Banja Luka City

Sustainable Energy Action Plan (SEAP)

COVENANT OF MAYORS

WHEREAS the Inter-Governmental Panel on Climate Change has confirmed that climate change is a reality and that the use of energy for human activities is largely responsible for it;

WHEREAS on 9 March 2007 the EU adopted the Energy for a Changing World package, committing unilaterally to reduce its CO2 emissions by 20% by 2020, as a result of a 20% increase in energy efficiency and a 20% share of renewable energy sources in the energy mix;

WHEREAS the "European Union Action Plan for Energy Efficiency: Realizing the Potential" includes the creation of a "Covenant of Mayors", as a priority;

WHEREAS the EU Committee of the Regions stresses the need to join local and regional forces, as multilevel governance is an effective tool to enhance the efficacy of actions to be taken against climate change, and therefore promotes the involvement of regions in the Covenant of Mayors;

WHEREAS we are willing to follow the recommendations of the Leipzig Charter on Sustainable European Cities, concerning the need to improve energy efficiency;

WHEREAS we are aware of the existence of the Aalborg Commitments, at the basis of many ongoing urban sustainability efforts and Local Agenda 21 processes;

WHEREAS we recognize that local and regional governments share the responsibility of fighting global warming with national governments and must be committed thereto independently of the commitments of other parties;

WHEREAS towns and cities account directly and indirectly (through the products and services used by citizens) for more than half of the greenhouse gas emissions derived from energy use related to human activity;

WHEREAS the EU commitment to reduce emissions will be achievable only if local stakeholders, citizens and their groupings share it;

WHEREAS local and regional governments, representing the closest administration to the citizen, need to lead action and to show example;

WHEREAS many of the actions, on energy demand and renewable energy sources, necessary to tackle climate disruption fall within the scope of competence of local governments, or would not be attainable without their political support;

WHEREAS the EU Member States can benefit from effective decentralized action at a local level in order to meet their commitment to greenhouse gas emission abatement;

WHEREAS local and regional governments throughout Europe are reducing global warming pollutants through energy efficiency programs, including sustainable urban mobility, and the promotion of renewable energy sources;

WE, THE MAYORS, COMMIT TO:

Go beyond the objectives set by the EU for 2020, reducing the CO2 emissions in our respective territories by at least 20%, through the implementation of a Sustainable Energy Action Plan for those areas of activity relevant to our mandates. The commitment and the Action Plan will be ratified through our respective procedures;

Prepare a baseline emission inventory as a basis for the Sustainable Energy Action Plan;

Submit the Sustainable Energy Action Plan within the year following each of us formally signing up to the Covenant of Mayors;

Adapt city structures, including allocation of sufficient human resources, in order to undertake the necessary actions;

Mobilize the civil society in our geographical areas to take part in developing the Action Plan, outlining the policies and measures needed to implement and achieve the objectives of the Plan. An Action Plan will be produced in each territory and shall be submitted to the Covenant of Mayors Office within the year following signing up;

Submit an implementation report at least every second year after submission of the Action Plan for evaluation, monitoring and verification purposes;

Share our experience and know-how with other territorial units;

Organize Energy Days or City Covenant Days, in co-operation with the European Commission and with other stakeholders, allowing citizens to benefit directly from the opportunities and advantages offered by a more intelligent use of energy, and to regularly inform the local media on developments concerning the action plan;

Attend and contribute to the annual EU Conference of Mayors for a Sustainable Energy Europe;

Spread the message of the Covenant in the appropriate panels and, in particular, encourage other Mayors to join the Covenant;

Accept termination of our membership of the Covenant, subject to prior notice in writing by the Secretariat, in case of either:

I) Failing to submit the Sustainable Energy Action Plan within the year following formally signing up to the Covenant;

II) Non-compliance with the overall CO2 reduction objective, as set in the Action Plan, due to failure to implement or insufficient implementation of the Action Plan;

III) Failing to submit a report in two successive periods.

WE, THE MAYORS, ENDORSE

The European Commission's decision to implement and fund a structure of technical and promotional support, including implementation of evaluation and monitoring tools, mechanisms to facilitate sharing of know-how between territories and tools to facilitate replication and multiplication of successful measures, within their budget;

The European Commission's role to assume co-ordination of the EU Conference of Mayors for a Sustainable Energy Europe;

The European Commission's declared intention to facilitate the exchange of experience among the participating territorial units, the provision of guidelines and benchmark examples for possible implementation, and linking to existing activities and networks that support the role of local governments in the field of climate protection. These benchmark examples should become an integral part of this Covenant, to be stipulated in its Annexes;

The European Commission's support providing for recognition and public visibility of the cities and towns taking part in the Covenant through the use of a dedicated Sustainable Energy Europe logo and promotion through the Commission's communication facilities;

The Committee of the Regions' strong support for the Covenant and its objectives, in representation of local and regional authorities in the EU; The assistance which those Member States, regions, provinces, mentor cities and other **institutional structures** supporting the Covenant provide to smaller municipalities in order that the latter may comply with the conditions set out in this Covenant;

WE, THE MAYORS, INVITE

The European Commission and the national administrations to set up co-operation schemes and coherent support structures, which help the signatories to implement our Sustainable Energy Action Plans.

The European Commission and the national administrations to consider the activities in the Covenant as priorities in their respective support programs, and inform and involve the cities in the preparation of policies and funding schemes concerning the local level in the scope of its objectives.

The European Commission to negotiate with the financial actors to set up financial facilities aimed at aiding accomplishment of the tasks within the Action Plans.

The national administrations to involve local and regional governments in the preparation and implementation of the National Energy Efficiency Action Plans and of the National Action Plans for Renewable Energy Sources.

The European Commission and the national administrations to support implementation of our Sustainable Energy Action Plans consistent with the principles, rules and modalities already agreed upon, and those which may be agreed upon by the Parties for the future at a global level, in particular within the UN Framework Convention on Climate Change (UNFCCC). Our active involvement in the CO2 emissions' reduction could also result in a more ambitious global target.

WE, THE MAYORS, ENCOURAGE OTHER LOCAL AND REGIONAL GOVERNMENTS TO JOIN THE INITIATIVE OF THE COVENANT OF MAYORS, AND OTHER MAJOR STAKEHOLDERS TO FORMALIZE THEIR CONTRIBUTION TO THE COVENANT.

INTRODUCTORY NOTE

Within the global activities, the UN has started in 1992 with work and activities related to problem of climate change by establishing the UN Framework Convention on Climate Change (UNFCCC). Bosnia and Herzegovina joined to and ratified this Convention in 2000. During this whole period, there were attempts at prevention of negative trends of climate change, for which cities and urban areas are most often seen as serious causes.

In Poznan, at the end of 2008, at a regular annual conference of the UNFCCC, it was concluded that 'the cities produce 80% of the total world emission of greenhouse gasses'.

The European Union (EU) is leading the global fight against the climate change and has established its top priorities. Its ambitious targets are expressed in the EU Climate Action and Renewable Energy Package , which commits the Member States to curb their CO_2 emissions by at least 20% until 2020. The EU has, by bringing 20:20:20 decision, motivated the European cities to actively get involved in realization of set targets, within the Covenant of Mayors.

Signatories of the Covenant of Mayors have contributed to these policy objectives through a formal commitment to go beyond this target through the implementation of their Sustainable Energy Action Plan.

The Covenant of Mayors is an agreement that supports the following:

- Decision of the European Commission to implement and finance structure of technical and promotional support, including implementation of tools for evaluation and monitoring, used mechanisms for making easier knowledge exchange between territories and tools for copying and multiplying of successful measures within their respective budgets;
- Role of the EC related to takeover of coordination the EU Conference of Mayors for Europe with sustainable energy;
- Announced intention of the EC to make easier exchange of experiences between territorial units of participants, providing examples and measurements for possible implementation and connecting of existing activities and networks that offer support to the role of local governments in the field of climate protection. These examples of measurements for possible implementation should become an integral part of the Covenant and to be placed into its annexes;
- Support of the EC in securing recognition and public awareness about big and small cities that are taking part in the Covenant by using of the logo *Europe with Sustainable Energy* and these that work on promotion though the instruments of communication of the Commission.
- Strong support of Committee of Regions towards the Covenant and its goals in presentation of local and regional governments in the EU;
- Help provided by the member states, regions, provinces, mentor cities and other institutional structures, which are supporting the Covenant and advisory to smaller municipalities in order to work in line with the Covenant conditions.

Signature of Banja Luka's Mayor in Brussels and undertaking specific obligations under the Covenant of Mayors were decisive for the Assembly of Banja Luka to establish a Council for Climate Change of Banja Luka, at its 9th session, held on 14th May 2009.

In addition to all these reason, special reasons, traditionally known for Banja Luka, should be particularly emphasized, which is its accepting challenges and trying to provide leadership.

GOALS

General goals correspond to those declared in the very Covenant of Mayors of the European Cities and, as such, they have a character of a long-term planning document. On the other hand, these have been adjusted with the existing development documents of Banja Luka, RS and BH, and offer new initiatives for radical change of philosophy and absolute acceptance of these sustainable development trends.

Set goals are such that they may clearly and measurably show all the changes of established goals within Banja Luka, but also a tendency to expand to the neighboring cities and areas. The role of Banja Luka should be particularly stressed here which, through these activities, undertakes the leadership in Bosnia and Herzegovina.

WHAT IS A SUSTAINABLE ENERGY ACTION PLAN?

By signing of the *Covenant of Mayors*, Banja Luka committed itself to prepare and submit the Sustainable Energy Action Plan in one year period from the signature date. This Action Plan is the key document, which shows how the local government will reach reduction of CO_2 emissions by 20% until 2020. Given that the Covenant is covering the whole territory of the city, Sustainable Energy Action Plan contains activities related to private and public sectors.

The European Commission has committed unilaterally to recognizing cities involved in the Covenant and provide for their public visibility. The Commission has implemented and funded the Covenant of Mayors Office, which provides technical and promotional support, including implementation of evaluation and monitoring tools, mechanisms to facilitate sharing of know-how between territories and tools to facilitate replication and multiplication of successful measures.

The Commission is committed as well to providing guidelines and benchmark examples for possible implementation and to link to existing activities and networks that support the role of local government in the field of climate protection. The European Commission Joint Research Centre (JRC) took on these tasks, in close collaboration with the Covenant's Office.

In principle, it is anticipated that SEAP's should include actions in the following sectors:

- Construction area, including new buildings and major refurbishment;
- Municipal infrastructure (district heating, public lighting, smart grids, etc);
- Land use and urban planning;
- Decentralized renewable energy sources;
- Public and private transport policies and urban mobility;
- Citizen and, in general, civil society participation;
- Intelligent energy behavior by citizens, consumers and businesses.

Reductions of greenhouse gas emissions due to industry delocalization are explicitly excluded.

Energy efficiency measures, renewable energy projects and other energy-related actions can be introduced in various activity areas of local governments.

Sustainable Energy Action Plans should be presented and debated by the civil society. SEAPs with a high degree of citizen participation are the most likely to get continuity in the long-term and to succeed in attaining their objectives.

Involvement of networks of local authorities is the core element of the Covenant of Mayors' Office. Funded through the Intelligent Energy Europe program, it consists of a dedicated team of professionals, aiming to: facilitate networking activities within the Covenant; support the promotion of the Covenant of Mayors; monitor the implementation of the Covenant by participating cities; provide technical support; support liaison with other actors in the Covenant; and support liaison with other relevant EU initiatives and strategies.

BASIC ACTIVITIES

Activities defined by this Action Plan foreseen until 2020, and are also divided per sectors and sub-sectors, according to propositions of the Covenant of Mayors of the European Cities. In the wide spectrum of activities that are to contribute to complete realization of the set goals, the most significant segments are related to: building, district heating, local production of electrical (renewable) energy, transport, usage of land – forestry and promotional activities.

As the activities will be done at least until 2020, the possibility of inclusion into other segments is not to be excluded.

When it comes to the activities related to improvement of utilization of energy, it is necessary to accept the EU Eco-Design, Labeling and other measures used in the EU.

In the **building sector,** particular attention will be paid to activities related to significant decrease of heat losses. That is why the Action Plan, in accordance with the European measures, requires establishing of minimum standards that will be applied onto small buildings, as well as those that will be related to new bigger buildings and buildings that are reconstructed – adjusted. Inclusion of the so-called 'passive buildings' presents a separate segment as well.

In the **energy production sector,** areas of electrical energy production in small hydro power plants (up to 20MW) and transfer of electrical energy are particularly integrated, that is, reconstruction of the electrical distribution network. Also, production of electrical energy from renewable sources is taken into account (geo-thermal energy, biogas, photovoltaic cells, wind energy).

In the **transport sector,** particular attention is paid to the question of usage of automobiles, traffic regulation as well as promotion of cleaner alternative transport. Popularization of as bigger usage of bicycles presents an indisputable global trend, therefore the Action Plan foresees specific activities.

Significant energy saving as well as reduction of carbon dioxide related to them are expected in the **district heating sector,** where particular attention is paid to modernized distribution network, thermal sub-stations and modernization of the boiler room at the district heating plant. In this sector, activities

related to usage of geothermal energy are particularly emphasized, thus a number of activities is foreseen about preliminary geo-thermal investigative works, that are to give answer as to the potential usage of this renewable energy source, whose inclusion into the energy balance of the City would result in the most significant reduction of carbon dioxide of all the proposed activities.

In the **land planning sector,** a number of afforestation activities is foreseen, above all in the Manjača plateau. Also, integration of energy efficiency principles into the secondary legislation and spatial and planning documents at the level of Banja Luka City is also foreseen.

As the activities about energy efficiency and usage of renewable energy are integral and complex and they present a long-term process, the process of education is specifically planned as well as a number of promotional activities. This is defined by projects in **a special sector – working with citizens and stakeholders.**

SPATIAL PLANNING

Basic spatial data

The City of Banja Luka covers northwestern part of Republika Srpska (BH). Position of the city is determined between 16º 48' and 17º 19' E and 45º 59' and 44 º 29'N. Neighboring municipalities are: Gradiška in the north, Laktaši in the northeast, Čelinac in the east, Kneževo in the southeast, Mrkonjić Grad in the south, Ribnik and Oštra Luka in the west, and Prijedor in the northwest. The City of Banja Luka finds its place on the boundary of mountain chains of middle Bosnian Mountains and lowland of Peripannonian belt in the north.

The vertical span of the city goas from 140 m (the left bank of the Vrbas River in Zalužani) with the highest peak being 1339 m (Goli Vis – Čemernica Mountain).

The city area belongs to 2 catchment areas – catchment area of the Vrbas River (the eastern part of the city - 891 km^2), and catchment area of the Sana River (the western part - 342 km^2)

Soil characteristics

Morphological and geologic characteristics had a dominant role in the soil generation in the city area . As a consequence, many soil types[1] were developed in the city area, which can be generalized in following pedosequences:

- Pedosequence on gravel and send /covers narrow belt on alluvium of the Vrbas and Vrbanja – mostly soils of I and II land capability class, today generally transformed in build up areas,
- Pedosequence on clay and loam - covers mostly the northwestern part of the city, but also covers small complexes in the Carst zone (Dobrnja, Stričići, Kadina Voda, valley of the Krupa River ...) In places where these soil types are present in the river valleys of Brkalos, Gomjenica, the Melinska River i Subotica, the most capable soils are observed.
- Pedosequence on soft limestone sediments - developed in the western part of town urban area (area with the most intensive building activities) (Petrićevac, Motike, Lauš, Zalužani, Dragočaj).

[1] Production capability of land is in direct proportion with production of biomas, that is, wtih the quantity of CO2, which is, in the photosynthesis process taken from the atmosphere

This zone has an unconvenient slope, with high vulnerability form erosion, landslides and the others geo-morphological processes.

- Pedosequence on limestone and dolomites – this soil types covers large area of the city surface, in the south in direction Banja Luka- Bronzani Majdan and it covers more than 50% of city, and present the main forest stand.
- Pedosequence on non-carbonate rocks – Soil types from this sequence are found on Kozara and Crni vrh, Stratinska area and partly Obrovac, having no importance for agriculture, but, on the other side, a valuable forest stands.

Land use/Land cover

Orohydrographic conditions, geology, climate, man-made influence, but also recent demographic movements have had a basic influence on the actual land use.

