heating systems), which could be an important part of the

largest smart energy system. District heating or district cooling systems with large heat or cold storage systems can already serve as temporary storage for surplus energy produced from renewable sources, especially passive and active solar energy, but only in Slovenia's largest cities. In rural areas, the main energy sources providing heat will most likely remain individual biomass and individual heat pumps in combination with other renewable energy sources (solar panels, etc.).

3 Identification of target countries and target groups

Within the framework of the DARLINGe project financed by the Danube Transnational Program, a detailed survey was previously carried out on the possibilities of geothermal energy utilization in a defined (delimited) area (**Figure 11**) of Bosnia and Herzegovina, Croatia, Hungary, Romania, Serbia and Slovenia, which represent the best geothermal potential of the region.

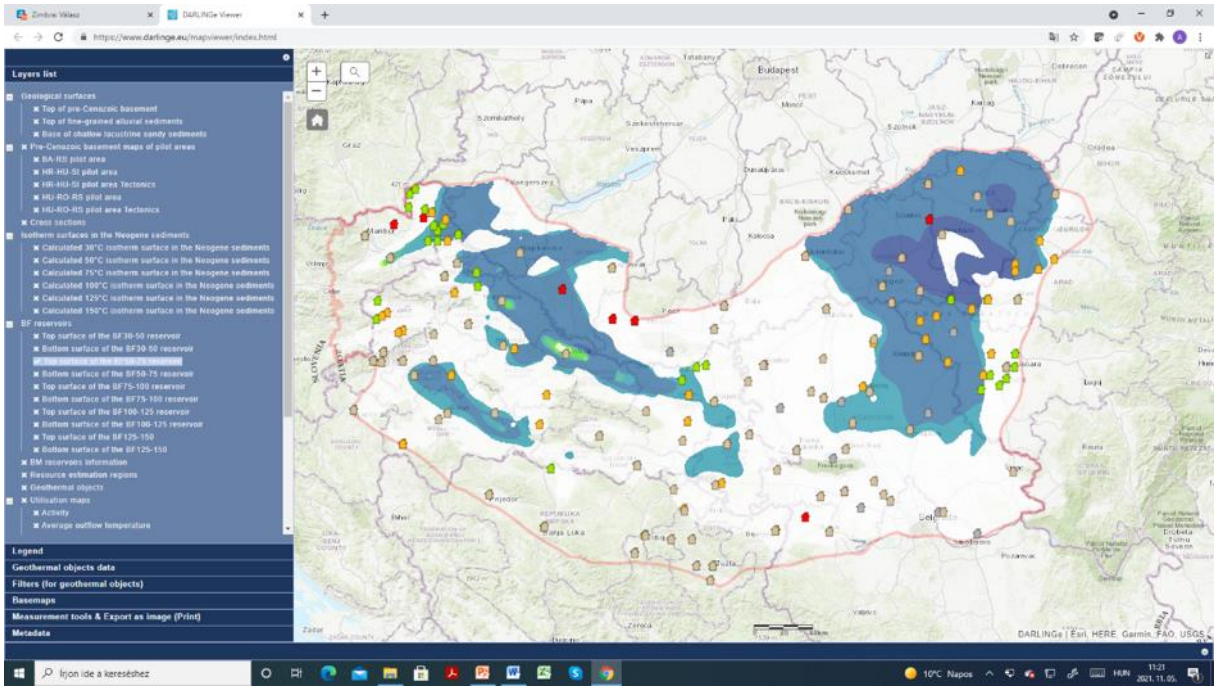

Figure 11 The possibilities of geothermal energy utilization in a defined (delimited) area *(source: www.darling.eu/mapviewer)*

Legend:

- red line: area boundary line
- blue zone: top surface of the BF 50-75 reservoir (i.e. 50-75 C thermal water is expected to be available)
- grey house: DH infrastructure
- red house: geothermal DH
- yellow house: use of thermal water
- beige house: more than 15,000 inhabitants
- green house: the town is connected to Convenant of Mayors

3.1.1 Identified DH infrastructure (towns) in the defined[8] area

Remark: Existing geothermal DH is with red.

3.1.1.1 Bosnia and Herzegovina

In FBIH

- Gračanica - Eko toplane Gračanica (https://eko-toplane.ba/pocetna
- Lukavac - JP Rad d.o.o. Lukavac (https://jpradlukavac.ba/misija-i-vizija/
- Srebenik - Komunalno preduzeće J.P "9. Septembar" Srebrenik d.d.
- Tešanj – JP Toplana d.d. Tešanj (https://toplana-tesanj.ba/#announcements)
- Tuzla – JP Centralno grinanje d.d. Tuzla (https://www.grijanjetuzla.ba/) + (*Summary of the study 'Analysis of Sustainable Heating Options for the City of Tuzla, Federation of Bosnia and Herzegovina')*
- Živinice - Javno preduzeće HORIZONTALA-ŽIVINICE d.o.o. Živinice (https://jphorizontala.ba/)

