

Market uptake of small modular renewable district heating and cooling grids for communities

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***Framework conditions on small district
heating and cooling grids in
Bosnia-Herzegovina and Visoko***

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1 Introduction – facilitating DHC

The framework conditions are important for the establishment and operation of collective district heating and cooling systems. A characteristic of collective systems compared to individual systems is that a collective system requires organisation – and this requires framework conditions e.g. to facilitate that the investments in hardware can be financed. The costs of financing should be minimized, reflecting the low risk characterizing district heating and district cooling supply.

Subsidies and taxes is an instrument which can influence the behaviour of the consumers. E.g. in Denmark the tax levels are relatively high, providing further incentive for energy efficiency.

This report (one of five reports constituting deliverable 2.5 in the CoolHeating project) provides an analysis of the framework conditions for small heating systems in the target country Bosnia-Herzegovina. The analysis comprise the different levels; EU-level (increasing capacity to enact EU-legislation), national level as well as regional and local level.

A key aspect of collective systems is trust. Trust is crucial for realizing the synergies of a collective system. This implies obligation of the consumers to pay for part of the fixed costs, i.e. to provide security that the investments will be reimbursed.

This report is supplemented by a Best Practice report (deliverable 2.1), which contains descriptions of a number of examples of renewable district heating plants in operation. Another supplementing report is on information material for the public (deliverable 3.3), which addresses the aspect of local acceptance.

The template for the report is provided by PlanEnergi, and the content is provided by the partner in Bosnia-Herzegovina.

2 Framework conditions for DHC in Bosnia-Herzegovina

District heating (DH) systems exist in Bosnia and Herzegovina (BiH). These are, however, often old and operate mainly on fossil fuels. Another burden is the complex administrative structure, as well as a lack of relevant strategies and a more coherent framework in the DH sector. A brief overview of the key positive and negative aspects in the DH sector of BiH is provided below.

Key positive aspects:

- Based on preliminary 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).¹
- There is also a growing interest in the use of solar collectors as well, especially in the public sector (7,000 m² installed collectors estimated, with an annual increase close to 28%).²
- There is a significant potential in geothermal energy, mainly in the central and northern parts of the country (estimated at 9.25 MWt available at 42 different sites).³
- More than 1,100 public buildings have been included in an Energy Management Information System (EMIS), for monitoring, comparison, etc.⁴
- A typology of residential buildings is currently being establishing for BiH, covering data on size, age and energy consumption level.⁵

Key negative aspects:

- 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.⁶
- The legal framework in the DH sector is incomplete, the country lacks an Energy Strategy, 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.⁷
- The heating sector is currently not regulated.⁸

¹ US Agency for International Development, Energy Investment Activity - USAID-EIA. (2016) Report on current status and BiH potential to build biomass power and cogeneration plants. Available from: <http://www.usaideia.ba/wp-content/uploads/2016/06/Report-on-current-status-and-BiH-potential-to-build-biomass-power-plants-in-BiH-English-3-31-16-final.pdf>

² United Nations Development Programme - UNDP (2014) First biennial update report of BiH under the United Nations Framework Convention on Climate Change. Available from: <http://ba.one.un.org/content/dam/unct/bih/PDFs/FBUR%20engleski%20za%20web.pdf>

³ Op. cit.

⁴ United Nations Development Programme - UNDP (2013) Climate Change Facility for BiH Cities. Available from:

http://www.ba.undp.org/content/bosnia_and_herzegovina/en/home/operations/projects/environment_and_energy/climate-change-facility-for-bih-cities/

⁵ Deutsche Gesellschaft für Internationale Zusammenarbeit - GIZ. (2016) USAID-EIA Workshop - Residential building typology in BiH. Available from: <http://www.usaideia.ba/wp-content/uploads/2015/11/ZZ-Presentation-GIZ-Building-Typology-local-11-11-15.pdf>

⁶ World Bank Group, International Finance Corporation - IFC. (2014) Unlocking the potential for private sector participation in district heating. Available from: http://www.ifc.org/wps/wcm/connect/8fb84a00496e1a08a2c9f2cda2aea2d1/WB+IFC+Private+Sector_web.pdf?MOD=AJPERES

⁷ Op. Cit.