Agricultural areas are distributed mainly through the central part of the City, with enlargement in the northern and northwestern part of the city, mostly in the river valleys of the Vrbas, Vrbanja, Suturlija, Široka and Dragočajska Rivers, in the valleys of smaller rivers such as the Brkalosa, Gomjenica, Subotice River, but also in the low hills between the Vrbas and Gomjenica. Recent demographic processes[2] reflected individual housing at a large scale, mostly in the most productive agricultural soils in the northern and northwestern part of urban zone. On the other side, depopulation of rural areas led to abandoning of agricultural production, with a lot of consequences /succession of vegetation, weed dispersion

Forests cover, being around agricultural land, a large belt of hill and mountain areas of the City. On the right bank of the Vrbas River, the forests covers mountains of Tisovac, Osmača, Čemernica, as well as hills Starčevica, Gakovica and slopes of Crni Vrh (Trapisti). The southwestern forest area of the city covers mountains Manjača, and Behremaginica in the northwest and the northwestern part of the city area of Piskavica and Banjalučka Kozara in the north are covered by forests.

Characteristics of vegetation

According to ecological - vegetational area distribution of BH, City of Banja Luka finds its place between 2 important areas at a European level - Peripannonian in the north and inner Dinarids in the south. This diversity is a consequence of diversity of ecological conditions, but also of strong anthropogenic influence, so primary, secondary and tertiary vegetation can be distinct.

Primary and secondary vegetation

According to Horvat, the urban zone of Banja Lukais a part of climax vegetation of sessile oak and hornbeam (Querco – Carpinetum). Areas under acid soil and hilly relief at the moment are is some **prograding** – degrading phases of this plant community. As above-mentioned phases in the city area, we can find clean phytocenoses of hornbeam, and different types of shrub areas, as a result of strong felling activities of main tree species, but also the coniferous plantations (Šehitluci, Trapisti). Secondary

[2] The City of Banja Luka has become a permanent shelter for several thousands of refugees from war affected areas of BH and Croatia.

vegetation appeared after cutting in oak forests and it belongs to mesophyl phytocenoses from the Arrhenenatheretalia order.

In the sessile oak zone, in dependence of relief and hydrologic conditions, other forest communities are present as well, though mostly forests of sessile oak (Quercetum montanum - degraded. Secondary vegetation in this case is grasslands of bracken. Forests of pubescent oak and hop hornbeam/Querco – Ostryetum carpinifoliae) are present in canyons and terrains with a steep slope in the western and southwestern expositions, while on the south sides in this relief we can find forests of pubescent oak and oriental hornbeam (Carpinetum orientalis).

Above a belt of sessil oak, there is a strong area of beech forests (Fagetum montanum), especially in the south part of the city on both banks of the Vrbas River (Mountains of Osmača, Tisovac, Čemernica, Manjača). Forests of beech and fir (Abieti – fagetum) in this area can be found on higher altitude, and on the Velika Manjača we can find forests of beech, fir and spruce. Importance of pure beech forests is not just in big economic value, but also they are the most important absorbers of CO_2, because of its area, wood stock and annual increment, and they are also main economic resource of forestry in the City's territory.

Low land area of the city is today a stand for fragments of degraded stages of flooded forests - type Quercion robori petreae, where several forest communities can be found. This forest stand trough clear cutting in history was transformed in the first place in agricultural areas, and today it is the urban area created precisely in those habitats

In the narrow belt of the Vrbas River banks, several **inundate** forest communities – type Salicion albae (willow forests) can be found. In urban area these communities are degrading, and becomes stand for invasive species, such as Echinocystis lobata, Helyanthus tuberosus ...

Tertiary vegetation

Ruderal flora of the city is presented with a large scale of biodiversity. This type of vegetation has its endangered communities /class Plantaginetea majoris/ to common nytrophylic and hygrophylic stands of class Bindetea tripartiti. One of main characteristics of this vegetation type is presence of invasive species, but also presence of refuge plants in old buildings. Specific type of vegetation are plants from arable land, but without adequate research results.

Land cover balances

According to official cadastral data, the following tables show data for the main areas:

Land	km^2	%
Total	**1239**	**100**
State property	454	36.6
Private property	785	63.3
Agricultural land	**650**	**52.4**
State property	63	9.7
Private property	587	90.3

Forest land	**466**	**37.6**
State property	288	61.7
Private property	178	38.3

Actual demographic processes led to significant abandoning of rural areas, which caused succession of vegetation towards pioneer forest ecosystems. On the other side, demographic process have led influx of many rural inhabitants in the City, which resulted in a huge scope of frequently uncontrolled building, mostly on agricultural surfaces of high land capability classes in the northern part of the City, and partly on forest land. The following table presents land use (land cover) in the City of Banja Luka according to the CORINE classification, while the relevant data are those related to the situation of the forests in the context of attaching of CO2 from the atmosphere.

CLC CLASS	**km^2**	**%**
Urban zones	22.8	1.8
Industrial or commercial units	2.2	0.2
Traffic network	0.3	0.0
Mineral extraction sites	0.3	0.0
Non – irrigated arable land	1. 5.4	2. 0.4
Orchards	1.9	0.2
Pastures	63.2	5.1
Complex cultivation patterns	396.9	32.0
Land principally occupied by agriculture with significant areas of natural vegetation	233.1	18.8
Broadleaved forest	457.0	36.9
Coniferous forest	4.8	0.4
Mixed forest	25.7	2.1
Grassland	9.1	0.7
Transitional woodland - shrub	14.3	1.2
Sparsely vegetated areas	0.7	0.1
Water courses	0.5	0.0
Water bodies	0.7	0.1
City Total	1239	100.0

Banja Luka has been developing under specific conditions, which makes it different when compared to other cities. The reached urban development level has come as the result of a complex process of interaction between many influencing spatial-physical and socio-economic factors that affected the development of the city in different ways and periods of time.

It is natural conditions that have always determined the spatial development of the City. Banja Luka is situated in an amphitheater-shaped basin. Its development is oriented to the north, which is favored by the stream of the Vrbas River and the main roads leading towards the cities of Gradiška and Prijedor.

The principles of the residential area territorial distribution are clearly differentiated in the entire urban area. The central urban zone is characteristic for its concentrated multifamily housing that is, in certain zones, combined with business and central functions and with urban forms of highly concentrated individual housing of high density, for example, urban villas. In the broader urban area, individual housing is dispersed, being in the form of private houses built on bigger construction land parcels and linearly concentrated along main roads in quite a distinctive manner.

A specific form of individual housing are illegally constructed housing settlements from the post-war period. They are characteristic for a high concentration of individual housing on frequently minimum land parcels, for chaotic dispersion, for utter disregard of any urban parameters and for no or the minimum of infrastructure whatsoever.

The total surface of the city (municipality) occupies **1,239 km²**, that is **123,900 ha**, whereas the **urban area** occupies around **183.47 km²,** that is **18,347.23 ha**, which makes up **14.81 %** of the City's territory.

Out of **18,347.23 ha** of the urban area **8,214.74 ha**, that is **44.77 %** is included in the spatial planning documentation.

Non-urban area of the city occupies around **1,055.53 km²**, that is **105,553 ha**, which makes up around **85 %** of the city territory. Out of **105,553 ha** of the non-urban area **545 ha**, that is **0.51 %** is included in the spatial planning documentation. The spatial planning documentation for **175 ha** of the non-urban area is being developed at the moment.

When it comes to strategic planning documentation there is the Municipal Spatial Plan of the City of Banja Luka, which covers the planning period from 1986 to 2005 and which was adopted in 1990. The Work Plan and Program for 2010 of the Banja Luka City Administration Sector of Spatial Planning envisages the adoption of the Decision on Auditing Banja Luka`s Spatial Plan. There is also the Master Plan, which was adopted in 1975, but the reviewed Master Plan draft proposal is being prepared in order to be adopted by the City Assembly.
In compliance with the Development Strategy of the City of Banja Luka, one of the most important objectives is sustainable development and increased efficiency in the management of resources. The Master Plan envisages:

1. The modernization and reconstruction of the existing district heating system:
    a. The improvement of the thermal insulation in existing facilities in order to have the specific average consumption of energy used for heating reach the similar level of consumption in modern facilities built in Europe,
    b. The modernization and reconstruction of the district heating system with the application of more efficient energy solutions.
2. The construction of new thermal energy facilities along with the application of energy-efficient solutions (three new district heating plants in the urban area planned to be constructed and connected to the district heating system).

3. The creation of conditions for the exploitation of alternative fuels on the basis of price competition, reliability of fuel supply and environmental significance / advantage to be given to national energy products/fuels.

4. The greatest possible share of alternative energy sources in district heating (geothermal energy, solar energy, wind energy, biomass energy, etc.).

5. The increase in air quality by decreasing fuel consumption and combustion product emission.

6. Increasing energy efficiency in building construction (planning of such facilities, saving natural reserves and maximizing the exploitation of renewable energies, avoiding adverse environmental impacts – the general consideration of passive solar heating principles should have a considerable impact on urban planning and design).

7. Preventing the establishment of new and the expansion of the existing sub-urban linear conglomerates that impair the continuity of the urban axis and unnecessarily burden the city with irrational infrastructure corridors.

8. The development of an urban green area comprehensive study.

9. Keeping agricultural land surfaces.

10. Expanding the border of special-purpose forests.

11. City Assembly`s passing of legal documents about environmental protection and its improvement in line with applicable regulations and laws; passing programs on environmental protection, the procedures, activities and criteria of environmental behavior and sanctions for not abiding by applicable laws.

12. The control of applied standards during the technical acceptance of facilities (whereby it is necessary to adopt a bylaw act about the contents, way of preparation and control of the technical documentation and about the technical inspection of buildings and issuing usage licenses by the Ministry of Spatial Planning).

13. The adoption of adequate local regulations to stimulate investors to reach the best possible energy optimization of facilities.

In compliance with the aforementioned, the Banja Luka City Administration Sector of Spatial Planning will plan its activities in the years to come in order to contribute to reaching the city strategic objectives within the framework of its competences.

GREENHOUSE GASSES INVENTORY FOR CITY OF BANJA LUKA

Introduction

Sustainable Energy Action Plan (SEAP) is a key document that shows how the local community as a signatory of the Covenant (Covenant of Mayor) will achieve commitments to reduce greenhouse gases (GHG) by 20% in relation to the base year in 2020. Therefore, it uses the results of emission inventory for

the base year in order to identify the most suitable areas and sectors of activities and possibilities for reducing emissions. Bosnia and Herzegovina is a signatory of the Kyoto Protocol and the UNFCCC Convention and the 1990th is determined as the base year for the emissions inventory development.

Emissions are expressed in tons of CO_2 and they are not taking into account other greenhouse gases (CH_4, N_2O, CO, NOx, NMVOCs, SO_2) because the baseline emission inventory didn't calculate sectors like agriculture and waste as a major source of CH_4 and N_2O.

Calculation of emissions for the 1990 is made on the basis of final energy consumption (MWh) and contains of the four tables:

- Final energy consumption
- Emissions of CO_2 or CO_2 equivalent
- Local production of electricity and the corresponding CO_2 emissions
- Local production of energy for heating / cooling (district heating / cooling, CHPs ...) and the corresponding CO_2 emissions

In order to determine priority actions to reduce GHG emissions, the inventory of emissions for the base year is divided into sectors and sub-sectors:

- **Buildings, equipment / facilities and industries**
    1. Municipal buildings, equipment/ facilities in the authority of the City of Banja Luka
    2. Tertiary (non municipal) buildings, equipment/ facilities which are not in the authority of the City of Banja Luka
    3. Residential buildings
    4. Municipal public lighting
- **Transport**
    1. Municipal fleet
    2. Public transport
    3. Private and commercial transport

The industry sector is not included in the calculation of emissions because the City of Banja Luka does not have authority over this sector and therefore there is no possibility to implement measures to reduce emissions.

According to different energy commodities, which are consumed within the local authority, the inventory is divided into:

- Electricity
- Heat/cold (district heating)
- Fossil fuels energy (natural gas, petroleum gas, fuel oil, diesel, gas, lignite, antracite)
- Renewable energy sources (biofuel, biomass, solar and geothermal energy)

Electricity refers to the total consumed energy in the local area, including the locally produced electricity and certified green electricity.

Heat/cold refers to heating energy that is consumed within the local territory, which is originating from the district heating or CHP (combined facilities for the production of heat and electricity) systems.

Fossil fuels energy include primarily thermal energy consumed in the local territory for heating objects that are not connected to district heating system and energy consumed in the transportation sector and industrial sector.
Renewable energy includes energy consumed in the local territory and produced from these sources: bio fuel, biomass, solar, geothermal energy.
The calculation of emissions is made according to IPCC methodology, which provides organized structure for calculations on various levels and sectors, depending on the available activity data, which would ensure the possibility of comparing reports of calculated emissions with other countries. The methodology is based on final energy consumption (MWh) and appropriate the IPCC default emission factors (tons per MWh).

Final energy consumption and corresponding CO_2 emissions

The total energy consumption in the local territory of the City of Banja Luka in 1990 amounted 1 457,944.38 MWh, which corresponds to the total CO_2 emissions of 664,322.94 t.

The most energy was consumed in the buildings, equipment / facilities sector, thus around 90% of total CO_2 emissions contributes to this sector, while in the transport sector it is 10% approximately.

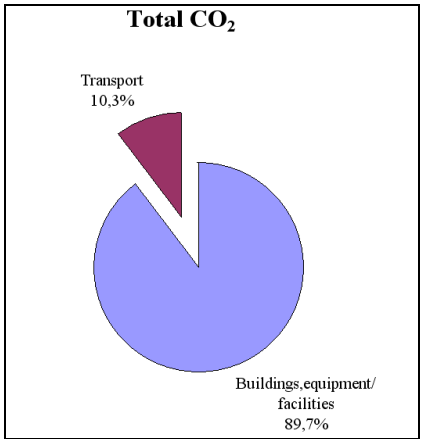
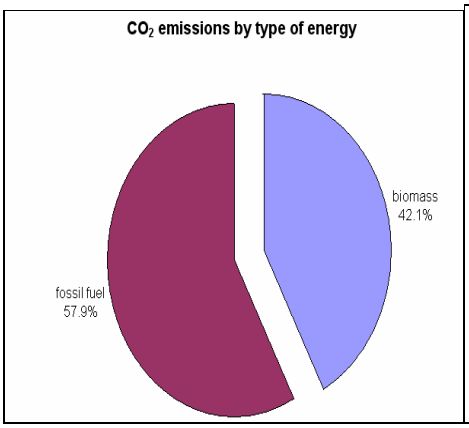


Figure 1. Total CO_2 emissions

The most CO_2 emissions occurred by combustion of fossil fuels (coal, fuel oil) used for thermal energy and electricity production.



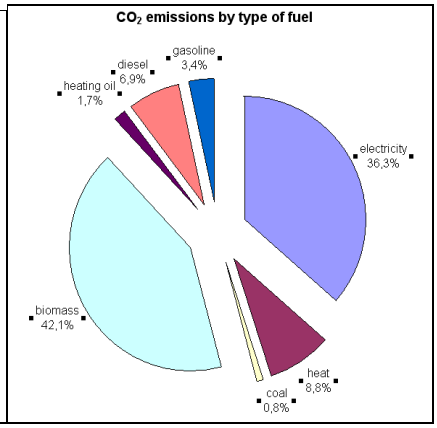


Figure 2. CO_2 emissions by type of energy

Figure 3. CO_2 emissions by type of fuel

The highest percentage belongs to the emissions from electricity production sector (36%) originating from thermal power plants in Bosnia and Herzegovina.

District heating sector contributes to overall CO_2 emissions by 8.8% and other objects that are not connected to district heating system, and using fossil fuels (coal, heating oil) for heating energy, contribute to the total emissions by 2.5%.

Largely, in the local territory of Banja Luka, biomass (wood waste) was used for the production of heating energy in the amount of 42%. It is considered for biomass to have "neutral ratio of CO_2," because the plants used CO_2 in the process of photosynthesis for re-growth and thus it does not contribute to "greenhouse effect". For this reason, the forests in the area of City represent a significant CO_2 sink.

Calculation of CO_2 emissions by sectors, given in the instructions of the Covenant (Covenant of Mayors), is shown below:

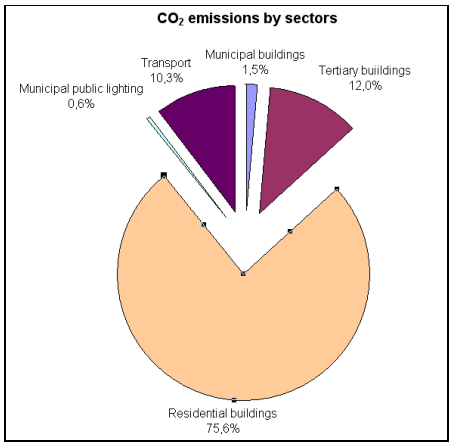


Figure 4. CO_2 emissions by sectors

Analyzing the CO_2 emissions from various sectors shows that residential and households in the area of Banja Luka have the largest share of total emissions. Approximately 76% of total emissions belongs to this sector. The largest part of the energy consumed in households comes from biomass combustion

(mainly for the production of heating energy) and electricity. About 30% of households are connected to district heating system, which contributes to the emissions from this sector accounted for 9%. Only 1% of emissions in the household occurs due to the use of coal.