In RS

- Banja Luka – Eko-toplana Banja Luka (https://ekotoplanebanjaluka.com/)
- Bijeljina – JP Gradska toplana Bijeljina(https://www.gradskatoplanabijeljina.com/onama.php)
- Doboj – Gradska toplana Doboj (https://toplanadoboj.ba/)
- Prijedor – Toplana a.d. Prijedor (https://www.toplanapd.com/)

3.1.1.2 Croatia

- Varaždin - Vartop d.o.o. (http://www.vartop.hr/hr/info/pravo_na_pristup_informacijama)
- Požega - Komunalac d.o.o. (https://www.komunalac-pozega.hr/djelatnosti/odrzavanje-sustava-grijanja
- Vinkovici- GTG Vinkovci d.o.o. (https://gtgvinkovci.hr/grijanje-2/)
- Vukovar - Tehnostan d.o.o (https://tehnostan-vukovar.hr/toplinarstvo/toplinski-sustav-vukovara/
- Karlovac - Gradska toplana d.o.o. (https://www.gradska-toplana.hr/o-nama)
- Topusko – Termalna Izvorska Voda Topusko d.o.o.
- Velika Gorica - HEP-Toplinarstvo d.o.o.
- Zaprešić - HEP-Toplinarstvo d.o.o.
- Samobor - HEP-Toplinarstvo d.o.o.
- Zagreb - HEP-Toplinarstvo d.o.o.
- Sisak - HEP-Toplinarstvo d.o.o.
- Osijek – HEP-Toplinarstvo d.o.o.
  https://www.hep.hr/toplinarstvo/about-us/basic-data/1582
- Virovitica - Plin Vtc d.o.o.
- Slavonski Brod – Brod-plin d.o.o. (https://www.brod-plin.hr/toplinarstvo/toplinski-sustav/

In Croatia, a special agency exists in relation with the geothermal activity, so called **Croatian Hydrocarbon Agency**. The Agency acts as operational support to competent bodies in domain of exploration and production of hydrocarbons in Croatia. Namely, the Agency is responsible for geological data management and presentation, preparation of license rounds, investors monitoring and support once they get the license and sign Production Sharing Agreement, implementation of

[8] The outlined area in shown on Figure 11 with some extensions, where relevant for the scope of this work.

environmental standards such as safety offshore and reporting towards European Commission. The Agency is responsible for the collection and preparation of documents that shall be presented to potential investors for their acquaintance with the hydrocarbon potentials in Croatia.

3.1.1.3 Romania

- Arad - CET Hidrocarburi S.A. https://www.cetharad.ro/
- Nadlac - Apoterm Nadlac S.A.
- Lovrin -
- Timisoara - Colterm S.A. https://www.colterm.ro/
- Beius – Transgex S.A. Oradea https://www.transgex.ro/
- Oradea – Termoficare S.A. and Transgex S.A. Oradea https://termo.cetoradea.ro/

In Romania, two companies only – **Transgex S.A. Oradea** and **Foradex S.A.** – have concession rights for the extraction of geothermal energy, so, they have a special monopoly for that activity.

Foradex is the oldest Romanian drilling company in existence, originally established by Romanian State in 1939 under the name of the Commercial Administration for Mining, Prospecting and Exploration (ACEX). The company was fully privatized in 2007. According to their declaration: *„…the main objectives of the company have been to undertake exploration and prospecting works using drilling, mining and other specialist methods to discover new fields of oil, gas, geothermal water and various other mineral deposits, and the design and manufacturing of the technical facilities needed for each individual drilling activity. In its more than seven decades of history the company has been successful in finding and identifying over 850 different individual deposits."*

Transgex is the other great company that perform geothermal waters drilling jobs in Romania.

According to local information some new geothermal drillings are going to be realized in Lovrin, in Sandra, in Dudesti Vechi and in Salonta (in the area close to the Hungarian border).

3.1.1.4 Serbia

- Sremska Mitrovica – JKP Toplifikacija Sremska Mitrovica
- Sombor – JKP Energana Sombor
- Ruma – JP Stambeno Ruma
- Bečej – JP Toplana Bečej
- Vrbas – JKP Standard RJ Ekoterm Vrbas
- Beočin – JP Toplana Beočin
- Bačka Palanka - SC Novi Sad-Gas Novi Sad, Toplana Partizan Bačka
- Novi Sad - JKP Novosadska Toplana

- Kovin - TE Controls
- Pećinci – JKP Sava
- Zrenjanin – JKP Gradska Toplana
- Temerin – JKP Temerin
- Odžaci – JKP Usluga Odžaci *(missig from the annual report)*
- Srbobran – JP Graditelj
- Žitište – JKSP Ekos
- Šabac - JKP Toplana Šabac
- Subotica - JKP Subotička Toplana
- Kikinda – JP Toplana Kikinda
- Pančevo - JKP Grejanje Pančevo
- Bogatić -

In Serbia, only one company– **Naftna Industrija Srbije (abbr. NIS; English: Petroleum Industry of Serbia) is a Serbian multinational oil and gas company** – has concession rights for the extraction of geothermal energy, so, they have a special monopoly for that activity.
The main activities of NIS are exploration, production and refining of petroleum and natural gas, sales and distribution of a broad range of petroleum and gas products, as well as the implementation of energy and petrochemical projects. The main NIS production facilities are in the Republic of Serbia, while subsidiaries and representative offices have been established in Bosnia and Herzegovina, Bulgaria, Romania, Russia and Angola.