⁸ Ministry of Foreign Trade and Economic Relations of BiH - MOFTER BiH. (2016) National Renewable Energy Action Plan of BiH - NREAP BiH. Available from:

- The National Energy Efficiency Action Plan of BiH (NEEAP BiH) is still awaiting adoption.^{9,10}
- The DH infrastructure in BiH is insufficient and a majority of DH companies have equipment more than 25 years old, prone to losses that may reach up to 60%.¹¹
- 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 entity Agencies for Statistics.¹²

There is nonetheless a positive trend in introducing alternative DH solutions in BiH, such as combined heat and power (CHP) systems based on waste woody biomass, solar collectors and similar. Some current examples of good practice, including existing and planned DH and CHP projects, are listed below:

Existing:

- Biomass heating - Eko-Toplane, Gracanica: 6 MWt biomass DH (since 2008).¹³
- Biomass heating - IEE Toplane, Gradiska: 12 MWt biomass DH (since 2012).¹⁴
- Biomass heating - Esco Eco Energija, Livno: 2+4+2 MWt biomass DH (since 2008, 2014, 2016).¹⁵
- Biomass heating - Toplana, Srebrenik: 4 MWt biomass DH (since 2012).¹⁶
- Hybrid Solar Collector/ Biomass heating - Sports Hall "Dalibor Perkovic - Dali", Livno: heating based on biomass (existing DH network) and solar collectors (since 2013).¹⁷
- Hybrid Solar Collector/ Biomass heating - Student Centre, Mostar: heating based on biomass (pellet stoves) and solar collectors, for 550 students (since 2012).¹⁸
- Biomass heating - Nemila: 3 MWt biomass DH (since 2013).¹⁹
- Biogas CHP - Agricultural Cooperative, Livnac: 37 kWe/ 70 kWt biogas CHP (since 2011).²⁰
- Biomass CHP - Toplana, Prijedor: 250 kWe/ 20 MWt biomass CHP (expected 2016).^{21,22}

http://www.ifc.org/wps/wcm/connect/8fb84a00496e1a08a2c9f2cda2aea2d1/WB+IFC+Private+Sector_web.pdf?MOD=AJPERES

⁹ Op. Cit.

¹⁰ Ministry of Foreign Trade and Economic Relations of BiH - MOFTER BiH. (2016) Energy Summit 2016 - Structure of energy efficiency sector in BiH. Available from: http://www.usaideia.ba/wp-content/uploads/2016/04/MOFTER_Minela-Pita_Structure-of-Energy-Efficiency-Sector-in-BiH-English.pdf

¹¹ References 2) and 8) above

¹² References 1) and 8) above

¹³ Eko Toplane Gracanica. (2016) Eko Toplane Gracanica - Website. Available from: <http://www.eko-toplane.ba/>

¹⁴ IEE Toplane Gradiska. (2016) IEE Toplane Gradiska. - Website. Available from: <http://www.ieegroup.net/projekti.html>

¹⁵ Esco Eco Energija. (2016) Energy Summit 2016 - Green energy park, Livno. Available from: <http://www.usaideia.ba/wp-content/uploads/2015/07/Dvokut-prezentacija-Green-Energy-Park-Livno.pdf>

¹⁶ Srebrenik Network. (2012) Investment in new heating plant. Available from: <http://www.srebrenik.net/vijesti/u-novu-kotlovnicu-investirano-750-000-km/>

¹⁷ US Agency for International Development, Enterprise energy Efficiency - USAID 3E. (2013) Livno pilot project sports hall - Fact sheet. Available from: http://pdf.usaid.gov/pdf_docs/PA00K5JZ.pdf

¹⁸ Student Centre Mostar. (2014) Significant results of the energy savings project in the Student Centre Mostar. Available from: <http://scm.pogled.ba/clanak/veliki-rezultati-projekata-ustede-elektricne-energije-u-studentskom-centru-mostar/38387>

¹⁹ Reference 2) above (UNDP)

²⁰ Reference 1) above (USAID)

²¹ Regulatory Commission for Energy of Republic of Srpska - RERS. (2016) Registry of RES Projects. Available from: <http://www.reers.ba/lat/node/1298>