Transport also provides a large contribution to total emissions of CO_2 (10%). This percentage includes the emissions from private motor vehicles, public transport, municipal fleet and commercial vehicles that are in the competence of the local authority of Banja Luka as well as vehicles that are not in the competence of the local authority like intercity and long-distance traffic. In 1990th the City of Banja Luka had only a few vehicles owned as municipality fleet. The largest part of the CO_2 emissions were caused by private cars, because the largest number of vehicles in the City of Banja Luka were owned privately.

Objects and building that are in the authority of the City (municipality and administration buildings, hospitals, kindergartens, high schools) are mostly connected to the district heating system and contribute to the overall emissions, with only 1.5%.

Objects that are not under the authority of the City (office buildings, banks, private facilities, hospitals, service sector, etc.) have a large share of total emissions (12%).

CO_2 emissions by type of fuel for each sector is shown below:

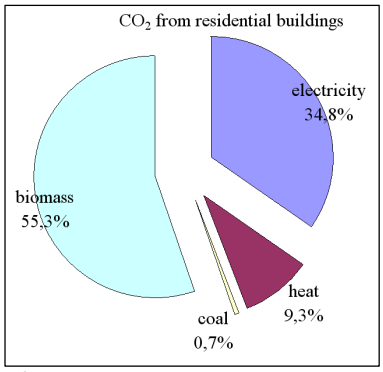


Figure 5. CO_2 emissions from residential building

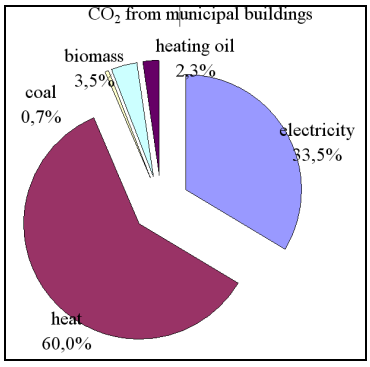


Figure 6. CO_2 emissions from municipal buildings

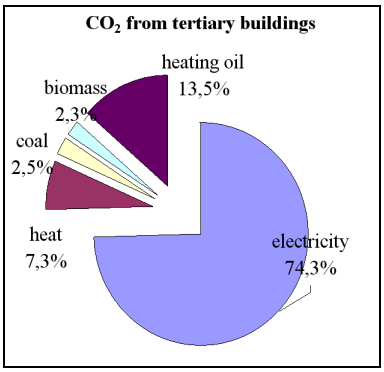


Figure 7. CO_2 emissions from tertiary buildings

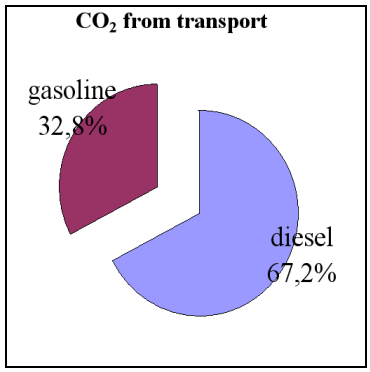


Figure 8. CO_2 emissions from transport

Local Electricity Production and corresponding CO_2 Emissions

In the area of Banja Luka power supply is done through the electric power distribution networks, and comes from hydropower and thermal power plants in Bosnia and Herzegovina. As already noted, the biggest CO_2 emissions are the result of combustion of fossil fuels, mostly the coal, to produce electricity in thermal power plants in Bosnia and Herzegovina.

For the calculation of CO_2 emissions based on the total consumption of electricity, an appropriate emission factor (t / MWh) is required, which includes:

a) National/European emission factor
b) Local electricity production
c) Purchases of certified green electricity by the local authority

The local emission factor for electricity (EFE) can be calculated by using the equation below:

$$\mathbf{EFE = [(TCE - LPE - GEP) * NEEFE + CO_{2LPE} + CO_{2GEP}] / (TCE)}$$

Where the following are:

EFE = Local emission factor for electricity in [t/MWhe]
TCE = Total electricity consumption in the local authority in [MWhe]
LPE = Local electricity production in [MWhe]
GEP = Green electricity purchases by the local authority in [MWhe]
NEEFE = National or European emission factor for electricity in [t/MWhe]
CO_{2LPE} = CO2 emissions due to the local production of electricity in [t]
CO_{2GEP} = CO2 emissions due to the production of certified green electricity purchased by the local authority in [t]

National emission factor NEEFE for electricity for Bosnia and Herzegovina is taken from the Initial National Communication (INC) of Bosnia and Herzegovina to the UNFCCC.

Reduction of CO_2 emissions through energy efficiency projects and local production of electricity from renewable sources are a priority of the Covenant of Mayors.

Inventory of GHG emissions can include local production of electricity if all the plants/units follow the next criteria:

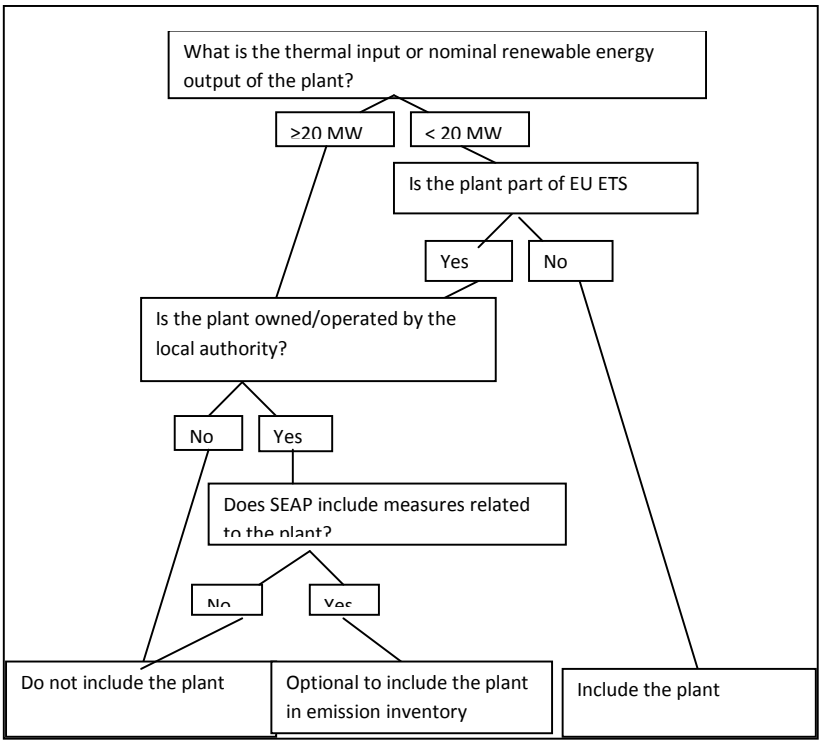
a) The plant/unit is not included in the European Emissions Trading Scheme (EU ETS);
b) The plant/unit is below or equal to 20MWfuel, as a thermal energy input, in the case of fossil fuel and biomass combustion plants, or below or equal to 20MWe, as a nominal output, in the case of other renewable energy plants (e.g. wind or solar).

These criteria are based on the assumption that the locally produced electricity from small plants serve the local electricity needs and that local authorities have competence on these facilities, and thus the ability to implement measures to reduce emissions. Large power plants primarily produce electricity to the larger distribution grid and they are authorized by the state.

In the area of the City of Banja Luka, there were no facilities for the local production of electricity in 1990, neither from fossil fuels or renewable sources like wind, solar, hydro (Hydro power plants in Vrbas - Bočac belong to Mrkonjic Grad).

The local community (municipality, city) can use certified green electricity for electricity supplying. This certified green electricity is purchased and have to meet the criteria for *guarantee of origin of electricity produced from renewable energy sources* set in the Directive 2001/77/EC and the Directive 2009/28/EC. In the area of the City of Banja Luka, there was no purchasing certified green electricity in 1990.

Figure 9. Decision tree diagram



Local Heat/Cold production and corresponding CO_2 emissions

This sector is primarily related to energy for heating / cooling that is produced and used in the area of the local community. It means the district heating and CHP (combined plant for the production of heat and electricity) systems.

The production and distribution of thermal energy in the City of Banja Luka were provided by district heating company (Toplana a.d.). The fuel used for production of thermal energy is heavy oil.

The following formula may be applied to calculate the emission factor for heat:

$$\mathbf{EFH = (CO_{2LPH} + CO_{2IH} - CO_{2EH}) / LHC}$$

Where the following are:

EFH = emission factor for heat in [t/MWhheat]

CO_{2LPH} = CO2 emissions caused by the local production of heat energy in [t]

CO_{2IH} = CO2 emissions caused by any imported heat from outside the territory of the local authority in [t]

CO_{2EH} = CO2 emissions caused by any heat that is exported outside of the territory of the local authority in [t]

LHC = Local heat consumption in [MWhheat]

Total thermal energy produced in the district heating plant in 1990 was used only in the area of the City of Banja Luka. For these sectors, it amounted to 209,100 MWh, which calculated on CO_2 emissions amounted to 58,338.9t (9% of total emissions).

Estimates of CO_2 emissions reduction in 2020 and recommendations

Huge energy consumption causes the increase of emissions of greenhouse gases. It is therefore necessary to take appropriate measures and activities at both state and local levels of government in order to reduce emissions and mitigate their negative effects.

The most GHG emissions in the area of Banja Luka arise due to the use of fossil fuels to produce heat and electricity as well as for transportation. This fact indicates the necessity of substitution of these fuels with new alternative types.

All measures and activities in certain sectors of activity, proposed and described in the SEAP document, indicate the possibility of energy savings up to 35%, which would result in CO_2 emissions reduction to 42.6% in 2020, compared to the base year of 1990, out of which 25.8% reduction is the result of introduction and usage of renewable energy sources (geothermal, hydro, solar energy).

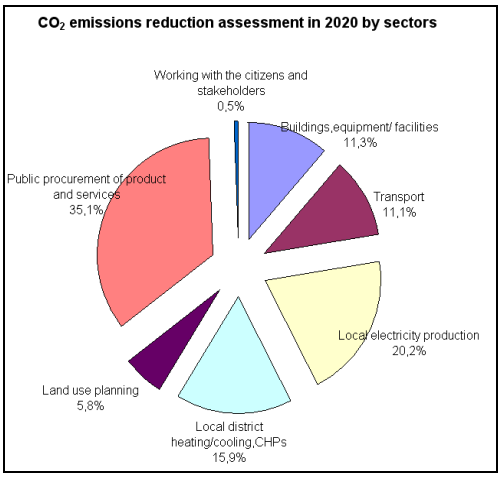


Figure 10. Estimates of CO_2 emissions reduction in 2020 by sectors

In the area of Banja Luka, there are great potentials for the usage of renewable energy sources (geothermal, hydro, solar energy) which are the main natural resources of the City.

The Vrbas and Vrbanja Rivers have great capacity for mini hydro power plants that are planned in the Urban Plan of Banja Luka 2008-2020 and planning documents of the Power Utility of the Republic of Srpska (hydro and mini hydro power plants in the Vrbas River of total installed capacity 100MW, as well as Delibašino selo a hydro power plant of installed capacity 4.1 MW).

Different activities in the field of district heating, which include modernization and reconstruction of primary and secondary distribution networks, installation calorimeter and the usage of geothermal energy as a renewable source in order to produce heat, indicate the possibility of energy savings, which would

result in CO_2 emissions reduction in the total share to 16%. Great natural resource of Banja Luka's region is its geothermal energy that can be used for both district heating and electrification of the City.

With establishment and improvement of legislation and law regulation in the field of energy-efficient buildings and facilities in order to increase the energy efficiency of buildings (required insulation of roofs and facades, installation of appropriate windows, thermostatic radiator valves), it is possible to achieve huge energy savings and thereby reduce emissions of CO_2 in the total share of 35 %.

Significant progress for emissions reduction can be achieved in the transport sector through the usage of alternative fuels as biodiesel and other biofuels, gas and electricity use as well as through the implementation of new regulations (vehicle age, type of fuel, traffic management, eco-taxes, etc.).

Usage of biomass to produce heat and electricity and the substitution of fossil fuels with biomass has a significant share in the overall reduction of emissions.

Projects of afforestation and building of parks and green surfaces as CO2 ‘sinks’, which are defined in the City’s planning documents, provide additional possibilities.

DISTRICT HEATING

Toplana is the single provider of heating services in Banja Luka, serving about 30% of the residential, commercial and administrative premises within Banja Luka city. The remaining buildings are heated by individual heating systems. Small residential houses are mainly heated by wood. Toplana supplies heat for space heating purposes only, and hot water is heated individually in each apartment, mainly by electric water heaters.

In Banja Luka, thermal energy for space heating Toplana supplied during the heating season only, which typically starts on about 15th of October and lasts until 15th of April. The duration of heating supply period is around 188 days on average. During the heating season, heat is supplied daily only from 6 am to 10 pm. During this time, Toplana undertakes to maintain the indoor temperature at +19°C (+/- 1°C). However, such a stable target of indoor temperature is not achievable under the current operating regime. Approximate outline of heat supply area and location of Toplana is shown in figure 11.

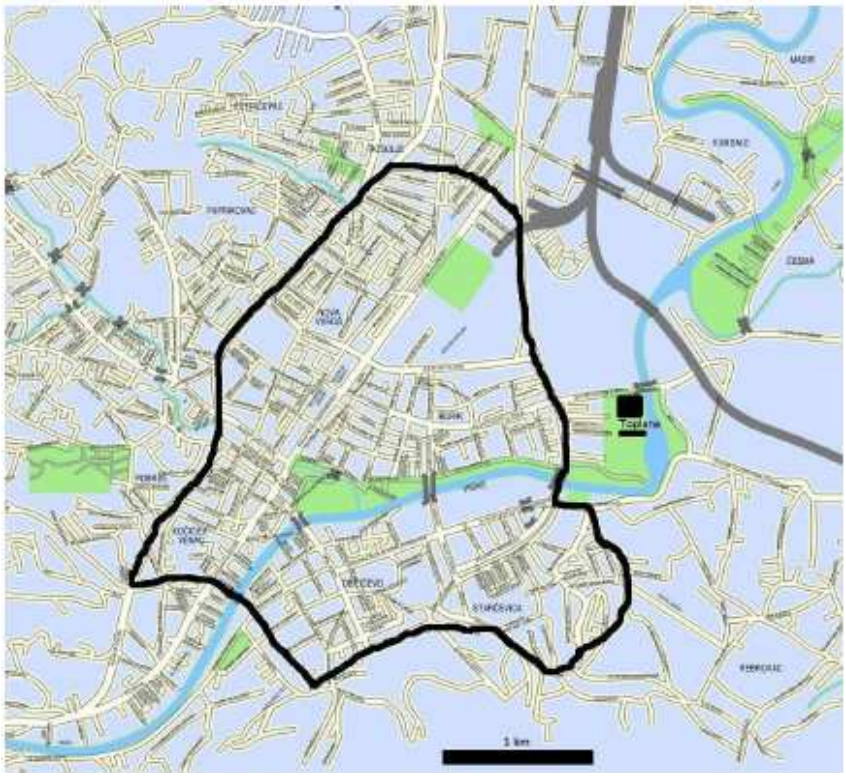


Figure 11. Approximate outline of heat supply area and location of main site

The analysis of district heating in the City of Banja Luka, which was conducted during the development of the Study 2006/07 led to the following conclusions:

- The TPK-50 boilers are, generally, in a reasonably good operational condition having been refurbished in 1999-2000.
- The burners, pumps, fans, and electric motors are in a reasonably good condition.
- Automation is completely absent.
- The boilers operate at a low average efficiency.

The annual efficiencies of the different parts of the heat production and distribution chain are estimated as follows:

- Heat production efficiency 80%.
- Heat losses from the network 11%.
- Hot water losses from the network 13%.

In short, the overall efficiency (as measured by total energy input versus heat received by consumers) Toplana system is about 60%, as compared to 80% in Western Europe.

Among others, the study contained the following conclusions:

- The current operations are wasteful of fuel by virtue of the lack of control systems and wasteful of energy by virtue of the level of leakage from the network,
- Complete modernization of the heat supply system would contribute to about 27% savings in fuel consumption, 93% savings in water consumption and 70% in electricity consumption.

Toplana is subject to a number of environmental laws. As the facility has a capacity in excess of 50 MW it is subject to provisions in respect of large combustion plants, and as it has a capacity in excess of 200 MW, it is also subject to IPPC legislation.