In 2008, the Russian company Gazprom Neft became the majority shareholder (51% of shares). In January 2010, about 20% of remaining shares of NIS were distributed by the Serbian government to the Serbian citizens. In June 2010, NIS was transformed into an open joint-stock company, and is listed on the Belgrade Stock Exchange since 30 August 2010. In March 2011, Gazprom Neft announced that it will purchase an additional 5.15% of shares of NIS, increasing their original share from 51% to 56%. NIS held a monopoly on all oil imports in Serbia until 2011.

In May 2022, the ownership structure was changed, with Gazprom Neft transferring 6.15% of shares to Gazprom, to avoid western sanctions on oil embargo introduced as reaction to the 2022 Russian invasion of Ukraine.

3.1.1.5 Slovenia

- Maribor - Energetika Maribor d.o.o
- Ptuj - Javna služba Ptuj d.o.o.
- Lendava - Petrol Geo, d.o.o., Lendava

3.1.2 Possible target groups

Based on the identified geothermal potential and for the existence of DH systems close to it, and with respect to the main goal - to transfer the Hungarian experience and knowledge of geothermal energy utilization opportunities for district heating -, in summary, we can make the following conclusions:

- The identified towns and DH systems **in BIH** (both in FBIH and in RS) seem to be **attractive opportunities** concerning the partnership, because the current heat production of DH systems need to be up-to-dated and the geothermal potential is unused yet. It's both an advantage (point of view of the opportunities of the Hungarian companies) and a disadvantage (financing point of view) that BIH isn't an EU member.
- The identified towns and DH systems **in Croatia** seem to be **attractive opportunities** concerning the partnership as well, decarbonization of DH systems here is also a current plan, and the geothermal potential is still underutilized. Croatia is an EU member, which is an advantage in terms of valorizing EU funds.
- The geographical area of the geothermal potential in **Romania** is limited (along the south-eastern border of Hungary), two big, professional drilling company have monopoly (concession rights), which are very active on this field. Romania is EU member, they can easier get financing resources. So, **Romania doesn't seem to be attractive target group** at the moment.
- The major part of the indentified towns and DH systems are **in Serbia,** DH systems need to be updated and the geothermal potential is unused yet here as well. However, the monopoly of NIS could be a difficulty factor for the partnership, in particular regard to the Gasprom majority ownership in NIS.
- The geographical area of the geothermal potential in **Slovenia** is very limited. Development of DH systems is in progress, so, here only a cooperation can be considered.

4 The sources of funding available to the region concerned to prepare and implement potential investments

4.1 Funds and EU programmes

4.1.1 EEA and Norway Grants

The EEA and Norway Grants are funded by Iceland, Liechtenstein and Norway. The EEA Grants are funded jointly by all three donor countries, while the Norway Grants are funded by Norway alone. The Grants have two goals – to contribute to a more equal Europe, both socially and economically – and to strengthen the relations between Iceland, Liechtenstein and Norway, and the 15 Beneficiary States in Europe. The objective of the Grants is to reduce social and economic disparities and strengthen bilateral relations. This strengthens the internal market, leading to a more prosperous Europe. The renewable energy, energy efficiency, energy security are supported goals in the current funding period and it will be probably more significant in the next period. In the new funding period (2022-2029) the resource – according to an information - will be increased about by 50%.

Only EU member country can be a beneficiary state, so, from our identified countries **Croatia** and **Romania** could be affected.

4.1.2 Instrument for Pre-accession Assistance (IPA)

From January 2007 onwards, the Instrument for Pre-Accession Assistance (IPA) replaces a series of European Union programmes and financial instruments for candidate countries or potential candidate countries, namely PHARE, PHARE CBC, ISPA, SAPARD, CARDS and the financial instrument for Turkey.

The IPA 2007-2013 ("IPA I") is made up of five different components:

- Assistance for transition and institution building;
- Cross-border cooperation (with EU Member States and other countries eligible for IPA);
- Regional development (transport, **environment**, regional and economic development);
- Human resources (strengthening human capital and combating exclusion);
- Rural development.

The IPA beneficiary countries are divided into two categories:

- EU candidate countries (Turkey, Albania, Montenegro, **Serbia** and the Republic of North Macedonia) are eligible for all five components of IPA;
- Potential candidate countries in the Western Balkans (**Bosnia-Herzegovina**, Kosovo under UN Security Council Resolution 1244/99) are eligible only for the first two components.

The IPA 2014-2020 ("IPA II") has continued to support beneficiaries.