Under construction:

- Biogas CHP - Gold MG, Donji Zabar: 989 kW_e/ 1 MW_{th} biogas CHP (expected 2016) [1; 25; 27].^{23,24,25}

Planned:

- Biomass CHP - Esco Eco Energija, Livno: 1.2 MWe/ 4.9 MWt biomass CHP (expected 2016).^{26,27}
- Biomass CHP - Sokolac: 1 MWe/ 4 MWt biomass CHP.²⁸

2.1 Energy policy

Bosnia and Herzegovina is a sovereign state with a decentralised political and administrative structure. Decision making involves the Council of Ministers of BiH, the governments of two Entities (Federation of BiH and Republika Srpska) and the government of the Brcko District of BiH. The Federation of BiH is further sub-divided into 10 Cantons.²⁹

Bosnia and Herzegovina is a Contracting party to the Treaty Establishing the Energy Community, as of 2006 when the country enacted the Decision on the Ratification of the Treaty (Official Gazette of BiH - International Treaties, issue no. 9/06). By entering into the Treaty, the country committed to gradual adoption of the EU acquis, concerning the electricity and gas sector, environmental protection, competition, renewable energy sources, energy efficiency, oil and statistics. Bosnia and Herzegovina, however, is in a specific position since the Constitution foresees two jurisdictions over the energy sector. These cover responsibilities of entity governments and responsibilities of the state level exercised through the activities of the Ministry of Foreign Trade and Economic Relations of BiH (MOFTER BiH).³⁰

At the state level, the Ministry of Foreign Trade and Economic Relations is the responsible party for coordination activities over the state and entity governments regarding the implementation of the directives covered by the Treaty. It should, nonetheless, be noted that at the entity and Brcko District level different regulatory and policy frameworks apply. A detailed overview of the present legal framework is provided in report from USAID.³¹

In line with the Decisions enacted by the Ministerial Council of the Energy Community, Bosnia and Herzegovina has several energy targets, of which the ones most relevant to this project are set out below:

²² Grad Prijedor. (2016) Inaugural ceremony for the new biomass heating plant. Available from: <http://www.prijedorgrad.org/newsPrewiew.aspx?newsCode=870&newsHeading=Sve%C4%8Dana%20primopredaja%20nove%20toplane%20na%20bio>

²³ Reference 1) above

²⁴ Reference 21) above

²⁵ E-Kapija. (2016) Biogas plants at Samac will soon start production. Available from:

<http://www.ekapija.com/website/bih/page/1520713/Biogasna-elektrana-kod-%C5%A0amca-uskoro-po%C4%8Dinje-proizvodnju-Firma-Gold-MG-planira-ulo%C5%BEiti-15-mil-KM-do-2020>

²⁶ Reference 1) above

²⁷ Reference 15) above

²⁸ Centre for technological, economic and environmental development - CETEOR. (2015) Feasibility study of district heating based on biomass CHP - Sokolac. Available from:

<http://www.opstinasokolac.biz/dokumenti/studija-kogeneracijskaenergana30092015.pdf>

²⁹ Reference 2) above

³⁰ Reference 8) above

³¹ US Agency for International Development, Energy Investment Activity - USAID-EIA. (2016) Draft report on the permitting regime and obstacles to investment in the energy infrastructure projects in BiH. Available from: <http://www.usaideia.ba/wp-content/uploads/2016/06/Report-on-Permitting-Regime-in-BiH-and-Obstacles-to-Investment-English-12-31-15-final.pdf>

- achieving a national renewable energy sources (RES) target share of 40% RES in final energy consumption by 2020, as compared to the 2009 34% reference level³²,
- limitation of emissions of certain pollutants into the air from large combustion plants in line with the Large Combustion Plant Directive (LCPD) and the Industrial Emissions Directive (IED), by 2027^{33,34},
- implementation of energy efficiency measures in line with the Energy Efficiency Directive, within deadlines specified by each target individually³⁵.