The data for baseline year, 1990

According to the data provided by Toplana, in the heating season 1989/90 heating of City Banja Luka was performed by Toplana and partly through the Incel-Energetika. Total consumption of fuel oil in the heating season 1989/90 was 19,300 tons, and to consumers, in the categories studied in this report, was delivered 209,100 MWh of thermal energy. From the supplied thermal energy, 80% is committed to residential customers or 167,280 MWh, and the rest, or about 41,820 MWh, commercial consumers (Municipal buildings and equipment/facilities - administrative and other facilities under the jurisdiction of the City of Banja Luka, and Tertiary (non-municipal) buildings, equipment/facilities - buildings that are not under the jurisdiction of the City of Banja Luka). Based on recommendations from the Toplana, these 20% is divided as follows:

- Administrative and other facilities under the jurisdiction of the City of Banja Luka, 10%,
- Buildings that are not under the jurisdiction of the City of Banja Luka, 10%.

The capacity of the connected consumers in 1991/92 amounted to 265 MW (this included all consumers, including industry) and Toplana was delivering heat energy to:

- 286 different business customers,
- 18,800 flats with a total floor space of 983,773 m^2 (average heating area amounted to about 52.33 m^2).
- Heating 35,580 m^3 hot water monthly.

These data were used to fill the table A, in a table SEAP, column Heat / Cold.

In a study [1] published in mid 2007, an analysis was carried out about several possible ways of heating of Banja Luka in the future, where it was shown that the existing district heating system with the necessary modernization, at this moment, is the lowest-cost option and currently the best solution. The study also analyzes the individual elements of the district heating system, and, in accordance with the conducted analysis, appropriate activities (measures) were proposed in order to modernize the existing system, and also the necessary funding to implement the proposed measures. In this report, we will list only those measures that were suggested by representatives of Toplana as well as their assessment of necessary financial resources to implement these measures. Each of these activities, should lead to increased overall efficiency of district heating, and thus to lower fuel consumption (heavx oil) in the boiler room of Toplana, for the same amount of heat delivered to the customer.

The boiler house

Present situation

The total installed capacity of the boiler house is 246 MW (4 boiler of 58 MW capacity and 2 of 7 MW boilers), of which 232 MW is currently operational[3]. The boiler house is fired by heavy oil fuel.

In Study the following condition is indicated. Due to the lack of proper control systems and, as a result of daily interruptions in heat supply, the boilers operate at low average efficiency. The burners, pumps, fans, and electric motors are in reasonably good condition, but there is a complete lack of automation. The Banja Luka Institute of Environmental Protection and Information carried out annual boiler measurements at Toplana in April 2007. The results show very high O_2 content in flue gas (15.6 %). The flue gas and temperature was also high (up to 207°C). Normal values for boilers that use similar fuels are about 4% to

[3] The boilers of 58 MW capacity are using for heating the city during the heating season. The boilers of 7 MW capacity were used earlier for heating of hot sanitary water

6% for O2, and about 140°C for flue gas temperature. The figures of Toplana boilers imply serious operational problems, indicating much lower efficiency of the boilers than could be reasonably achieved.

The plan of modernization of boiler house

Plan of modernization, predicts significant improvement of the efficiency of transformation of thermal energy fuels in the boiler house. Amongst others, the following activities are also planned with this purpose:

- Purchase new oil burners, pumps, motors and fans,
- Installation of variable speed drives to main motors,
- Installation of local automation,
- Installation of heat meters in boiler houses,
- Installation of equipment for gas (oxygen) removal from the make-up water,

The objectives of the implementation of modernization are:

- Improved combustion of fuel, less emissions combustion products to the air,
- Fuel and energy savings,
- Cost savings in maintenance and operation (staff),
- Improved operation and safety.

Implementation of the modernization of boiler houses, it is envisaged that the in 2020, the savings realized in fuel economy (compared to projected consumption without the implementation of modernization) of 1,170 t fuel oil, which is around 13,066 MWh of thermal energy, which would result in a reduction in CO_2 emissions of around 3,645.42 t.

Primary and secondary distribution network

Present situation

The thermal energy is distributed through the primary network to the substation, from which it is, through the secondary network, delivered to consumers. The primary heating network is maintained by Toplana, and the owners bear the costs of maintenance of housing installations in buildings and other facilities. The total length of district heating network is 155 km. The share of modern pre-insulated pipes is about 5% of the total network length.

The network is generally in bad condition and suffers from external and internal corrosion. External corrosion occurs because of damaged insulation protective coat, causing penetration of outside water from the ground into the pipeline structures and damage of the steel pipes (external corrosion of steel pipes) and the heat insulations (increasing heat losses). Internal corrosion occurs due to inadequate quality of the make-up water. To illustrate the poor condition of the network, it is indicated that Toplana water consumption averages around 180,000 m^3/year, which is about 1,000 m^3/day during the heating season. Compared to the volume of the networks (it has been estimated that volume of water in the network is about 7,300 m^3), the water in the Toplana system changes completely in 8 days. The comparable figure in Western Europe is about one change in a year (365 days). In relative terms, the water consumption rate for Toplana is about 45 times higher than the typical rate in Western Europe.

Primary network and its modernization

Hot water from the boiler room is pumped, through the primary network, to the substation. The primary network comprises 45 km of pipes. These primary pipelines are generally located in concrete channels and insulated with mineral wool. As already noted, most of the network is in poor condition and is exposed to internal and external corrosion and it therefore needs reconstruction. Because of increasing

heat energy consumption in the city, due to connecting of new consumers, it will be necessary, in the future, to increase the capacity of the primary pipeline. This increase in capacity is best carried out jointly with the reconstruction of the primary pipelines.

The reconstruction of the primary network will achieve savings in maintenance costs and fuel (through reduced heat losses) and water costs from the network. In addition, the extension of the pipeline provides for the possibility of new customers connecting to the heat the supply system, which generates additional revenues to Toplana.

The plan of reconstruction predicted the following activities:

- Replacement of the worst network sections
- Replacement of valves in chambers and other components

The objectives of the implementation of reconstruction are:

- Reduced heat and water losses
- Improved reliability and quality of heat supply
- Reduced maintenance costs

With reconstruction of primary network, it is envisaged that in the 2020, the savings realized in fuel economy (compared to projected consumption without the implementation of reconstruction) of 1395 t of heavy fuel oil, which is around 15578,7 MWh of thermal energy, which would result in a reduction in CO_2 emissions of around 4346,47 t.

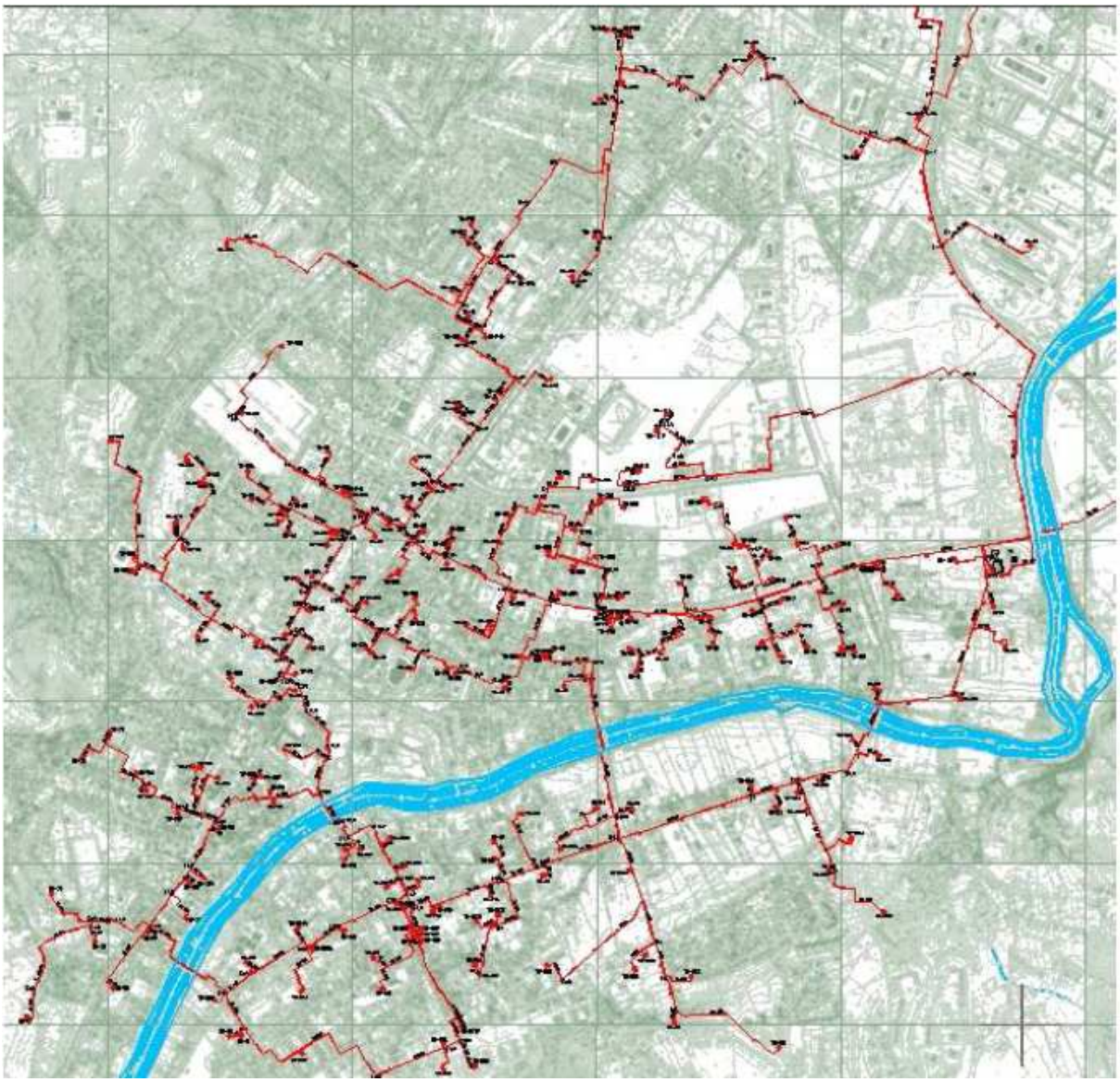


Figure 12 Schematic primary pipeline and substation plan for the network

Secondary network and its modernization

The total length of the secondary network is about 110 km of pipelines. Parts of the pipelines secondary networks are damaged due to corrosion. The corrosion and other substances in the water tend to block the secondary pipes, preventing customers from receiving the amount of heat they should receive, and therefore, the damaged sections should be replaced. The secondary networks receive the heat and make-up water from the primary network, through the substations, but due to the lack of heat meters (in buildings) and flow meters (in substations), the amount of water losses in each section of the secondary pipelines is not known.

The plan of reconstruction, predicted the following activities:

- Replacement of the worst network sections
- Replacement of valves in a chambers and other components

The objectives of the implementation of reconstruction are:

- Reduced heat and water losses
- Improved reliability and quality of heat supply
- Reduced maintenance costs

With reconstruction of secondary network, it is envisaged that in the 2020, the savings realized in fuel economy (compared to projected consumption without the implementation of reconstruction) of 1,170 t fuel oil, which is around 13,066 MWh of thermal energy, which would result in a reduction in CO_2 emissions of around 3,645.4 t.

The substations

Present situation

Heat transfer from primary to secondary distribution network, is achieved through heat exchangers which are located in substations. According to obtained data in the Study [1] is indicated, the following condition. The total number of substations is 209. Of these, 188 substations are operational, while the remaining 21, which served old industrial facilities, are now out of operation. About half of the operational substations are owned by Toplana, and the others are owned by consumers. It is anticipated a growing number of substations installed in new buildings will be owned by the building developers and later owned by the flat owners. The existing substations are obsolete, involving outdated technology. They are equipped with heat exchangers, control valves, and only some of them with heat meters. Some of the heat exchangers are leaking water.

The plan of modernization of substations

It is proposed to modernize all the substations that are connected to Toplana network and are operational. For this purpose it is necessary to carry out:

- Replacement of control valves and automatic regulators,
- Replacement of heat exchangers, if necessary,
- Installation of water flow meters between primary and secondary networks,
- Installation of heat meters,
- Automation.

The objectives of the implementation of modernization are:

- Cost savings,
- Improved comfort and service to customers,
- Measurement of heat consumption of each group of buildings supplied by each substation,
- Monitoring of water consumption in secondary networks and buildings.

With modernization of substations, it is envisaged that in the 2020, the savings realized in fuel economy (compared to projected consumption without the implementation of modernizations) of 720 t heavy fuel oil, which is around 8,040.64 MWh of thermal energy, which would result in a reduction in CO_2 emissions of around 2,243.33 t.

Installation of heat meters in buildings

According to data obtained in the Study only about 5% of heat sales are based on heat meter readings. It is proposed to install heat meters in all customer buildings to facilitate monitoring of heat consumption in each building, and, in that way, creating the conditions for payment based on actual consumption of heat energy. In addition, it will be possible to monitor the heat losses in the secondary networks, helping to locate pipelines needing replacement.

As a result of implementing these activities, it is envisaged that in the 2020, the savings realized in fuel economy (compared to projected consumption without the installing of heat meters) of 45 t fuel oil, which is around 502.54 MWh of thermal energy, which would result in a reduction in CO_2 emissions of around 140.3 t.

Plans for the development of district heating in Banja Luka in the period from 2010 until 2020

In the draft of the Urban plan for the City Banja Luka for the period from 2008 until 2020 [2], building of a new plant in an urban area and their involvement in district heating system of Banja Luka are planned. For this reasons, creation of appropriate Feasibility Studies for new district heating systems in predicted areas is planned in this Report, which would, among other things, suppose to provide answers about the size of the heat consumption, the type of energy source that could be used in a planned heating plants, the possibilities using of renewable energy sources (geothermal, biomass, etc.) in the City district heating system, etc.

Conclusion

Total investment funds needed to invest in the district heating system of Banja Luka, to achieve the planned reduction in CO_2 emissions in 2020, as stated in the document "Sustainable Energy Action Plan of the City of Banja Luka, amounts to 36.5 million Euro (Figure 13 and Figure 14).

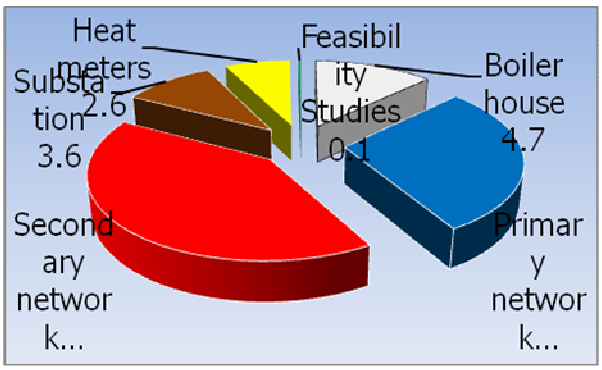


Figure 13 Provided investments in the district heating system of City Banja Luka, in the Action Plan, until 2020 in millions of Euros per sectors

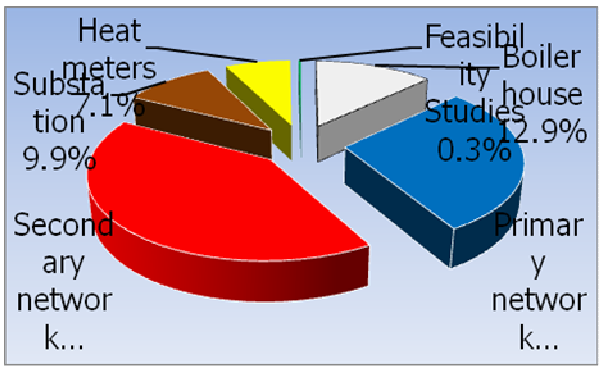


Figure 14 Provided investments in the district heating system of City Banja Luka, in the Action Plan, until 2020 in percents per sectors

As a result of the implementation of measures envisaged in the Action Plan, in 2020, in the district heating system of Banja Luka, it should be achieved through reducing fuel oil consumption of 4,500 tons (Figure 15 and Figure 16), compared to a scenario without the implementation of

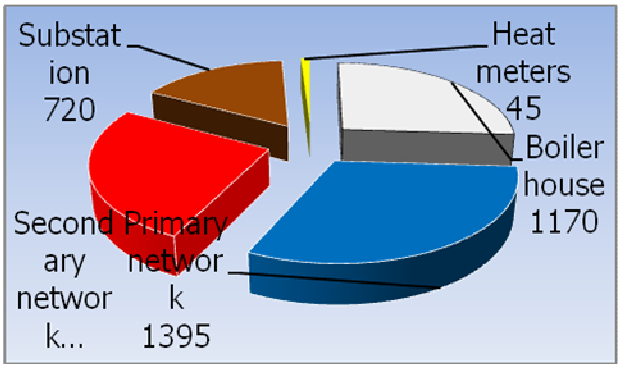


Figure 7 Expected reduction in fuel oil consumption in the district heating system of City Banja Luka as a result of implementation the Action Plan in 2020, in tons per sectors

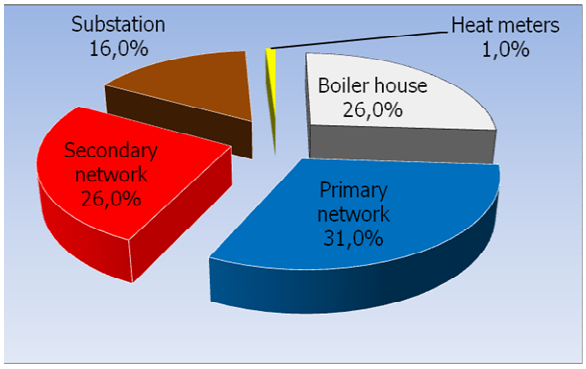


Figure 8 Expected reduction in fuel oil consumption in the district heating system of City Banja Luka as a result of implementation the Action Plan in 2020, in percent per sectors

these measures, which corresponds to 50,293.88 MWh of thermal energy (Figure 17), and a decrease in CO_2 emissions from 14,020.92 tons (Figure 18).