IPA II has consisted of five policy areas:

- The transition process towards Union membership and capacity building;
- Regional development;
- Employment, social policies and human resources development;
- Agriculture and rural development;
- Regional and territorial cooperation.

The geothermal energy as a renewable energy is one of the tool of environmental protection that could belong to „regional development" branche of the IPA fund.

IPA III (2021-2027) has the following specific objectives:

- to strengthen the rule of law, democracy, the respect of human rights and fundamental freedoms,
- to promote non-discrimination and tolerance,
- to reinforce the effectiveness of public administration and to support transparency, structural reforms and good governance at all levels,
- to shape the rules, standards, policies and practices of the IPA III beneficiaries in alignment with those of the EU and to reinforce regional cooperation, reconciliation, good neighbourly relations and people-to-people contacts and strategic communication;
- to strengthen economic and social development and cohesion,
- **to reinforce environmental protection, increase resilience to climate change, accelerate the shift towards a low-carbon economy, develop the digital economy and society and strengthen sustainable connectivity in all its dimensions;**
- to support territorial cohesion and cross-border cooperation across land and maritime borders, including transnational and interregional cooperation.

The geothermal energy as a renewable energy is one of the tool of environmental protection which is able to accelerate the shift towards a low-carbon economy.

From our identified countries **Serbia** and **BIH** could be affected.

4.1.3 Neighbourhood, Development and International Cooperation Instrument

The Neighbourhood, Development and International Cooperation Instrument – Global Europe (NDICI–Global Europe) aims to support those countries most in need in overcoming long-term developmental

challenges. It contributes to achieving the international commitments and objectives that the EU has agreed to, in particular the 2030 agenda and its **sustainable development goals**, and the **Paris Agreement**.

NDICI–Global Europe's **specific objectives** are as follows.

- To support and foster dialogue and cooperation with non-EU countries and regions in the **neighbourhood**, in sub-Saharan Africa, in Asia and the Pacific, and in the Americas and the Caribbean. To develop special strengthened partnerships and enhanced political **cooperation with the European neighbourhood**, founded on cooperation, peace and stability and a shared commitment to the universal values of democracy, the rule of law and respect for human rights, and aiming at deep and sustainable democracy and progressive socioeconomic integration, along with people-to-people contacts.
- At the global level, to protect, promote and advance democracy and the rule of law, including accountability mechanisms, and human rights, including gender equality and the protection of human-rights defenders. To support civil-society organisations. To further stability and peace and prevent conflict, thereby contributing to the protection of civilians. To address other global challenges such as climate change, protection of biodiversity and the environment, and migration and mobility.
- To respond rapidly to situations of crisis, instability and conflict, including those that may result from migratory flows and forced displacement and hybrid threats, and to respond to resilience challenges, including natural and man-made disasters and the linking of humanitarian aid and development action, along with the EU's foreign-policy needs and priorities.

NDICI–Global Europe strengthens **specific priorities** through horizontal targets.

- At least 93% of expenditure should fulfil the criteria for official development assistance.
- At least 20% of official development assistance spending should be dedicated to social inclusion and human development.
- 30% of NDICI–Global Europe should contribute to **climate-change objectives**, while also contributing to the ambition of providing 7.5% of annual spending under the multiannual financial framework to biodiversity objectives in the year 2024 and 10% in 2026 and 2027, while considering the existing overlaps between **climate and biodiversity goals**.
- Indicatively, 10% of NDICI–Global Europe should be dedicated to action supporting the management and governance of migration and forced displacement, and addressing the root

causes of irregular migration and forced displacement when they directly target specific migration challenges.

- At least 85% of new measures should have gender equality as a principal or a significant objective. At least 5% of these measures should have gender equality and women's and girls' rights and empowerment as a principal objective. Finally, there are two additional thematic spending targets for geographic programmes: at least 15% for human rights, democracy and good governance; and at least 45% for inclusive and sustainable growth for human development.

From our identified countries **Serbia** and **BIH** could be affected.

4.1.4 European Innovation Council – EIC Accelerator

European Innovation Council (EIC) established by the European Commission, under the Horizon Europe programme (2021-27). Horizon Europe is the EU's key funding programme for research and innovation with a budget of EUR 95.5 billion. It tackles climate change, helps to achieve the UN's Sustainable Development Goals and boosts the EU's competitiveness and growth.

The programme facilitates collaboration and strengthens the impact of research and innovation in developing, supporting and implementing EU policies while tackling global challenges. It supports creating and better dispersing of excellent knowledge and technologies.

The EIC Accelerator supports individual Small and Medium Enterprises (SMEs), in particular Startups and spinout companies to develop and scaleup game-changing innovations. In some cases small mid-caps (up to 500 employees) are supported.

The EIC Accelerator provides substantial financial support with:

- grant funding (non-dilutive) of up to EUR 2.5 million for innovation development costs,
- investments (direct equity investments) of up to EUR 15 million managed by the EIC Fund for scale up and other relevant costs. Companies working on technologies of strategic European interest can apply for EIC investments of more than EUR 15 million.