Each of the specified targets is or is still expected to be accompanied by an associated National Action Plan, involving policies, regulatory measures and mandatory targets. An overview of the status in each of the specified sectors is given below:

- **NREAP BiH - National Renewable Energy Action Plan of Bosnia and Herzegovina**, was adopted in March 2016 by the Council of Ministers of BiH. The plan is based on previously adopted entity action plans for the use of renewable energy sources and consolidates the measures set out therein. The sectoral goals for 2020 RES shares adopted by the NREAP are set out as follows: electricity sector 56.9% (baseline 50.3%), heating and cooling sector 52.4% (baseline 43.3%) and transport sector 10% (baseline 0.9%).^{36,37} More details on the specific targets for the heating and cooling sector will be provided in the following paragraph.
- **NERP BiH - National Emission Reduction Plan of Bosnia and Herzegovina**, was adopted in December 2015 by the Council of Ministers of BiH. The plan sets out emission ceiling values for nitrogen oxides (NO_x), sulphur dioxide (SO₂) and dust from the combustion plants covered by the plan. The target is to achieve a gradual emission reduction over the timeframe January 2018 - December 2027, in line with the LCP and IED Directives.^{38,39}
- **NEEAP BiH - National Energy Efficiency Action Plan of Bosnia and Herzegovina**, is still under preparation and was still not adopted. The plan will most likely be based on entity action plans for energy efficiency, where plans for Republika Srpska were already adopted, while a draft for the Federation of BiH is still under review. The same applies to the entity Laws on energy efficiency. Beginning of 2016 a working group was appointed in view of drafting a final version of the document. The general indicative target of the plan is to achieve a 9% energy saving for BiH by

³² Energy Community. (2012) Decision of the Ministerial Council of the Energy Community – D/2012/04/MC-EnC: Decision on the implementation of Directive 2009/28/EC and amending Article 20 of the Energy Community Treaty. Available from: <https://www.energy-community.org/pls/portal/docs/1766219.PDF>

³³ Energy Community. (2013) Decision 2013/05/MC-EnC on Implementation of Directive 2001/80/EC on the limitation of emissions of certain pollutants into the air from large combustion plants. Available from: <https://www.energy-community.org/pls/portal/docs/2386185.PDF>

³⁴ Energy Community. (2013) Decision 2013/06/MC-EnC on Implementation of Chapter III, Annex V, and Article 72(3)-(4) of Directive 2010/75/EU. Available from: <https://www.energy-community.org/pls/portal/docs/2386186.PDF>

³⁵ Energy Community. (2015) Decision 2015/08/MC-EnC on Implementation of Directive 2012/72/(EU) on energy efficiency. Available from: <https://www.energy-community.org/pls/portal/docs/3854291.PDF>

³⁶ Reference 8) above

³⁷ Ministry of Foreign Trade and Economic Relations of BiH - MOFTER BiH. (2016) Energy Summit 2016 - Status of development and implementation of NREAP, NEEAP and NERP - Implementation Objectives and Program. Available from: http://www.usaideia.ba/wp-content/uploads/2016/04/MOFTER_Sladjana-Bozic_Status-of-Development-and-Implementation-of-APs-English.pdf

³⁸ Op. Cit.

³⁹ Ministry of Foreign Trade and Economic Relations of BiH - MOFTER BiH. (2015) National Emission Reduction Plan of BiH - NERP BiH. Available from: <http://www.usaideia.ba/dpa/document.php?id=75045>

2018 from energy efficiency measures, as compared to the 2010 base demand level.⁴⁰

2.2 DHC related legislation

According to the First biennial update report of BiH under the UNFCCC⁴¹ buildings are responsible for the highest share of end-use energy consumption in Bosnia and Herzegovina, due to their age and low energy efficiency. In total thermal energy consumption households accounted for 75.8% in 2012. At the same time, the main source of CO₂ in Bosnia and Herzegovina was the energy sector, contributing to more than 75% of the total CO₂ emissions (77.7% in 2011). The progress on key documents regulating energy consumption and GHG emissions, has nonetheless been very slow.