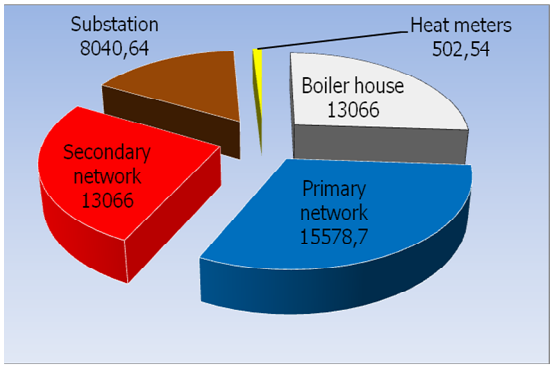


Figure 9 Expected savings in thermal energy in district heating system of City Banja Luka as a result of the implementation the Action Plan in 2020, in MWh per sectors

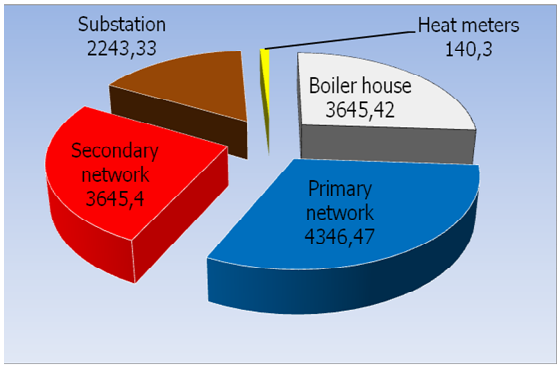


Figure 10 Expected reduction in CO_2 emissions in the district heating system of City Banja Luka as a result of implementation the Action Plan in 2020, in tons per sectors

BUILDINGS

The problem of analyzing the existing building stock is the lack of accurate and exact data. The last census, which collects detailed database of all buildings, was in 1991 and its partial results were published as an unofficial report and are very scarce. We used data from the Census and database of the Urban Institute of Republic of Srpska. After the 1995 a statistical data on construction of collective residential buildings have been collected, while data on public, business and individual housing have not[4].

Age of physical structures constructed in the area of the city is different. The inner-city area has somewhat preserved its building fund, that is, buildings from the period of the Austro-Hungarian

[4] We studied in parallel the census of 1981, 1991, the Urban Plan 1993, and 2015 trying to get to the more reliable data on the fund built building in the area of Banja Luka.

occupation and the period of the Kingdom of Yugoslavia. Unfortunately, their number is not great because there was a catastrophic earthquake of 1969. Construction after the earthquake has demanded quick building, and entire settlements were built by application of prefabricated construction (Borik). At that time, a large number of temporary prefabricated buildings were built. Development of the city is experiencing stagnation from 1990 to 1995. Post-war building is characterized mainly by housing - family building, and buildings for collective housing, as well as business and commercial buildings.

The energy losses in buildings directly depend on the age structure, which is associated with the technology and materials for construction, quality of construction, maintenance and regulations in force at the time of construction. The oldest buildings date from the late 19th and early 20th century, with performance of the ancient technique of building with very thick full-brick walls (from 38 to 90 cm). A huge number of buildings built from 1945 to 1970 used new materials and techniques because of the need for rapid construction and it is characterized by poor heat-insulated characteristics, which have emerged as result of lack of regulations governing the thermal protection of buildings. Adoption of rules and standards governing this area takes place between the 1970s and 1980s. Most residential areas built at that time with different prefabricated systems, with no or insufficient insulation thickness. Prefabricated wooden buildings are of very poor heat-insulation characteristics. In the period since 1980s construction was done in a better quality manner. The building regulations improved the quality of the walls used to build systems with thermal insulation. Regulations adopted in late 1990s are valid up to date.

The buildings constructed after the 1995 have the two typical cases - buildings which are derived from the solid parts of the thermal insulation layer and carpentry of questionable characteristics, and, as well as another group of buildings, particularly in the sector of individual construction, where we find a great number of houses which have not been completed. These buildings were partially completed, usually without insulation in attic or facade and are poorly insulated on the ground floor.

As for buildings constructed until 1980s, there is a possibility of reducing energy consumption by around 60%, even to 80%, with measures to improve energy efficiency of the building shell (thermal insulation of roofs, exterior walls, floors, better sealing, replacement of windows) and improving or replacing HVAC systems.

Possible energy savings - the approximate value that could be achieved during rehabilitation are as follows:
- 20 cm roof insulation present approximately 11% savings
- 12 cm of insulation of external walls is approximately 20-25% savings
- 6 cm insulation ground floor is about 6% savings
- Replacing windows with energy-saving glass 20% savings

Achieving greater savings, with a much greater insulation thickness, is not realistic to expect, because increased thickness requires all the details to be adjusted to it (for example, 20 cm of insulation on the façade, 30 cm in the roof and such), however, it is also possible to achieve this in some cases when the existing construction of the building enables it**.** This means that the lower the energy, consumption can be brought down the level of 70 to 30 KWh/ m²a, which corresponds to low-energy buildings in the EU

(Grubovisek, 2005). In certain cases, it is possible to reach the standards of passive buildings with only 15 KWh/ m²a of the energy needed for heating.

The consequences of war events accelerated construction for displaced population, whose family homes were not entirely finished. Their completion, that is, insulation of facades, with the final finish, as well as insulation of attics, garrets and last upper floors provides a big opportunity to improve energy efficiency and reduce energy consumption. Additional savings can be achieved by replacing the current biomass stoves with higher levels of efficiency. Reducing energy consumption in the sector of building management can be achieved by application of the European standards in construction. Standards of low-energy and passive buildings make a huge saving in buildings, which will be built in a very simple way and it can contribute to reducing energy consumption and thus carbon dioxide emissions.

It is necessary to do various activities to enhance public awareness of business entities - companies, institutions of public administration, as well as citizens of the need and importance of reducing energy consumption, as well as the possibilities of simultaneous execution of works to improve the comfort and energy recovery. All these activities should be accompanied by appropriate policies and incentives at the level of the city administration, to the credit lines of the banking sector. At the same time all these works, allow employment for more people, which is important for the economy and economic growth of the City.

For the illustration, it was estimated that, by the use of the above-mentioned measures only on the existing building managed by the City, it is possible to achieve savings of energy consumption of 36.000 MWh and emission reduction of 1.004,4 tCO_2 until 2020, while for the individual family houses it is possible to achieve reduction of 450 MWh and 1,632 tCO_2 per year.
An energy efficient building will contribute to achieving the goal to 2020: 20% reduction in carbon dioxide emissions, 20% of energy from renewable sources.

TRANSPORT

Transport is one of the most important areas of both other cities as well as of Banja Luka, i.e. it presents its blood stream. As the traffic is an important factor of economic and social development of the City, and an area without which development cannot even be imagined, it is in the interest of and a goal to the social community to increase the quality of the transportation system.

However, in addition to this positive dimension, traffic has its negative dimension as well. Namely, rapid development of the city, constant expansion of the street network and the expansion of the number of motor vehicles in the city area, taking into account all the surrounding areas depend of Banja Luka as an administrative, political, economic, cultural and sports center of the region, this has led to a number of negative impacts that traffic has on the quality of life in the city, such as environmental pollution, creating noise and vibration, big time losses due to traffic jams and a series of extraordinary events such as traffic accidents.

To reduce the large share of traffic in the total pollution of atmospheric air is necessary to carry out a series of activities that are classified into two groups. The first group consists of technical measures to improve the technical characteristics of motor vehicles, and the other group is the organizational measures.

Banja Luka should build its strategy on organizational measures that actually present implementation of the so-called 'clean' projects on the basis of which the environment will be protected, that is, emissions of harmful gases will be reduced, such as:

1. *The use of biodiesel in public transport passengers.* Biodiesel is a liquid non-mineral fuel produced from vegetable oils (turnip, soybean, palm ...), recycled waste of edible oil or animal fat with methanol transesterifakacion process. It has properties equal to those that have mineral diesel fuel and is used as its substitute, or it is added to it to a certain extent. By this , use of diesel fuel could be reduced by 20,848.50 l, which makes 450 MWh, i.e. reduction of 150 tCO_2.

2. Improvement of bicycle traffic. With construction of new and reconstruction of existing bicycle paths and lanes, and construction of parking for bikes, it is necessary to create conditions for equal participation of bicycle traffic in the traffic system of the city of Banja Luka as well as affect citizens' commitment to the use of bicycles, both in sports and recreation as well as for other purposes. By this project, the use of diesel fuel would be reduced by 1,675.642,00 l, which makes 20,169 MWh, which is reduction of 5,385 tCO_2 and gasoline 1,365,084.00 l, whuch makes 16,989 MWh, which is reduction of 9,782 t CO_2.

3. Extraordinary control of exhaust gases and technical safety of vehicles in order to increase the technical safety of public transportation vehicles and other vehicles involved in traffic, and thus cause an increase in technical roadworthiness and reduce greenhouse gases emitted into the atmosphere.

4. Establish a center for automatic control and regulation of traffic, which will result in much better regulation of traffic in a way that the regulation is momentarily, i.e. depending on the traffic load, therefore it would come to improving the throughput capacity of intersections, increase speed of movement, reduce time losses, air pollution, noise, etc.. By this project, the use of diesel fuel could be decreased by 2,393,774.00 l, which makes 28,814 MWh, which is reduction of 7,693 tCO_2 and gasoline by 1,950,121.00 l, which makes 24,270 MWh, which is reduction of 6,043 t CO_2.

5. Establish a Center to monitor public transportation vehicles within which there would be continuous supervision of movement of public transportation vehicles for passengers within precisely defined network of lines, and on the stations displays would be set up on the basis of which the passenger will know exactly in how many minutes the bus arrives. In parallel with the mentioned activities, a new way of collection of payment would be organized using electronic tickets. All of this would have the aim to increase the attractiveness of public transport to passengers and increase the number of passengers using public transport, that redistribution of way to travel in favor of public transportation, as well as mass transport of passengers, thus reducing the use of cars. By this project, the use of diesel fuel can be reduced by 722,750.00 l, which makes 8,699 MWh, that is reduction of 2,323 tCO_2 and gasoline by 1,725,750.00 l, which makes 21,477 MWh, which is reduction of 5,348 t CO_2.

6. Launching a campaign called 'Eco inspection in Eco vehicles, in which the city environmental inspectors perform their daily activities with electrically driven vehicles that are completely environmentally clean cars without exhaust gas emissions. In this way, Banja Luka, by its own example and its own behavior had a leadership role, and contributed to the development of ecological consciousness of its citizens.

By taking a series of measures in the field of traffic but also from all other areas, in order to ensure the continued development of the city on the one hand, and protection of the environment and reducing the level of emissions and noise on the other side.

POWER SUPPLY AND POWER CONSUMPTION

Electricity consumption in town area in 1990 was as follows:

Municipal buildings and facilities	3.2 GWh
Tertiary (non-municipal) buildings and facilities	58.2 GWh
Residential buildings	171.9 GWh
Municipal public lighting	3.9 GWh
Industry (MV and HV consumption)	193.5 GWh
TOTAL	430.7 GWh

Based on data for the base year of 2009 and on City Development Strategy for Period 2007-2015 and other relevant decisions of the City Assembly of Banja Luka and other relevant authorities, projects described below are proposed in order to achieve set targets for CO_2 emission reduction.

Municipal Buildings, Equipment/Facilities

Installation of energy efficient lighting

All facilities should be fitted with energy efficient bulbs and lamps instead of incandescent light bulbs and standard neon lamps Standard old generation lamps should be replaced with energy-saving lamps and bulbs with superior technical characteristics. Meeting this objective requires the following:

- Replacement of all conventional (standard) lamps with energy efficient lamps with superior technical characteristics

Effects of savings which can be achieved in this way can be 440 MWh and emission reduction of CO_2 448t.

Tertiary (Non municipal) Buildings, Equipment/ Facilities

Installation of energy efficient lamps

All facilities should be fitted with energy efficient bulbs and lamps instead of incandescent light bulbs and standard neon lamps. Old generation lamps should be replaced with energy-saving lamps and bulbs with superior technical characteristics. Meeting this objective requires following:

- Replacement of all conventional (standard) lamps with energy efficient lamps and bulbs with superior technical characteristics

Effects of the savings which can be achieved by this way can be 1,200 MWh and emission reduction of CO_2 1,220.4t.

3. PUBLIC LIGHTING

3.1. Public lighting remote control

Public lighting should be turned on only in periods with low natural light illumination level. In summer, it should be turned on 1 hour later and turned off 1 hour earlier, compared to the winter. Meeting this objective requires the following:

- Installation of Ripple Control System (RCS) equipment in order to proved ripple control signal at all locations necessary
- Installation of RCS receiver at all public lighting installation within the reach of ripple control signal. Elsewhere, time-switches should be installed instead
- Adjustment of RCS system and time-switches time scheme according to the season (winter/summer)

Effects of savings which can be achieved in this way can be 792 MWh and emission reduction of CO_2 805.5t

3.2. Public lighting reconstruction

Standard old generation lamps should be replaced with energy-saving lamps with superior technical characteristics. Meeting this objective requires the following:

- Reconstruction of public lighting and installation of energy efficient lamps with superior technical characteristics and longer life span
- Installation of auxiliary equipment accompanying new energy efficient lamps

Effects of savings which can be achieved in this way can be 990 MWh and emission reduction of CO_2 1,007t

Residential

Installation of energy efficient lamps

All facilities should be fitted with energy efficient bulbs and lamps instead of incandescent light bulbs and standard neon lamps. Old generation lamps should be replaced with energy-saving lamps and bulbs with superior technical characteristics. Meeting this objective requires the following:

- Replacement of all conventional (standard) lamps with energy efficient lamps and bulbs with superior technical characteristics

Effects of savings which can be achieved in this way can be 340 MWh and emission reduction of 345.78tCO_2

Other – Electrical Engineering

Construction of hydropower plants and small hydropower plants

Construction of hydropower plants and small hydropower plants with total generating capacity of 100 MW is anticipated in the Master Plan for the City of Banja Luka. Meeting this objective requires the following:

- Estimation of environmental impact and construction justifiability
- Construction of hydropower plants and small hydropower plants

Reconstruction of small hydropower plant „Delibašino selo"

Reconstruction of the first hydropower plant "Delibašino selo", with installed generating capacity of 4.1 MW, is anticipated in the Master Plan for the City of Banja Luka as well as with investment plans of the Power Utility of the Republic of Srpska (ERS). Meeting this objective requires the following:

- Revision of project documents
- Reconstruction of powerhouse
- Construction of a new dam in accordance with project documents

Modernization and reconstruction of distribution grid

Modernization and reconstruction of distribution grid, accompanied with upgrade of MV level to 20 kV in the whole city area. Reduction of distribution losses bv 3%. Meeting this objective requires the following:

- Replacement of all 10 kV lines with new 20 kV lines
- Upgrade of all MV/LV transformer substations to 20 kV level
- Energy meters in all transformer substations

Effects of savings which can be achieved in this way can be 15,000MWh and emission reduction of CO_2 1,5255t.

Construction of roof-mounted PV system at municipal buildings

Construction of demonstration project roof-mounted PV systems with Crystalline silicon PV modules at several municipal buildings with total generating capacity of 50 kWp. Meeting this objective requires the following:

- Usage of the Covenant of Mayors' Office in order to gain technical support for this sort of projects, and to learn of PV projects best practices financed by the EU, all with best possible preparation of project documentation in mind
- Installation of solar cells.