In addition, EIC selected companies receive coaching, mentoring, access to investors and corporates, and many other opportunities as part of the EIC community.

The EIC welcomes applications from innovators in all EU Member States and countries associated to the Horizon Europe programme. It particularly welcomes applications from startups and SMEs with female CEOs.

Remark: Association to Horizon Europe is the closest form of cooperation with non-EU countries, which allows entities of associated countries to participate in programme actions on equal terms with entities of EU countries. It is offered not only to EU neighbouring countries, but also to any country in the world with a strong research and innovation capacity that share common values.

There are four categories of countries eligible for association with the programme

- *Members of the European Free Trade Association (EFTA) which are members of the European Economic Area (EEA).*
- *Acceding countries, candidate countries and potential candidates.*
- *European Neighbourhood Policy (ENP) countries.*
- *Other third countries and territories that fulfil a set of criteria related to their economic, political and research and innovation systems.*

In this way, all of our identified countries could be affected (Croatia, Romania, Slovenia are EU members, BIH and Serbia are third countries to Horizon Europe).

4.1.5 LIFE programme 2021-2027

LIFE programme is the EU's framework funding programme for the environment and climate change. As of 2021, the LIFE programme includes the new Clean Energy Transition sub-programme. The LIFE programme supports the EU in achieving its European Green Deal ambitions. EUR 98 million in the Clean Energy Transition (CET) program in 2022, while more than EUR 130 million in the 2023 budget are expected to be available for the implementation of projects that meet the objectives.

4.1.6 Innovation fund

The Innovation Fund is one of the largest European programmes to fund demonstrations of innovative CO2-reducing technologies or low-carbon technologies. The project scope can be related to Carbon Capture, Utilisation and Storage (CCUS), low-carbon technologies or processes in energy intensive industries, renewable energy generation and energy storage. Up to 60% of the CAPEX/operational costs of a project can receive funding.

The Innovation Fund's call to support large-scale investments is expected to be published in November 2022 with a budget of more than EUR 3 billion.

4.1.7 Western Balkans Green Center (WBGC)

The Western Balkans Green Center is an international development agency in the field of climate protection. The aim of the Center is to support Hungary's NDC achievements through facilitating Hungarian environmental technology export activities in the Western Balkans region. Based on the decision of the Government of Hungary, the Western Balkans Green Center Nonprofit Llc. was established in 2019 under the supervision and governance of the Ministry for Innovation and Technology, in order to contribute to the climate protection efforts exercised by the Western Balkan countries as well as the green transformation of their economies through grants supporting technology export activities of Hungary-based enterprises active in the field of environmental protection. The Western Balkans region is heavily exposed to the effects of climate change, causing increasing summer heat waves and unpredictable rainfall. These conditions combined with generally outdated utility infrastructure and the frequent usage of polluting technologies underline the importance of support for both climate change mitigation and adaptation measures.

The goal of WBGC is to provide **Hungary-based companies** with grants for project preparation and capacity building activities in the Western Balkans **to contribute to the climate protection activities** of the target countries fulfilling their nationally determined contributions (NDCs) set forth in the Paris Agreement on Climate.

Supported activities

- investment preparation
- capacity building activities
- business planning

Supported sectors

- **Energy efficiency and renewable energy**
- Water management and wastewater treatment
- Waste management
- Forestry and agriculture
- Urban Environment
- Other activities related to climate change mitigation or adaptation

Target countries

- Albania
- **Bosnia and Herzegovina**
- Kosovo

- North Macedonia
- Montenegro
- **Serbia**

WBGC have and will have some different calls for applications, among them, concretely concerning the area of energy efficiency and renewable energy.

WBGC's goal and activity totally covers our target that Hungarian professional enterprises can participate in the developments of geothermal DH in West Balkan countries. From our identified countries **Serbia** and **BIH** could be affected, but Hungarian SMEs can be supported only.

4.1.8 HEPA - Hungarian Export Promotion Agency

The main goal of HEPA is to support HEPA's general export promotion activities by the operation of dedicated financial instruments specifically targeting the Western Balkan region. The programs are designed to support the application of Hungarian technologies and the export development activities of Hungarian companies in the Western Balkans, demonstrating Hungary's commitment to supporting the countries of the region in their preparations for EU accession.

HEPA has issued a call for proposals for Hungarian companies in order to stimulate economic relations between Hungary and **Serbia**, Montenegro and **Bosnia and Herzegovina**. The long-term effect of the Western Balkans Investment Scheme is to contribute to the growth of remittances from the profits realized by Hungarian companies abroad, and thus increase national income. The grant may be used by the beneficiaries to develop their majority-owned joint ventures or their subsidiaries engaged in economic activity in the target countries. In parallel, a bilateral governmental cooperation agreement with Serbia is being implemented, in the framework of which cooperating Hungarian and Serbian companies will provide free infrastructural project preparation services to Serbian beneficiaries through the financing of the Hungarian state.