The state level in Bosnia and Herzegovina has very limited competences in the energy sector. This results in a scattered regulatory framework for the DH sector and is specific to each entity. There is no DH sector strategy on any level and the most commonly used laws in operating DH systems are the Law on Communal Activities and the Law on Local Self-Governance. Other laws relevant to the sector cover only some aspects of DH sector development (Law on Renewable Energy Sources and Efficient Cogeneration, Law on Spatial Planning and Construction), and are specific to each entity. With regard to laws specific to the sector, the Law on Energy in Republika Srpska does not explicitly cover heat energy, while the Law on Heat Energy in the Federation of BiH is still under preparation. Regulatory responsibility for the DH sector is not separated from the ownership and is in practice exercised through local authorities. Due to significant decentralization, decision making is locally driven and differs substantially depending on the location. There is no independent regulatory authority and the tariff methodology, calculation and approval is established at the canton and municipal levels. Social protection programs targeted at low-income households are less developed and act as blanket subsidies benefitting all connected households.⁴²

Based on the data from 2014, there are about 30 district heating companies in BiH supplying around 12% of BiH households. The prices of thermal energy are not based on actual costs and a vast majority of buildings are still covered by lump-sum billing systems. Most DH companies are subsidised by local governments, which does not allow for any major investments.⁴³

In reference 2) above an overview of activities for climate change mitigation measures is provided, covering the heating and cooling sector as well. The measures involve, amongst others, installation of new plants based on RES for heating, introduction of biomass to existing DH companies, reconstruction and modernisation of DH networks, as well as energy efficiency measures in buildings. The deadlines are set over a timeframe from 2020-2040, with a clearly defined overview of the current status, coordination and management, as well as expected outcomes.

With regard to strategic actions in the heating and cooling sector, according to the NREAP BiH [6] an increase of 9.1% in RES share in final energy consumption is foreseen for the 2010-2020 timeframe. The expected 2020 RES structure would consist of 99.6% solid biomass, 0.1% biogas and 0.2% geothermal energy. In addition, 1% of the planned electricity sector target capacities are expected to be installed in biomass fired CHP plants. Energy efficient heating systems are considered as well, as one of the measures in improving energy efficiency in the residential sector.

⁴⁰ References 8) and 10) above

⁴¹ Reference 2) above

⁴² Reference 6) above

⁴³ Reference 2) above

In order to achieve the set targets, a set of actions and support schemes is foreseen by reference 8) above. A general overview of the current and the planned framework is provided in the following paragraph.

2.3 Incentives – taxes and subsidies

When it comes to present support mechanisms, both entities have feed-in tariffs in place for CHP electricity exported to the grid. Other incentives include Priority access and dispatching for CHP and renewable plants, in terms of interconnection policies.⁴⁴ A general overview of the current feed-in tariffs applicable to electricity exported to the grid by technologies associated to the heating/ cooling sector is provided in Table 1.

Table 1. Overview of current feed-in tariff support applicable to electricity from technologies associated to the heating and cooling sector^{45,46}

Technology	Federation of BiH	Republika Srpska
Biomass - solid (up to 10 MW)	0.11 - 0.15 €/kWh	0.11 - 0.12 €/kWh
Biogas (up to 1 MW)	0.13 - 0.44 €/kWh	0.12 €/kWh
CHP (up to 5 MW/ 10 MW)	0.07 €/kWh	0.03 - 0.08 €/kWh
Duration	12 years	15 years

As according to reference 8) above the entity governments, upon proposal from the Ministry where applicable, may introduce the following additional incentive measures as well:

- subsidies and other reliefs for domestic production and procurement of equipment used for heating or cooling using RES (solar collectors, heat pumps, etc.),
- setting up of a local energy market for RES heat trade by introducing a register of heat origin,
- introducing an obligation for large consumers of heat to have a share of the heat generated from RES.

It should, nonetheless, be noted that there are no specific feed-in tariffs for heat production from cogeneration or renewable sources.⁴⁷ Besides, though feed-in tariffs are foreseen for CHP generated electricity, according to the dynamic quota from reference 8) above, no CHP will receive such support for now. With regard to technologies relevant to the heating and cooling sector, the quota foresees support for up to 70.04 GWh (19.45 MW) electricity from biomass plants in 2020, which corresponds to only 6.5% of the estimated technical potential.⁴⁸ In addition, the current prices of thermal energy are not based on actual costs and most district heating companies are subsidised by local governments, as previously explained.⁴⁹ Decision making is locally driven and differs substantially depending on the