Construction of wind turbine system at Banj Brdo

Construction of demonstration project of novel vertical axis wind turbine (VAWT) technology at main Banja Luka's picnic ground "Banj Brdo". With this project, this very popular tourist facility ran by the municipal authority should become energy self-sufficient facility. Meeting this objective requires the following:

- Preparation of project documentation in close cooperation with local inventors and producers of this system,
- Installation of the turbine at Banj Brdo.

RENEWABLE ENERGY SOURCES

Geothermal energy

The first estimate of geothermal potential of hidrogeothermal resource on Banja Luka territory, with a view to using it for supplying the heating network and other purposes was done a long time ago in 1992. The conception analyzed the possibility of heating of the City of Banja Luka, which had been, until that time (as it still is today) realized in a classic manner. The most urban part of city was heated by burning heavy oil at the heating plant, and the second, bigger part of the city was heated individually, in different ways. The main fuel – heavy oil is provided from abroad. This fact is one, among other things, that initiates the need of finding a new source of thermal energy, as its partial or complete substitute, as well as the necessity of encouraging domestic local energy. Geothermal energy from thermal waters, which is accumulated in sediment-rocks, of Mesozoic age, on the territory of the City of Banja Luka, is energy which can partially, if not completely, replace heavy oil in heating of the City of Banja Luka.

The concept-maker of this possibility to heat the City of Banja Luka with GE and its using for other purposes is late Jovan Perić, a Construction Engineer, who was a full-time Professor at Mining and Geological Faculty in Belgrade. He was the main Project Engineer in „ Project of regional research of epicenter earthquake areas from 26th to 27th October 1969 for seismic macro-regionalization of the area". According to that idea, Banja Luka should have built one deep well cca 2000m, with the target to define conditions and possibilities for using GE of underground water with temperature of 90^{o}C. That idea has not been realized until today.

On the basis of the Study, it was determined what is geothermal energy potential, and whether these were assessed:

1. Quantity of heat energy , which can be obtained from the city territory
2. Geothermal exploitation reserves of GE in the Banja Luka basin
3. Possibility of economic usage for heating and other purposes
4. Possibility of usage for production of electrical energy using binary power plant
5. Possibility of long-term economic policy and strategy of industry and city government for using GE.

In relation with the aforementioned, a number of questions arises, which are very important for investors and designers, too:

1. Can heat energy, from deep geothermal resource (2000 do 2500 m), realize self-sustainable heating system?
2. In which time can return of invested assets be expected?
3. Are our legal regulations in this area incentivizing and compatible with the European one?
4. With which incentive measures should the country encourage investors and the like?

Banja Luka, as the main city of the RS, and the second city in B&H, in terms of its size, is located in the Vrbas River valley, underneath which, in the layers of the Pannonian basin, there are porous water-resistant lime and dolomites, with sediments of Mesozoic age rocks. In the area of this basin, these rock masses are known as agents of geothermal waters, which may be used in the Banja Luka heating system (in three regimes of 130/90^{o}C, 90/70^{o}C and 70/50^{o}C), as:

1. Economic replacement of fossil fuels,
2. Additional heating source within the actual heating system
3. Individual source of heating energy for future expansion of the city systems of central heating.

Regional and geothermal characteristics by territories and close-vicinity surroundings of Banja Luka basin:

1. Project external temperature for Banja Luka, T_o=15^{o}C

2. Value of thermal flow in the Banja Luka territory basin and it's environment, according to OGK, have normal average value thermal flow for the continental part of Europe, 60 mW/m^2

3. Parameters of regional geothermal models of the Eerth's crust in the territory of Banja Luka, which are certainly defined two parameters:

    - Depth of the Earth's crust, 32 do 33 km

    - Depth of "sediment layer", depth to base sediment, from 2 to 4 km.

Hydro-geothermal (contemporary) and palaeo-geothermal phenomena (thermal sources and skin-deep sources) present the main indicators of presence of hydro-geothermal systems in the Banja Luka basin. Their place in territory and geographic arrangement show that presence of system, which is certainly bigger than area of the basin.

New hydro-geothermal phenomena:

Site	The approximate elevation of spring-type sources	Drilled wells	Measured temperature values.	Thermal water is used for
1. Šeher	165 altitude - Broken spring of Artesian type	1.one depth 150m 2.one depth130 m	t_{min}=30^{o}C t_{max}=35 ^{o}C	1. Balneology 2. Heating with heat-pumps
2. Slatina	205 altitude -Broken spring of Artesian type	1. No significant amounts of CO2 –thermal sources, drilled well, SB-1, SL-1, SB-3, P-1, 205 altitude 2. Sources of CO2 gas, the so-called "Slatinska Ilidža-Kiseljaci" 3. Groups of sources of CO2 gas, with two drilled wells SL-2, and "Longhole of the Slatina spring", 150-160 altitude.	t_{max}=44 ^{o}C	1. Balneology 2. Heating with heat-pump (40 l/s,for heating "Slateks" with heat pumps)
3. Laktaši		126 altitude. Plus 2 thermal waters in the area of Laktasi. 1. The river Vrbas t_{max}=23^{o}C , 2. Way Laktaši–Petoševci t_{max}=26,5^{o}C	t_{max}=26-32^{o}C	20 l/s 1. balneology 2. Heating with heat-pumps.
3. Priječani		180 "Ilidža"	t_{max}=16^{o}C	

Building of the four deep geothermal examinational wells BLB-1, BLB-2, BLB-3, BLB-4:

Self-flow	$Q_{min}=m\cdot c_v\cdot\Delta T= 60\cdot 4,2\cdot(80-15)$	16.38 MW

	$Q_{max}=m\cdot c_v\cdot\Delta T= 160\cdot 4,2\cdot(85-15)$	47.04 MW
Flow with pump	$Q_{min}=m\cdot c_v\cdot\Delta T= 120\cdot 4,2\cdot(85-15)$	35.28 MW
	$Q_{max}=m\cdot c_v\cdot\Delta T= 200\cdot 4,2\cdot(90-15)$	63.00 MW
DIRECTLY USING → $Q_{max}=m\cdot c_v\cdot\Delta T= 1000\cdot 4,2\cdot(90-15) =315$ MWt o Operating reserve GE, censused cca 1000 l/s from geothermal fluid o Average temperature 90 ^oC **FOR CASE "DUBL" USING → $Q_{max}=2000\cdot 4,2\cdot(90-15)= 630$ MWt** • Estimated capacity cca 2000 l/s from geothermal fluid • Average temperature 90 ^oC (ΔT= (90-15=75 ^oC)		

Provided activities for building of examinational geothermal drills:

Main hydro-geologic collector by thermal water is in karstified carbons rocks masses medium and upper trias old.

- Depth above 2000 m,
- Total depth collector is above 1500 m.
- Drill across this collector do to advent main tunnels and caverns, to advent eruption thermal water.

Examinational drill number.	Site	Forecast HG area cut and ED construction drills	Regime and technology building ED	Advent thermal waters and gasses	Expected pressures
1	2	3	4	5	6
BLB-1	In the site of the factory Incel Banja Luka	Source		Depth 100-500m (20-40^oC), gases	Sources
BLB-2	Place Pišteljić				
BLB-3	Factory Trapisti				

BLB-4	Place Luke			
BLB-5	Duboki Potok		• 18 do 20 °C	•
BLB-6	Prijakovci	Structural-piezometar drill	• In depth of 70 to 80m (level self-flow 170 altitude)	
BLB-7	Village of Trn			

Advent of thermal water at the depth of:

Depth	Expected temperature of thermal waters	Comment
100-500 m	20 to 40 °C	
to 2000 m	60 to 70 °C	→ possible advent gasses CO_2 i H_2S
From 2000 to 3000 m	80 to 110 °C	→ possible advent gasses CO_2 and small quanttoH$_2$S

Calculated amounts of geothermal energy reservoir of the Banja Luka valley indicates the validity of preliminary design plants to produce electricity. Since the temperature of geothermal water is less than 100 ° C, a binary cycle may be used for production, converting heat energy into mechanical energy of water and then, through a generator into electrical energy. Optimization of the plant is performed according to the selection of the most suitable working media. Selection criteria for the working fluid selection are that plant has to reach the highest energy and thermodynamic efficiency. Is was estimated that, with this project, effects of savings could be 8.760 MWe/god , which makes emission reduction of 8.908,92 t CO_2.

Given that the current level of development of geothermal technology in such a world, that in every part of the Earth's surface seeks to enable the national exploitation of geothermal energy at a price that is comparable and often lower than the price of energy derived from fossil fuels, we should endeavor to follow the trend and code. It has a great expansion in research and the pure energy of ecological importance, but in our climate, in the territory of former Yugoslavia, in recent years is evident stagnation of economic research for known financial reasons. However, due to the increasing energy crisis that fits into the world, it is important to start research and find ways to contain the use of this form of energy. The reasons for this are multiple: economic, environmental and energy (E3). In the Republic of Srpska it is possible to produce electricity from geothermal resources. It is believed that it is justified to develop and build a 1 MW binary plant at the location of the Banja Luka valley. Based on calculations conducted using thermodynamic model plant and thermodynamic analysis of the evaluation process. Obtained a competitive price is the price of electricity from conventional fuels and fits in the average interval price of electricity in the European energy system.

Biogas

Biogass is one of very interesting and important energy sources in the world in the class of renewable sources of energy. It can have a big role in the area of energy sector of Republic of Srpska, because it has realistic potential for that. In the future, renewable sources of energy must become an imperative for production of energy. This could be realized on farms, using various types of waste (animal excrements, feces and urine, agricultural waste, etc.) for production of biogas.

Biogas is one such fuel provided from renewable energy sources. It is obtained by methane fermentation, i.e. anaerobic fermentation of organic substances. It is an ideal energy source for several reasons: biomass energy is accumulated in living organisms, and it is therefore practically indestructible; sources for obtaining biogas are numerous, investments in equipment are relatively small, the remains after the fermentation is the first -class organic fertilizer, protection of the environment is dealt with at the same time, and so on.

For cost-effective waste raw material for production of biogas we think the one of which there is a sufficient amount throughout the year and which is of the appropriate composition (the contents of microbiologically degradable ingredients), no toxic substances and the like.

Liquid or semi-liquid manure, which is waste from livestock production, is an excellent raw material for production of biogas. It consists mainly of animal waste, excrements (feces and urine), residues, straw and other material from litter, and inorganic impurities. Production of manure is not the same since the beginning of breeding of certain animals; it increases with the animal weight increase. In this context, biogas production is higher with an increase in the production of manure. Approximately, it can be counted on getting 0.4 to 0.6 m3 of biogas per kg of entries, that is, 0.8 to 1.0 m3 / kg of decomposed organic components of liquid manure. Relationship between the amount of biogas, liquid manure from milking cows (KM), breed cattle (BC), swine (S) and poultry (P), a rough estimate can be based on the proportions: KM: BC: S: P = 5: 7: 8 :1 0 (Gacesa et all, 1985).

Resulting biogas is used in different ways to produce heat, start up engines, to produce electricity and so on.
Under normal operating conditions of methane process of fermentation, it is produced around 660 to 1100 l / kg (liters of biogas per kg of fermentation decomposed organic substance), and its heat value is from 21 to 26 MJ/m3. It mainly depends on the content of CO2 in it. But for most of the calculations, it is taken that biogas heat value is of about 23 MJ/m3. If there is more than 40% of CO2 in the biogas, it virtually becomes incombustible (by removing CO2 from biogas, its heat value would get very close to the heating value of pure methane, which is 35.8 MJ/m3).

According to the aforementioned, a project of biogas production was foreseen at cattle farms on Manjaca Mountain. Using assessments related to the animal fund in this area, it can be calculated that it is possible to produce 17,747 MWh/year of heating energy and reduce 7,152 tons of CO2,as well as 12,059

Biogas is used to cover the energy needs of households, for heating of rooms, drying hay, grain and vegetables, and depends on a number of factors, such as plant capacity, type of raw material that is

subject to anaerobic fermentation, seasons, weather conditions, etc.. Due to necessity to consider these options, it is necessary to build on every farm an annual energy production and consumption plan. .

Biomass

Biomass as a sink

The process of photosynthesis, as a fundamental natural process by which CO2 is attached from atmosphere, also represents a fundamental process in production of organic substance. Increment of biomass is a measurable indicator and it is directly proportionate to the amount and intensity of attaching of CO2 from the atmosphere. The basic measure of the CO2 sink from the atmosphere is the increment of timber, which for the forest in the territory of the City amounts to 219,360 m3. It should be noted that forests represent a long-term sink, because the CO2 through a timber bound for a longer period.

It is possible to significantly increase the given amount, through the activities related to the proper management of existing forests, as well as through creation of new forests. Through projects defined within the SEAP, in the period until 2020, it is possible to realize an additional reduction of CO2 in the amount of 16,484 tons, or the equivalent of 68,699 MWh.

Biomass as an energy source

Form of a settlement structure of the City, degree of urbanization and level of coverage of district heating resulted in the fact that wood is the basic energy source used for heating in households and this being in an estimated annual amount of 360,292 m3.

Using wood waste from forestry and sawmill production is present in negligible amounts, although it should be pointed out that the launching of Wood Processing Industry Vrbas, as a significant undertaking, which generates large quantities of wood waste will renew that issue.

According to the fact that district heating system covers only about 35% of the city needs, the rest is made of individual stoves. Because of the large part of small existing boiler rooms has been technologically overcome, in addition to using large quantities of the fossil fuels, they also represent a very serious problem for the environment. In the scope of the SEAP, some projects has been applied, which have the aim to replace the existing boiler rooms running on coal with the modern boiler rooms based on biomass., which would results, according to estimates, in savings of about 9.745.9 MWh and reaching of CO2 emission reduction of about 3,450t CO2. Promotional activities which could contribute to installation of the household boiler rooms, according to estimation can make energy consumption savings of 16,243.2 MWh and make emission reduction of 6,546t CO2. It is important to mention that in Banja Luka some forms of ESCO (Energy Saving Company) has already appeared, primary related to biomass. In short, in the parts of City where building blocks already exist and which are not in the range of district heating system, some private companies dealing with heat supply have already appeared. Continuation and growth of this trend can be expected at a level acceptable from the logistic and spatial planning aspect in the City.

Solar Energy

Banja Luka is the city placed in a continental zone, though, regardless to that, production of solar energy should not be neglected. Primarily, we should thereby consider promotional activities leading to home installation for hot sanitary water production. That will be particularly important taking into consideration that most of the households do heating of sanitary water by electricity at the moment, which is not rational and it has becoming increasingly expensive.

A Project proposal, which can lead to the promotion of the households solar system installation, can make annual savings of about 2,160MWh/year and CO2 emission reduction of about 2,196.72t CO2.

Another aspect of solar energy usage are photovoltaic systems, but potential projects related to this issue are already mentioned in the chapter related to the electrical systems.

IMPLEMENTATION, MONITORING AND REPORTING

Implementation

The implementation of the SEAP is a step that takes the longest time, efforts and financial means. This is the reason why mobilization of stakeholders and citizens is critical, which implementation of the very SEAP mostly depends on. The role of a Council at the City level is significant, which would coordinate all the activities between citizens and stakeholders, and it would, to a significant extent, perform promotion of all the activities and it would encourage institutions and citizens to get involved into the realization of SEAP. Motivation is an important factor, as people need to be encouraged and motivated to get engaged in the realization of SEAP.

During the implementation phase, it will be essential to ensure both good internal communication between different departments of the local authority, the associated public authorities and all the persons involved into the implementation process, as well as external communication (citizens and stakeholders). This will contribute to awareness-raising, increase the knowledge about the issues, induce changes in behavior, and ensure wide support for the whole process of SEAP implementation.

Monitoring of progress and energy/CO2 savings is an integral part of SEAP implementation. Finally, networking with other local authorities developing or implementing SEAP, will provide additional value towards meeting the 2020 targets by exchanging experience and best practices, and establishing synergies. Networking with potential Covenant of Mayors signatories, and encouraging their involvement in the Covenant of Mayors is also recommended.

Some tips to put a SEAP into practice:

- Adopt a Project Management approach: deadline control, financial control, planning, deviations analysis and risk management. Use a quality management procedure.
- Determine responsible institutions and persons for the implementation of SEAP (Council for Climate Changes, city agencies, city departments responsible for SEAP implementation, etc).
- It is necessary to prepare specific procedures and processes aimed at implementing each part of the project. A quality system is a useful tool to make sure that procedures are in accordance with the objectives of SEAP implementation.