4.2 Banks

4.2.1 European Bank for Reconstruction and Development (EBRD)

The European Bank for Reconstruction and Development (EBRD) was founded in 1991 to create a new post-Cold War era in central and eastern Europe. They are now doing more than ever before - across three continents - to further progress towards 'market-oriented economies and the promotion of private and entrepreneurial initiative'. The EBRD is owned by 71 countries, as well as the European Union and the European Investment Bank.

Project investments are at the heart of EBRD's operations.

The EBRD offers a wide range of financial instruments and takes a flexible approach in structuring its financial products. The principal forms of direct financing that the EBRD may offer are loans, equity and guarantees.

EBRD is active in all countries identified by us, and they have financed some energy efficiency and RES projects in the near past.

4.2.2 Hungarian Banks

Among the banks operating in Hungary the **OTP Bank** and the **CIB Bank** expressed their interest for possible financing geothermal projects with participation of Hungarian enterprises in West-Balkan region.

Some country specific financing opportunities are summarized in Annex 1 (Bosnia-Herzegovina) and Annex 2 (Croatia)

5 Preliminary identification of domestic (Hungarian) companies

Hungarian enterprises which would see a market opportunity and would be interested in the implementation of future geothermal (district) heating projects have been identified.

In Hungary, there are two associations which represent the enterprises interested in geothermal energy: the Magyar Termálenergia Társaság - MTT (Hungarian Thermal Energy Society, Public Benefit Association) and the Magyar Geotermális Egyesület - MGE (Hungarian Geothermal Association), both have many members. The Magyar Távhőszolgáltatók Szakmai Szövetsége – MaTáSzSz (Association of Hungarian District heating Enterprises) represent the Hungarian DH sector. Their members are DH supplier and producer companies and several industrial companies which are interested in DH sector as a subcontractor.

The Hungarian enterprises which would be interested in the participation of geothermal projects in West-Balkan are as follows.

Magyar Termálenergia Társaság - MTT (http://termalenergia.hu/) – geothermal sector

- **Mining-Support Kft.** (https://mining-support.com/hu) – geothermal planning, reservoir-engineering expertise, geochemical mapping.
- **Facture Kft.** – architectal engineering.
- **Geo-log Kft.** (https://www.geo-log.hu/) – geophisical metering and engineering; geological research.
- **K-P Kontúr Kft.** – engineering.
- **GREENMEN Energia Kft.** (https://greenmen.hu/) – engineering, main contractor activity, project management.
- **InnoGeo Kft.** (https://innogeo.hu/) – project developer (spin-off company of the University of Szeged).
- **Geomega Kft.** (http://www.geomega.hu/) – geophisical-geological services (engineering, research, shallow drilling).
- **HGD Kft.** (https://www.hgd.hu/) – heating and cooling by heat pump (planning, implementation), geological expertise.

MTT indicated that any getting into contact with their members should be made through them.

Magyar Geotermális Egyesület – MGE (http://www.mgte.hu/) – geothermal sector

- **Modivi Aqua Kft.** (www.modivi.hu) – well drilling, expertise.
- **Termálterv Kft.** (www.termalterv.hu) – planning, implementation, operation.
- **Szentesi Városi Szolgáltató Kft.** (www.szvszkft.hu) – municipality owned company which operates geothermal DH system.
- **Bóly Város Önkormányzata** (www.boly.hu) – municipality which indipendently have created a geothermal DH system and operates it.
- **Veresegyház Város Önkormányzata** (www.veresegyhaz.hu) - municipality which indipendently have created a geothermal DH system and operates it.
- **Termálterv Kft.** (www.termalterv.hu) – planning, implementation, operation

Magyar Távhőszolgáltatók Szakmai Szövetsége – MaTáSzSz (www.tavho.org) **– DH sector**

- **Reál-Energo Kft.** (https://real-energo.hu/) - engineering, main contractor activity, project management.
- **Grundfos Kft.** (https://www.grundfos.com/hu) – pump producer (part of a multinational company group).
- **Terra21 Kft.** (https://www.terra21.hu/) – civil engineering, pipe construction, technological fitting work.
- **Isoplus Kft.** (https://www.isoplus.hu/) – preinsulated (DH) pipe producer.
- **SADE Kft.** (https://www.veolia.hu/hu/sade-magyarorszag-melyepito-kft) – civil engineering.
- **Veolia Energia Magyarország Zrt.** (https://www.veolia.hu/) - implementation