⁴⁴ Reference 6) above

⁴⁵ Regulatory Commission for energy in the Federation of BiH - FERK. (2016) Regulations - Renewable energy sources. Available from: <http://www.ferk.ba/ba/akti-ferk-a/pravilnici/18560-obnovljivi-izvori-energije>

⁴⁶ Regulatory Commission for energy in Republika Srpska - RERS. (2016) Tariff systems and prices - Renewable energy sources. Available from: <http://www.reers.ba/lat/node/1246>

⁴⁷ Reference 6) above

⁴⁸ Reference 1) above

⁴⁹ Reference 2) above

location, including the heat tariff methodology, calculation and approval, which results in significant differences in the heat tariff level as well.⁵⁰

2.4 Permitting procedures

The permitting procedures for the construction of plants in Bosnia and Herzegovina are quite complex. They involve a number of licenses and permits administered at more than one level of government, which sometimes causes overlaps in jurisdictions as well. The procedures differ by entity and in the case of the Federation of BiH by entity and canton level as well. Plant construction primarily implies compliance with building procedures, which in line with references 1) and 31) above, involves the following key permits listed in order of issuance:

- Urban permit,
- Construction permit,
- Operational license.

Other key documents involve the: Environmental permit, Energy permit, Water permit and Permits associated to grid connection (where applicable), as prerequisite for some of the previous documents.

A detailed overview of the present legal framework is provided in reference 31) above.

2.5 Time for authorization and transaction costs

In reference 31) above a detailed overview of the permitting regime in Bosnia and Herzegovina is provided. In this paragraph only some of the points will be touched upon.

It is worth noting that the permitting procedures for the construction of plants in Bosnia and Herzegovina involve obtaining more than 50 permits, consents, approvals and other administrative acts, as according to information available to reference 31) above. The amount of documents varies, however, depending on the plant capacity.

Administrative procedures prescribe a general deadline of 30 days for permitting proceedings. An administrative body, however, may request additional documents to be submitted, which usually results in an extension of the deadline. The procedures cannot proceed in parallel, because they are for the most part mutually conditioned.

The provision of information on permitting procedures is not done institutionally and there is no single body that has the jurisdiction to manage an entire permitting process. Cooperation, at the same time, is rather insufficient between the competent institutions involved.

The permitting procedures at all government levels are characterized as lacking transparency. Information and guidelines are not easily accessible, they are for the most part not available on websites, and are often not in electronic form. Information is mainly provided in the local language, which adds additional difficulty in obtaining information on specific regional requirements by foreign investors.

Administrative fees and taxes payable in proceedings to the institutions of Bosnia and Herzegovina differ by document and stage and are defined by the Law on Administrative Taxes and amendments thereof (Official Gazette of BiH, issue no. 16/02, 19/02, 43/04, 08/06, 76/06, 76/07).⁵¹

⁵⁰ Reference 6) above

⁵¹ Civil Service agency of BiH - ADS. (2016) Law on administrative taxes. Available from: http://www.ads.gov.ba/v2/index.php?option=com_content&view=article&id=1971%3Azakon-o-administrativnim-taksama&catid=55%3Afinansiranje-institucija-bosne-i-hercegovine&Itemid=178&lang=sr

3 DHC in Visoko

The previous section has focused on the national level and the regulatory framework for DHC in Bosnia and Herzegovina. This section provides the local perspective, describing the potential for DHC from an implementation point of view. The target municipality in Bosnia and Herzegovina is the Municipality of Visoko.

The Municipality of Visoko is located in the central part of Bosnia and Herzegovina, on the stretch between Sarajevo and Zenica, with border municipalities: Kiseljak, Busovaca, Kakanj, Vares, Breza, Ilijas and Ilidza.

According to currently available data, there are 41.352 residents living on the territory of the Municipality of Visoko in an area stretching over 230.8 km².

The Municipality of Visoko is fully committed to the project, expecting it to substantially contribute to environmental protection and preservation. The project will as well reduce the dependence on gas imports, providing a more sustainable solution for heating.

3.1 Supply of heating and cooling in Visoko

At the moment, there is only a natural gas network set up in capacity of a district heating system in the Municipality of Visoko. Because of the low standard, however, many consumers turn to individual solutions for heating, with the heating systems most commonly being based on solid fuels, such as coal, wood and similar.