- Establish a score-card system for tracking and monitoring of SEAP. Indicators such as percentage of compliance with deadlines, percentage of budget deviations, percentage of emissions reduction with the measures already implemented and other indicators deemed convenient by the local authority may be proposed.
- Plan the follow-up with the stakeholders establishing a calendar of meetings and workshops in order to inform them. Interesting ideas would certianly be accepted during the mentioned meetings.
- Anticipate future events and take into account negotiation time and administrative steps to be followed by the public local and Republic administration bodies, which are necessary for successful startup of the project. Public projects have long time of implementation, and for that reason, it is highly necessary to have precise planning, which is a basis for successful implementation of SEAP.
- Council on Climate Changes at the City level has to propose and inform the members directly engaged in the implementation of SEAP as well as other stakeholders about additional education and include them into the activities related to SEAP implementation.
- To the largest extent, staff from the Council should be educated, in order to create a strong team working on the SEAP implementation, as it is to be expected that those people in the Council are, to a significant extent, familiar with all the former activities in this area.
- It is necessary to inform the Assembly of the City of Banja Luka and the Mayor about activiteis related to the implementation of SEAP, and at least once a year, that is, more often if they require so, in order to have insight into the level of implementation and in order to have their obligations presented to them in the following period.
- For implementation of some of the SEAP activities, it is necessary to perform previous checks, such as pilot or demonstration projects, in order to establish justifiability behind realization of certain activities.

Overview Table of Parties Responsible for Actions

No.	Institutions/individuals	Activity
1.	Mayor	
2.	City Assembly	
3.	Council on Climate Changes	
4.	City Departments	
5.	City Development Agency of Banja Luka	
6.		
7.		

Overview Table of Estimated Costs and Possible Sources of Funding per Actions

Implementation of this Action Plan requires certain financial assets that are preliminarily estimated for each of the planned project activities. At this moment, it is not possible to make accurate prediction of the necessary funds for some project activities and, for such projects, it will be necessary to develop additional feasibility studies, elaborated reports, measurements or other activities, which will more accurately define the necessary means for their implementation.

It should be stressed here that project activities under this Action Plan are planned to be financed from a number of available sources.

The City of Banja Luka will finance one part of these project activities, from its own funds, that is, from funds which are, for this or similar purposes, regularly planned in the annual budget of the City.

The second part of the planned activities will be financed from the budget of other relevant organizations, institutions and competent ministries of the Government of the Republic of Srpska and Bosnia and Herzegovina. For example, there is a Fund for Environmental Protection in the Republic of Srpska, which should soon be transformed to include energy efficiency in the scope of its activities. It is necessary for the City of Banja Luka to initiate, in the set out procedures, acceleration of activities on transformation of the Fund, in order to start as soon as possible with its active work.

In addition, as perhaps the most important sources of funding for project activities, during the implementation period, there will be continuous exploration of opportunities for funding and co-financing of project activities through the European funds, including donations and favorable loans from various international institutions (EU, EBRD, WB, UNDP, etc. .), as well as by potentially interested private and institutional investors, either through programs of public-private partnership, or other available models of funding.

In this process (as well as throughout the implementation of the plan), an especially important role is to be played by a body competent for implementation of this Action Plan, which is planned to be established. Given the complexity of the project and the number of planned activities, it is necessary, as soon as possible, to start with establishment of this body to begin the realization of these activities. This is particularly important because of the need of fund-raising to finance these planned activities. The fact is that the procedures for obtaining certain financial assets are quite often long and require a lot of documentation and it is therefore important to get into this process as soon as possible.

Also, taking into account the fact that it will be necessary to ensure involvement of the wider community for implementation of some of project activities, a possibility of incentivizing participation of as wider population as possible, citizens, companies, organization and institutions through certain models of subsidies, deferred payments or other available models, especially in the areas of buildings, district heating, transport and land use planning.

The following table presents an overview of planned activities and projects with estimated costs, grouped by sectors as in the original table. The table shows estimated costs of activities, estimated reduction of CO_2 and calculation, where it was possible, of the average cost of reduction of a ton of CO_2. In addition, the table shows predicted start time and duration of individual activities.

Parameters such as the estimated cost, estimated reduction of CO_2 and the average cost of CO_2 reduction per ton and the very nature of certain activities may be used for assessment and classification of activities by specific priorities and opportunities for funding and implementation in the planned period. For some projects, it was not possible to quantify the estimated reduction of CO_2 and therefore, for the purpose of finding sources of funding, they can be evaluated more by the nature of the project and on the basis of detailed descriptions that are attached to this document.

The body predicted for the implementation of the Action Plan will, as part of its activities, elaborate on individual projects in details and provide more technical support needed for their implementation.

No.	Project	Estimated costs (EUR)	Estimated reduction of CO_2 emission (t)	Cost of reduction (EUR/t)	Duration of project						
					2010	2011	2012	2013	2014	2015	201
	Buildings, equipment/ facilities and industries	**26,767,500.00**									
	Municipal buildings, equipment/facilities	*1,925,000.00*									
1	Improving energy efficiency of existing buildings	1,620,000.00	1,004.40	1,612.90							
2	Installation of energy efficient lighting	300,000.00	448.00	669.64							
3	Energy audit of Banjaluka City Hall	5,000.00	n/a	-!							
4	Improving energy efficiency of City Hall and promotion.	xx	n/a	-							
	Tertiary (non municipal) buildings, equipment/ facilities	*4,500,000.00*									
5	Improving energy efficiency of existing buildings - Tertiary	4,000,000.00	3,627.00	1,102.84							
6	Installation of energy efficient lighting	500,000.00	1,220.40	409.70							
7	Introduction of PV panels for lighting purposes	-	-	-							
	Residential buildings	*16,242,500.00*									
8	Improving energy efficiency of existing residential buildings parts	4,050,000.00	8,160.75	496.28							
9	Improving energy efficiency of existing buildings – residential (individual houses)	1,350,000.00	1,632.15	827.13							
10	Installation of energy efficient lighting	2,000,000.00	691.56	2,892.01							
11	Introduction of high efficient household biomass boilers - new generation	3,375,000.00	6,546.00	515.58							
12	Introduction of solar thermal panels for hot water heating in households	2,250,000.00	2,196.72	1,024.25							
13	Introduction of low temperature heat pumps for household heating using underground waters	675,000.00	62.77	10,753.54							

14	Improving energy efficiency of existing buildings – residential buildings	1,800,000.00	602.64	2,986.86								
15	Replacement of the existing old household coal boilers with the new generation of biomass boilers	742,500.00	3,450.00	215.22								

No.	Project	Estimated costs (EUR)	Estimated reduction of CO_2 emission (t)	Cost of reduction (EUR/t)	Duration of project						
					2010	2011	2012	2013	2014	2015	201
	Municipal public lighting	*3,800,000.00*									
16	Public lighting reconstruction	1,700,000.00	1,007.00	1,688.18							
17	Public lighting remote control	2,100,000.00	805.50	2,607.08							
	Other: energy efficiency inspection in buildings	*300,000.00*									
18	Energy audits	300,000.00	n/a	-							
	Transport	**9,000,000.00**									
	Municipal fleet	*80,000.00*									
19	Eco inspections in eco vehicles	80,000.00	n/a	-							
	Public transport	*3,620,000.00*									
20	The use of biodiesel in public transport	620,000.00	15.54	39,897.04							
21	Formation of Center for Monitoring of Public Transport Vehicles	3,000,000.00	8,671.00	345.98							
	Private and commercial transport	*5,300,000.00*									
22	Formation of Center for Automatic Management and Traffic Control	5,000,000.00	13,736.00	364.01							
23	Development of bicycle traffic	300,000.00	9,615.00	31.20							
	Other: control of vehicles										
24	Extraordinary control of exhaust gases and technical safety of vehicles	-	-	-							
	Local electricity production	**23,150,000.00**									
	Hydroelectric power	*8,000,000.00*									
25	Reconstruction of small hydropower plant „Delibašino selo“	8,000,000.00	13,627.80	587.04							

	Wind power	*50,000.00*									
26	Construction of wind turbine system at Banj brdo	50,000.00	32.31	1,547.51							
	Photovoltaic	*25,000.00*									
27	Construction of roof-mounted PV system at municipal buildings	25,000.00	56.44	442.95							
	Combined heat and electrical energy production	*75,000.00*									
28	Usage of bioass in the area of Banja Luka for the needs of heat and electrical energy production	75,000.00	19,416.70	3.86							

No.	Project	Estimated costs (EUR)	Estimated reduction of CO_2 emission (t)	Cost of reduction (EUR/t)	Duration of project						
					2010	2011	2012	2013	2014	2015	201
	Other: modernisation and recontruction of electrodistribution network and introduction of binary cycles based on geothermal waters	*15,000,000.00*									
29	Modernization and reconstruction of distribution grid	12,000,000.00	15,255.00	786.63							
30	Using the geothermal energy from longholes underground of Banjaluka's area for production electric energy by binary power-plant 1MW	3,000,000.00	8,908.92	336.74							
	Local district heating/cooling, CHPs	**39,685,622.00**									
	District heating plan	*36,500,000.00*									
31	Modernisation of the primary transfer and distribution network	10,500,000.00	4,346.47	2,415.75							
32	Modernisation of the secondary transfer and distribution networks	15,000,000.00	3,645.40	4,114.77							
33	Modernisation of thermal substations	3,600,000.00	2,243.33	1,604.76							
34	Modernisation of the boiler house at the company Toplana	4,700,000.00	3,645.42	1,289.29							
35	Installations of heat meters in buildings	2,600,000.00	140.30	18,531.72							
36	Feasibility Study of areas currently not included by the City District Heating system, pursuant to a new Urban Development Plan of the City of Banja Luka until 2020.	100,000.00	n/a	-							
	Other: Geothermal energy	*3,185,622.00*									
37	Using the geothermal energy from deep longholes in the area of Banja Luka for city heating - a study.	130,212.00	n/a	-							
38	Using the geothermal energy from deep longholes in the area of Banja Luka for city heating - geothermal investigated works	180,000.00	n/a	-							
39	Using the geothermal energy from ldeep ongholes in the area of Ban ja Luka for city heating .	2,875,410.00	31,156.49	92.29							

No.	Project	Estimated costs (EUR)	Estimated reduction of CO_2 emission (t)	Cost of reduction (EUR/t)	Duration of project						
					2010	2011	2012	2013	2014	2015	201
	Land use planning	**2,787,000.00**									
	Strategic urban planning	*1,112,000.00*									
40	Initiative for Changing Planning and Building Law Regulations	15,000.00	n/a	-							
41	Integration of Energy Efficiency Principles into the Bylaws of the City of Banja Luka	30,000.00	n/a	-							
42	Integration of Energy Efficiency Principles into the Spatial and Planning Documents of the City of Banja Luka	800,000.00	n/a	-							
43	Preparation of GIS on local green areas	120,000.00	n/a	-							
44	Local law on green areas	27,000.00	n/a	-							
45	Preparation of GIS on most important CO2 polluter in Banja Luka Municipality	120,000.00	n/a	-							
	Transport/mobility planning	*100,000.00*									
46	Repair of heat areas on parking places by formation of tree lines network	100,000.00	n/a	-							
	Other: Afforestation/landscape	*1,575,000.00*									
47	Accomplishment of natural regenerations in high forest with artificial interpolation	15,000.00	355.14	42.24							
48	Afforestration in degradated areas and bare soils	200,000.00	3,946.00	50.68							
49	Afforestration on bare soils in private ownership	125,000.00	1,973.00	63.36							
50	Afforestration of degradated and bare soils on Manjaca plateau	250,000.00	3,946.00	63.36							
51	Re-cultivation on Ramici dump site	60,000.00	1,973.00	30.41							
52	Research on potential sites/habitats for establishing of pilot plantations of poplar trees	125,000.00	3,946.00	31.68							
53	Landscape design ing of a new city park in Lazarevo with an alley along the Široka Rijeka	800,000.00	345.00	2,318.84							

No.	Project	Estimated costs (EUR)	Estimated reduction of CO_2 emission (t)	Cost of reduction (EUR/t)	Duration of project						
					2010	2011	2012	2013	2014	2015	2016
	Public procurement of products and services	**25,000.00**									
	Energy efficiency requirements/standards	*25,000.00*									
54	Preparation of a study on technical requirements for Energy Efficiency in Buildings, as a pre-condition for bringing a Decision on energy-efficient consumption in buildings in the municipality of Banja Luka.	25,000.00	99,561.15	0.25							
	Working with citizens and stakeholders	**7,115,000.00**									
	Advisory services	*3,700,000.00*									
55	EC Funding opportunities - technical support for project preparation, submission and implementation	1,200,000.00	n/a	-							
56	Establishment of institutional and business cluster for renewable energy and energy efficiency	1,200,000.00	n/a	-							
57	Construction & Energy	300,000.00	n/a	-							
58	Waste and Energy	1,000,000.00	n/a	-							
	3. Financial support and grants	*4. -*	*5.*	*6.*	*7.*	*8.*	*9.*	*10.*	*11.*	*12.*	*13.*
18. 59	Establishing bodies for implementation of SEAP	19. xxx	20. n/a	21. -	22.	23.	24.	25.	26.	27.	28.
33.	***Raising public awareness***	*2,150,000.00*									
60	Energy days	400,000.00	n/a	-							
61	EE Certification in Buildings	1,000,000.00	n/a	-							
62	WASTE2ENERGY	500,000.00	n/a	-							
63	Promotion of energy efficient lighting	150,000.00	n/a	-							
64	Promotion the geothermal energy as renewable source energy for heating	100,000.00	n/a	-							

	Banja Luka city										

No.	Project	Estimated costs (EUR)	Estimated reduction of CO_2 emission (t)	Cost of reduction (EUR/t)	Duration of project						
					2010	2011	2012	2013	2014	2015	201
	Training and education	*1,065,000.00*									
65	Training for improvement of energy efficiency in buildings	500,000.00	n/a	-							
66	Energy Efficiency in schools	250,000.00	n/a	-							
67	Development of Manuals for the Energy efficient designing	15,000.00	n/a	-							
68	Educating designers in Energy Efficient design	150,000.00	n/a	-							
69	Promoting the need of energy saving of in small and medium –size enterprises	150,000.00	n/a	-							
	Other: Promotion of passive solar buildings	*200,000.00*									
70	Pilot Project: Co-financing of building of low-energy and passive solar houses in wood in BH	xxx	1,088.00	-							
71	Pilot Project: Design and construction of the first passive solar school (Kindergarten) in Banja Luka	xxx	241.80	-							
72	Buildings of low-energy or passive solar colony	xxx	n/a	-							
73	Improvement of legislation and local policy	200,000.00		-							
	Other sectors	**500,000.00**									
	Other sectors: microclimate monitoring	*500,000.00*									
74	Microclimate monitoring in the City of Banja Luka	50,000.00	n/a	-							
75	Air quality monitoring in the City of Banja Luka	400,000.00	n/a	-							
76	GHG inventory for City of Banja Luka	50,000.00	n/a	-							

	TOTAL	**109,030,122.00**									

Monitoring and Reporting

Monitoring activities are an important segment of the realization of SEAP and project/program activities. Continuous monitoring of implementation plan will enable continuous improvement of action plan implementation process. The main activity is to define indicators for monitoring success of implementation programs, such as the amount of investment in projects to mitigate climate change, the amount of emission reductions, energy savings and other resources, reducing local pollution, promote international cooperation, media and professional interest for climate issues, the degree of public awareness of climate issues and others. In addition, the plan is to establish a database for monitoring and evaluation of achievements and establish a system for verification and record the results of all project activities under the auspices of the City's Council on Climate Changes and the establishment of systems for control implementation plans, continuously monitoring the implementation of individual projects and reporting on results achieved.

Local authorities are planning to organize monitoring and evaluation of the Action Plan, through a fundamental review of performance indicators for the implementation of the program.
Some of the indicators are:

- Quantities of reduced emissions and increase of the sinks
- Level of investment in projects to mitigate climate change
- Number of projects to mitigate climate change, international and domestic (executed, in the implementation and development)
- Number of new jobs accomplished by applying measures
- Proportion of domestic and imported components in Project
- Do adopted and developed new technologies
- Saving energy and other resources generated by applying measures
- Other positive effects of measures (reduction of local pollution, promote international cooperation, etc.).
- Media and professional interest in climate issues
- Level of public awareness on climate issues
- Other indicators specific to the application of the measures

For monitoring and evaluation of achievement it is necessary to establish the database, and for some indicators, such as for example the interest of public media and the level of public awareness, it is necessary to determine the initial state by interviewing people and so on.

City's Council on Climate Changes will be required to annually report on the results of the implementation of SEAP to the City Government (internal monitoring). The Covenant of Mayors will perform a control of SEAP every two years (external monitoring). The signatories of the Covenant are obliged to submit a Report every second year after submission of the SEAP, with the aim of evaluation, monitoring and verification of the results. A specific SEAP monitoring and reporting guidebook will be

published by the European Commission in 2010, which will define all the reporting procedures. The Report needs to include CO_2 emission inventory (monitoring of emissions). Local authorities encourage CO2 emission reduction in accordance with the Action Plan, though they may consider how this decrease may affect the economy or some resources, thus decreasing the emission reduction. The Council on Climate Change is obliged to, at least once in four years, to prepare a detailed report on the state of emissions (MEI) and submit it to the City's Assembly and the Covenant, i.e. Report on Realization is submitted without MEI in the 2nd, 6th, 10th and 14th ……year, while the Report including the MEI is submitted in the 4th, 8th, 12th and 16th … year.