Non member enterprises

- **Földhő Bt.** – engineering, planning
- **PannErgy Nyrt.** (https://pannergy.com/) – geothermal project investor
- **MVM Zöld Generáció Kft.** (https://zoldgeneracio.mvm.hu/) – member of MVM Group (bigest state owned energy company group), geothermal project investor
- **Mannwitt** (https://www.mannwit.hu/) – engineering, planning
- **BTIX Kft.** (https://www.btix.hu/) - geophisical-geological services
- **CEGE Közép-Európai Geotermikus Energia Termelő Zrt. (**http://www.cegeltd.eu) – research, exploration, utilization of geothermal energy
- **Centrál Geo Kft.** (https://www.centralgeo.hu/) – geological research
- **Földtani Kutató Mérnök Iroda Kft.** – geological research
- **Háromkő Földtani és Geofizikai Kutató Bt.** (https://www.haromko.hu/)– geological research
- **Mecsekérc Zrt.** (https://www.mecsekerc.hu/) – geological research
- **MS Energy Solutions Kft.** (https://www.ms-energy.org/) – geological research, exploration, implementation
- **Aquaplus Kútfúró, Építő és Termálenergetikai Kft.** - well drilling, implementation
- **MOL Nyrt.** (https://www.mol.hu/) – Hydrocarbon and geothermal extraction
- **Rotary Fúrási Zrt.** (https://www.rotarydrilling.hu/)- well drilling, implementation
- **KS ORKA Hungary Kft.** – implementation of geothermal plant
- **Engie Group** (https://engie.hu/rolunk/) - implementation
- **ELCO-Power Kft.** (https://elco-power.hu/)- implementation

- **Olvisz 98 Olajipari, Vízügyi Szolgáltató Kft.** (https://olvisz98.hu/) - implementation
- **Rotacqua Kft.** (https://www.rotaqua.com/) - implementation
- **Hansa Invest Kft.** - well drilling, implementation
- **Vikuv Vízkutató és Fúró Zrt.** (https://vikuv.hu/)- well drilling, implementation
- **MB 2001. Olajipari Szolgáltató Kft.** - well drilling, implementation
- **ZÁÉV Zrt.** (https://www.zaev.hu/hu/) - implementation
- **SWIETELSKY Magyarország Kft.** (https://www.swietelsky.hu/)- implementation
- **Kraftszer Kft.** (https://www.kraftszer.hu/) – project management, main contrator activity, implementation, engineering in the energy sector.

6 Future B2B meetings

The most efficient tool in order to reach the main goal - to transfer the Hungarian experience and knowledge of geothermal energy utilization opportunities for district heating and to put Hungarian enterprises in a business position – is organizing B2B meetings in the target countries.

The target countries – based on the analysis of Chapter 3 (3.1.2) - BIH (both in FBIH and in RS), Croatia and Serbia (NIS monopoly is a difficulty factor). Romania doesn't seem to be an attractive target group. Slovenia is a special case, there a bilateral cooperation – between Slovenian and Hungarian DH associations - could be feasible.

6.1 BIH

Two B2B meetings should be organized: one in Banja Luca (practically it is the Capital of RS) and one in Tusla (quite big town in FBIH with DH system) or in Sarajevo (if Tusla is technicaly not suitable). MaTáSzSz has no relationship with any DH association (no information if it exists) in BIH. There is a pronouncement from the Hungarian foreign trade attaché of BIH that the organization of B2B meetings on both site is feasible and the help of embassy has been promised.

6.2 Croatia

One B2B meeting should be organized in Zagreb. There is no active DH association in Croatia, but HEP-Toplinarstvo d.o.o. (the bigest DH supplier company in Croatia) is a supporting member in Euroheat

and Power (European DHC-CHP[9] association) where the MaTáSzSz is supporting member too. Besides that MaTáSzSz has other bilateral professional relation in Croatia. Croatian Hydrocarbon Agency would be an important partner as well. There is a pronouncement from the Hungarian foreign trade attaché of Croatia that the organization of a B2B meeting is feasible and the help of embassy has been promised.

6.3 Serbia

One B2B meeting should be organized in Novi Sad. MaTáSzSz has a cooperation agreement with the Serbian DH business association „Toplane Srbije"(DHBA Serbia), so organization of a B2B meeting in cooperation is feasible. However, NIS monopoly concerning the extraction of geothermal energy limits the decision-making possibility of the Serbian DH supplier companies. Moreover, the Gasprom majority ownership in NIS is a delicate question in current geopolitical situation.

6.4 Possible topics and agenda of future B2B meetings

A B2B meeting can be separeted logically in two parts: presentations (knowledge transfer) and consultations (relationship building).

Topics of presentations:

- Hungarian situation of the DH based on geothermal resource, realized projects, opportunities, difficulties, country strategy.
- Technological points of interest, experiences, specialities.
- Economical questions
- Financing opportunities: funds, bank loans

The possibility of face to face discussions must be created in the consultation phase.

[9] District Heating and Cooling – Combine Heat and Power

Annex 1: Available funding sources in Bosnia Herzegovina

Depending on the territory, the following loans, support measures and grants for geothermal energy development in BiH are available:

1) On the territory of the entire BiH:

- The EU/EBRD Western Balkans Sustainable Energy Credit Line Facility II (WeBSEFF II)-loan with a grant for private and public sector. This credit line for financing energy efficiency and renewable energy projects is provided by the European Bank for Reconstruction and Development (EBRD) and it is distributed via two banks in B&H: UniCredit Bank and Raiffeisen BANK.
- The EBRD through the GEFF program encourages energy efficient technologies with participation in the project up to 20% from EU funds. Funds are placed through banks and microcredit organizations operating in BiH: UniCredit Bank Mostar, UniCredit Bank Banja Luka, Partner Mkf, Sparkasse Bank of BiH, ProCredit Bank of BiH, Microcredit Company Mikrofin, Intesa Sanpaolo Bank of BiH.
- Loans from IFC Funds - a loan program (IFC Canadian climate change program) for small and medium-sized enterprises in purpose: a) Energy efficiency projects (EE) - reconstruction, renovation or adaptation within buildings, b) Renewable energy projects (RE) - installation, construction or expansion into fixed assets (except wind power plants), c) Energy efficiency (EE) and renewable energy (RE) equipment design projects. Loans is available in BiH through UniCredit Bank.
- KfW Entwicklungsbank (German Development Bank) - KfW promotes primarily wind energy, hydropower and solar energy but also geothermal heat and biomasses. A credit line, which supports projects in the area of improving energy efficiency and reducing CO2 emissions is available in Bosnia and Herzegovina via Raiffeisen BANK.

2) On the territory of FBiH:

- Support measures for projects in the field of environmental protection that is provided and managed by Fund for Environmental Protection of FB&H (includes financing the preparation of Studies and Research Projects for geothermal energy, procurement of technologies for the use of geothermal energy, etc.);
- Development Bank of FBiH is providing a credit line for long-term crediting of renewable energy projects (wind, solar, hydropower, geothermal energy, biomass and biofuels) and other environmentally friendly renewable sources. Beneficiaries of the loan can be: all companies, as well as natural persons (craftsmen) and administrative bodies / budget users / public institutions / public companies / public utility companies / institutes / agencies and other institutions registered at the federal / cantonal or local administrative level.

3) On the territory of each canton (10) in the FBiH:

- The government of each canton (10) in FBiH provides incentives (grants) for projects that contribute to the protection of environment; institutions that managing the funding process are cantonal ministries that are responsible for physical planning and / or environmental protection.

4) On the territory of Tuzla Canton in FBiH:

- "Model / mechanism of co-financing measures to increase energy efficiency of the housing sector" - this financial mechanism was established as a financial instrument for energy saving and implementation of measures to increase energy efficiency of residential objects in Tuzla Canton. Within this measure, the Government of Tuzla Canton, through the Ministry of Physical Planning and Environmental Protection of Tuzla Canton, provides co-financing of project documentation and installation of heat pumps for heating and cooling of individual residential units.

5) On the territory of RS:

- Support measures based on Law on Renewable energy sources and efficient cogeneration which providing the Government of RS (System Operator of Renewables Production Stimulation is the body that managing funding process);
- Co-financing investment in RES that is provided and managed by Fund for Environmental Protection of the Republic of Srpska.

Annex 2: Available funding sources in Croatia

In September 2021 two calls for proposals were published by the Ministry of Regional Development and EU Funds that jointly with the Energy Institute Hrvoje Požar manages the Energy and Climate Change Programme co-financed by the EEA Financial Mechanism 2014-2021. The focus of the first call was the preparation of the technical documentation for the development of geothermal projects. The call for proposal was in line with the Hydrocarbon Exploration and Exploitation Act (OG 52/18, 52/19 and 30/21), so cofounding was only provided to project proposals whose project scope was designed around the development of the following eligible technical documents: geothermal potential study, the proposal for the publication of a tender notice, preparation of tendering documentation, operations plans and construction plans, environmental impact study, reserve's study, documentation related to the determining the exploitation field and various technical documentation for heating/cooling infrastructure and connections towards district heating system, buildings, or any other commercial usage site. Because of significant interest and restricted budget, out of twenty-six project proposals received, only the ten best projects were selected for co-funding and were offered the contract planned to be signed by the end of May 2022.

The focus of the second call was investments in infrastructure required to utilize geothermal energy. The call supported project proposals that are planning to develop the pilot investments related to the construction or refurbishment of production and injection wells in areas with existing exploration or production licenses, refurbishment and/or extension of existing geothermal heating systems, construction of infrastructure connections to integrate geothermal heat into an existing district heating system or technological and infrastructure changes for existing district heating systems to integrate geothermal energy sources. Project promoters or project partners had to have a valid license for the exploration or production of geothermal water. The call for proposals was also restricted to geothermal energy utilization for heating purposes only and not electricity generation. Because of significant interest and restricted budget, out of seven project proposals received, only the three best projects were selected for co-funding and were offered the contract planned to be signed by the end of May 2022.

Many of those projects are going to establish bilateral cooperation with renominated companies from a donor state, Iceland, which will further strengthen the capacity to manage and promote renewable energy and lay the foundation for the continuation of cooperation on future joint projects. The Programme Operator also established small grant schemes within the Energy and Climate Programme. They published two open calls for proposals to cofinance two projects with a maximum amount of

200,000.00 EUR. One of the calls is related to establishing the public Deep geothermal energy database.

The programming of the 2022-2029 financial perspective just started and Croatian implementing bodies as well as all the potential beneficiaries and stakeholders showed great interest in the continuation of co-funding projects focused on geothermal energy utilization.