These types of heating systems results in a series of negative effects for the municipality. Since solid fuels are not renewable sources, they increase dependence on other alternative solutions after being exhausted. The reduced availability of non-renewable energy sources may hence result in a significant increase in energy prices. During the combustion of coal, each heating system emits the greenhouse gas CO₂ into the atmosphere as well.

According to the Spatial plan of the Zenica-Doboj Canton and the Municipality of Visoko^{52,53}, on the territory of the Municipality of Visoko the following gas lines are placed:

1. State line Semizovac - Zenica,
2. State line Visoko - Kresevo, Kiseljak,
3. Local network.

The current competitor to heating based on solid fuels in the Municipality of Visoko is natural gas. The company JP "Visoko Ekoenergija" d.o.o. has built a network in a larger part of the municipality and is intending to expand the network further to the remaining parts. The indicated company has significantly lowered the price of natural gas in the municipality over the last period.

Local gas networks cover the entire urban area of the city, parts of LC Mostre, LC Arnautovici and Mulici, and all commercial business zones in the city of Visoko (Topuzovo Polje, Ozrakovici, Cekrekcije). Currently, the gas network connects 1,500 households and small commercial users, as well as 40 industrial and large consumers.

The proportion of the population heated by natural gas compared to other fuels (wood, electricity, pellets and other fuels) is 10:90.

⁵² Cantonal Institute for Urban and Regional Planning, Zenica - Ministry of Physical Planning, Transport, Communications and Environmental Protection, Zenica. (2006) Spatial plan of the Zenica-Doboj Canton for the timeframe of 20 years (2009-2029).

⁵³ Cantonal Institute for Urban and Regional Planning, Zenica - Municipality of Visoko. (2015) Spatial plan of the Municipality of Visoko (2014-2034).

3.2 Energy resources available in Visoko

The brown coal is imported from other municipalities, such as Kakanj, Breza and Banovici, for the needs of those who use brown coal as an energy source for heating. A major part of the municipality is covered by forest, which opens possibilities for biomass based heating. Wood as an energy source for heating is supplied locally.

An additional advantage for the Municipality of Visoko is that is situated on the route between Zenica and Sarajevo, along with the thermal power plant Kakanj. Future plans for heating systems are connected to a cogeneration project from the thermal power plant.

3.3 Initiation, planning, implementation and operation of DHC in Visoko

Due to poor air quality in the Municipality of Visoko caused by alternative heating such as brown coal and the use of vehicles without catalysts, the municipality is committed to implement heating solutions based on renewable energy sources, to reduce pollution.

Business people who work in the area of the Municipality of Visoko are very much interested in implementing a district heating system based on biomass waste, agricultural residues, and similar.

There has recently been an expansion of a broiler farm in the municipality, which produces large amounts of waste from broilers that can be used as a renewable energy source. Through the process itself, the farm is implementing measures to generate biogas by dehydration of waste, reducing greenhouse gas emissions and entirely solving the problem of waste.

3.4 Potential and barriers for DHC in Visoko

District heating systems exist in Bosnia and Herzegovina, however, they are quite outdated and are mainly based on fossil fuels. In addition, another problem is the complex administrative structure, as well as a lack of appropriate strategies and a coherent framework in the heating sector.

Based on preliminary estimates there is a significant potential in energy from biomass waste, agricultural residues, forestry and wood processing. There is a growing interest in the use of solar panels, particularly in the public sector [30].

The Municipality of Visoko will gather data on energy use among citizens and local utilities and the result will be a map of the heat demand which will support the decision making process and will enable integration into the future Sustainable Energy Action Plan (SEAP) of Visoko. The SEAP is currently under preparation.

However, Bosnia and Herzegovina still has a complex administrative structure, with a high degree of decentralization and many legal acts regulated by various regulatory authorities. In addition the legal framework in the heating sector is incomplete, while the National Energy Efficiency Action Plan for Bosnia and Herzegovina is still awaiting adoption.⁵⁴

⁵⁴ Municipality of Visoko. (2016) Development strategy of the Municipality of Visoko (2015-2021) - Energy and mining (page 28).