The Implementation Report contains quantified information on measures implemented, their impacts on energy consumption and CO2 emissions, and an analysis of the SEAP implementation process, including corrective and preventive measures when this is required.

Report contains qualitative information on SEAP implementation too. It consists of analysis of current condition, and corrective and preventive measures. European commission will prepare a form for both reports, and the City Council on Climate Change of the City of Banja Luka will have to deliver it. Needed indicators are necessary in order to assess the progress of SEAP implementation, and progress of monitoring and reporting too. Specific guidelines for SEAP monitoring by the European Commission will give orientation for monitoring parameters that may be used.

Further implementation of the research will lead to the inclusion of climate changes in the broader process of sustainable development planning and sectoral development plans, regional planning, planning and design of buildings and settlements, the standards for the design and construction of hydraulic facilities and structures, institutional training for the application of modern methods of improving climate forecasts and climate research.

PUBLIC AWARENESS AND PROMOTION

Key role for local authorities

Local authorities have a key role in mitigating climate change. Over half of greenhouse gas emissions are created in and by cities and their surrounding areas. 80% of the population lives and works in cities, where up to 80% of energy is consumed. Local authorities, being the closest administration to the citizens, are ideally positioned to understand their concerns. Moreover, they can address the challenges in a comprehensive way, facilitating the conciliation between the public and private interest and the integration of sustainable energy into overall local development goals, be it development of alternative energy, more efficient energy use or changes in behavior.

Local governments must therefore become leading actors for implementing sustainable energy policies, and must be recognized and supported in their effort. The Covenant of Mayors is an ambitious initiative of the European Commission that gives the lead to Europe's pioneering cities to mitigate climate change

through the implementation of intelligent local sustainable energy policies that create stable local jobs and increase citizens' quality of life and address crucial social issues.
The formal commitment of signatories is translated into concrete measures and projects. Signatory cities accept to report and being monitored on their implementation of the Action Plans. They also accept termination of their involvement in the Covenant in the case of non-compliance.

Cities also commit to allocating sufficient human resources to the tasks, mobilizing society in their geographical areas to take part in implementation of the action plan, including organization of local energy days, and networking with other cities.

Working with citizens and key stakeholders

Citizens and stakeholder participation is an important dimension of the sustainable energy process for at least three reasons. First, a broad based group brings a breadth of knowledge information of the energy issues, its history and current situation and conditions. Secondly, a broad based group helps full acceptance of SEAP as the strategic orientation. Thirdly, work with citizens and stakeholders is a great tool to initiate possibilities for partnership, mutual actions and cooperation necessary for successful SEAP implementation.

1. Thus, SEAP contains actions (projects) that are focused on advocacy for improvement of legislation, policy and city's decisions in order to make easier investments and reduction of administrative barriers for improvement of energy efficiency, renewable energy sources and emission reduction of green house gases. Furthermore, in this part of SEAP, there are suggested activities for promotion of sustainable energy, emission reductions through the following actions:

- Strengthening public awareness and promotion of intelligent use of energy, renewable energy and GHG emission reduction through organization of Energy Days and permanent informing of citizens;
- Promotion and introduction of heat meters in households, apartments and public buildings,
- Networking and building of partnerships between public and nongovernmental sector (including private sector, enterprises, and nongovernmental organizations);
- Implementing of energy audits of public buildings, building under City authority and private buildings due to identification of reconstruction projects in order to increase energy efficiency, decrease energy consumption, decrease of operational costs and eventual changes of energy sources for single or group of buildings;
- Conducting of trainings for key stakeholders on technical and technological aspects of energy efficiency improvement, methods and tools for implementation of actions and projects, sources of finance, local legislation and EU directives;
- Promotion and research of best available techniques for intelligent use of energy, possibilities for their adoption to the area of Banja Luka, adequate waste management and treatment, use of waste as energy source;
- Education of young people in intelligent use of energy covering encouragement use of renewable energy sources, optimal use and impact on environment (global warming);
- Encouragement of initiatives for improvement of conditions in urban environment through energy savings and construction of health and environment harmless buildings;

- Promotion and strengthening public awareness on intelligent and sustainable construction, ecological materials and equipment, benefits that may be achieved by sustainable building;
- Promotion and achieving permanent and sustainable practice in use of biomass as energy source(waste from processing) and improvement of production conditions in accordance with the EU standards in process industries on the territory of the City of Banja Luka;
- Encourage and promote initiative for introduction of certification in buildings according to EU standards based on improvement of living conditions and improvement of energy efficiency.

The expected SEAP results in the field of work with citizens and stakeholders:

- Strengthened awareness of citizens and stakeholders on climate change, energy efficiency and sustainable energy sources;
- Gained trust and support from citizens;
- Educated employees in governmental institutions (municipal and republic) and organizations (governmental, quasi-governmental and nongovernmental), owners and managers of enterprises, and other stakeholders;
- Organization of Energy Days with goal of promotion of rational (intelligent) use of energy, renewable energy sources, and environmental protection. It is very important to note very important role of media promotion of main objectives of the Action Plan and future improvements in its implementation;
- Initiated and encouraged active involvement of civil (citizens') society into process of SEAP implementation;
- Established cooperation with nongovernmental and governmental organizations and networks from other cities that signed the Covenant;
- Affirmation of the Covenant and attracted other municipalities to join the process;
- Supported involvement of private sector in SEAP implementation;
- Built public/private partnership as the basement for implementation of plan and actions;
- Simplified procedures for investment in business and other projects for improvement of energy efficiency, renewable energy sources and reduction of green house gases;
- Reduction of heat energy consumption by controlling of delivered energy and changes in charging practice;
- Identified projects, secured financing, implemented and coordinated projects;
- Conducted energy audits in buildings according to the EU directives;
- Improved knowledge and information status of stakeholders on energy and financial potentials for energy efficiency improvement and methods for project implementation;
- Identified the best available techniques and solutions for management of communal waste in order to increase energy efficiency at project area and reduce pollution level of environment;
- Conducted assessments of savings and reduction of green house gases emission through different aspects: analyze of current situation in construction of buildings, strengthened awareness of citizens; promoted sustainable building methods, ecological materials and equipment; education and equipping;
- Provided concrete and useful information to stakeholders connected to possibilities and benefits from sustainable construction of buildings; advocacy for legislation improvement, policy and city's

decisions for easier investment and improvement of energy efficiency, renewable energy sources and reduction of green house gases emissions;

- Strengthened public awareness and level of knowledge of targeted groups about importance of their active participation in the process of energy costs reduction, use of renewable energy sources, and use of generated waste as a fuel (biomass) from ecological, health and economical aspect through education of managers and key employees in production companies;
- Changed and improved practice in process industries (food processing, wood processing etc.) related to use of energy and waste management generated in the production;
- Strengthened awareness and animated local government related to importance of introduction of energy efficiency certification in buildings;
- Conducted assessment current situation in buildings, taking into consideration old and new building;
- Established cooperation between related stakeholders in order to establish bio-energy chains and promotion of importance for conducting of Energy Audits for each company.

Bibliography

1. Студија енергетског сектора у БиХ, 2008 / BH Energy Sector Study, 2008. / BH Energy Sector Study, 2008.
2. Initial National Communication (INC) of Bosnia and Herzegovina to UNFCCC
3. IPCC (2006) Guidelines ,Volume 2
4. Web pages Power Utility of the Republic of Srpska, http://www.elektroprivreda- rs.com/ pocetna.htm EEA, 2009.
5. EMEP/EEA air pollutant emission inventory guidebook — 2009. EEA, Copenhagen, Available at http://www.eea.europa.eu/publications/emep-eea-emission inventoryguidebook-2009
6. Covenant of Mayors ,SEAP Guidelines - Part I: The SEAP process, step-by-step towards the -20 % target by 2020
7. Covenant of Mayors , SEAP Guidelines - Part II: Baseline emissions inventory
8. Covenant of Mayors, SEAP Guidelines - Part III: Technical measures for energy efficiency and renewable energy
9. Ђуковић Ј., Бојанић В., „Аерозагађење“, Институт заштите и екологије, Бања Лука, 2000 / Đuković J., Bojanić V. Air Pollution, Protection and Ecology Institute, Banja Luka, 2000.
10. Smanjenje isticanja vode u Banja Luci i Projekat unašređivanja zaštite životne sredine, Završni izvještaj, jul 2007. godine / Decrease of Water Leakage in Banja Luka and Project of Environmental Improvement, Final Report, July 2007.
11. Lokalni ekološki akcioni plan grada Banja Luka, Banja Luka septembar 2009. godine / Local Environmental Action Plan of the City of Banja Luka, Banja Luka, September 2009.
12. Studija izvodljivosti, Banjalučki toplifikacioni sistem, Burgess&Niple, juni 2003. / Feasibility Study, Banja Luka Heating System, Burgess & Niple, June 2003.
13. Termoelektrana toplana Banja Luka, Knjiga 1, Izbor lokacije, kapaciteta i osnovne koncepcije, Energoprojekt – ENTEL, Beograd, mart, 2000. godine / Thermal Power Plant – Heating Plant Banja Luka, Book 1, Selection of a Site, Capacity and Basic Concept, Energoprojekt – ENTEL, Beograd, March 2000.

14. Grabovšek,Bojan, *Zmanjšanje rabe energije za ogrevanje v obstoječih zgradbah,* Bioklimatske zgradbe 8, Ljubljana, 2005, p 39.
15. B.Grubovšek, *Zmanjšanje rabe energije za ogrevanje v obstoječih zgradbah,* Bioklimatske zgradbe 8, Ljubljana, 2005. p. 41.
16. Renewable& Systainable Energy Reviews. An International Journal. Pergamon. Editor in Chief: Lawrens L. Kazmerski. National Renewable Energy Laboratory, USA. Vol.1, Nym ½. Nature and techology of geothermal energy; E. Barbier, p.p. 1-69; March/June 1997.
17. Geothermal Edycation Office,1997.»Geothermal energy worldwide»Online, Available World Wide Web.
18. Fletcher S., O'Mara K., Jennings P.,: Murdoch University, Alternative Energy development Board of WA, June 1999.
19. Di Pippo R., Geothermal electric power, the state of the world- 1985 Int.Symp.on Geot.energy, International volume. Geothermal Resources Council, Davis,Ca, 1985,pp.3-18.
20. Vision for the future, Anon Source: Bulletin.Geothermal Resources Council, 1998., USA 171-177 ISSN: 0160-7782 CODEN:BGRCDD In English.
21. Wright,P.M.: «The earth gives up its heat», renewable Energy World, vol.1, no.3,pp.21-25.1998.
22. Prva ocjena geotermalne potencijalnosti hidrogeotermalnih resursa na području Banja Luke u cilju njihovpg korištenja za toplifikaciju i druge svrhe. Rudarsko-geološki fakultet Univerziteta u Beogradu. Institut za hidrogeologiju, Laboratorija za geotermalnu energiju, Beograd, septembar 1992.god. / First assessment of geothermal potential of hydro-geothermal resources in the area of Banja Luka with the aim of their usage in heating and other purposes. Mining and Geological Faculty of the University of Belgrade, Institute for Hydro-Geology, Laboratory for Geothermal Energy, Belgrade, September, 1992.
23. Problematika istraživanja resursa geotermalne energije sa posebnim osvrtom na mjesto i ulogu geofizičkih metoda ispitivanja. Savez inženjera i tehničara rudarstva, geološke i metalurške struke Jugoslavije. Komitet za geofiziku, 1987.godine. / Problems in researching resources of geothermal energy with specific attention to the place and role of geo-physical examinations, Association of Engineers and Technicians of Mining, Geological and Metallurgic Professions of Yugoslavia, Committee for Geophysics, 1987.
24. Antal C., Maghiar T.: Utilizarea energiei geotermale, Conversia energiei geotermale in energie electrica, Editura Universitatii din Oradea, Ovidiu Gavrilesku, Joan mintas, 2000.god.
25. Đuričković V.: Transformatori toplote, Termodinamičke i inženjerske osnove, Beograd-Banja Luka, 2000.god. / Đuričković V.: Heat Transformers, Thermo-dynamic and engineering basis, Belgrade-Banja Luka, 2000.
26. Tica G.: Mogućnost korištenja geotermalne energije sjevernog dijela Republike Srpske za proizvodnju električne energije, Magistarski rad, Mašinski fakultet Univerziteta u Banjaluci, Banja Luka,april 2002.god./ Tica G.: Possibility of using geothermal energy of the northern part of Republika Srpska for production of electrical energy, Master's Thesis, Faculty of Mechanical Engineering of the University of Banja Luka, Banja Luka, April 2000.
27. Knezic, L.; Baras, J.: Prikupljanje, prerada i koristenje biogasa i mulja, str.43.T.1.; Tehnolosko-metalurski fakultet, Beograd, 1. YU simpozij Biogas-teorija i praksa, Donji Milanovac, 1985./ Knezic, L.; Baras, J.: Collection, processing and usage of biogas and mud, page 43.T.1; Technological and Metallurgic Faculty, Belgrade, 1st YU Symposium, Biogas – theory and practice, Donji Milanovac, 1985.
28. Gacesa, S.; Grujic O.i Klasnja M.: Sirovinski resursi i proizvodnja biogasa, Tehnoloski fakultet, Novi Sad, 1. YU simpozij Biogas-teorija i praksa, Donji Milanovac, 1985. / Gacesa, S.; Grujic O.and Klasnja M.: Raw material resources and production of biogas, Faculty of Technology, Novi Sad, 1st YU Symposium, Biogas – theory and practice, Donji Milanovac, 1985.

29. Stankovic L.; Zaharijev Z.; Kovačevic S.: Uredjaji za proizvodnju biogasa, Poljoprivreni fakultet, Novi Sad, 1. YU simpozij Biogas-teorija i praksa, Donji Milanovac, 1985./ Stankovic L.; Zaharijev Z.; Kovačevic S.: Equipment for production of biogas, Agricultural Faculty, Novi Sad,1st YU Symposium, Biogas – theory and practice, Donji Milanovac, 1985.
30. ANIWASTE- PROGRAM CARDS EU ZA BiH. Studija izvodljivosti. Životinjski otpad. Integralno rješavanje problema otpada sa farmi i klaonica u sjeverozapadnom regionu BiH, / ANIWASTE – EU CARDS PROGRAM FOR BH, Feasibility Study. Animal waste. Integral resolution of the problem of waste from farms and slaughter houses in the north-western region of BH.
31. Gordana Tica, Petar Gvero, Marinko Bogojević: Mogućnost korištenja biogasa kao energetskog izvora u Republici Srpskoj, Prvi međunarodni kongres "Ekologija, zdravlje, rad, sport" Banjaluka, 08.-11.Jun2006. / Gordana Tica, Petar Gvero, Marinko Bogojević: Possibility of biogas usage as a source of energy in Republika Srpska, First International Congress "Ecology, Health, Work, Sport", Banja Luka, 8th – 11th June 2006.
32. G. Tica., P. Gvero: Mogućnost proizvodnje i korištenja biogasa kao energenta u Republici Srpskoj, Naučno-stručni skup o gasu i gasnoj tehnici sa medjunarodnim učešćem GAS 2009 - Vrnjačka Banja, 19-22 maj 2009.g. / G. Tica., P. Gvero: Possibility of production and usage of biogas as energy in Republika Srpska. Scientific and professional meeting on gas and gas technique with international participants GAS 2009 – Vrnjacka Banja, 19-22 May 2009.
33. P. Gvero, G. Tica: Bioenergetski potencijal Republike Srpske; Akademija nauka i umjetnosti Republike Srpske; Naučni skup Resursi Republike Srpske Banja Luka, oktobar, 2007./ P. Gvero, G. Tica: Bio-energy potential of Republika Srpska, Academy of Sciences and Arts of Republika Srpska, Scientific meeting, Resources Republika Srpska, Banja Luka, October 2007.
34. G. Tica, P.Gvero, V. Đuričković. Biogas . Energetski resurs budućnosti u B&H. Međunarodna konferencija o dostignućima elektrotehnike, mašinstva i informatike, Banjaluka, 28. i 29. maj 2009. / G. Tica, P.Gvero, V. Đuričković: Biogas: energy resource of the future in BH, International Conference on Achievements of Electrical Engineering, Mechanical Engineering and IT Science, Banja Luka, 28th and 29th May 2009.