SUSTAINABLE ENERGY ACTION PLAN OF TREBINJE MUNICIPALITY

Trebinje, December 2011

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Issued by:
Trebinje municipality, December 2011, supported by the United Nations Development Programme (UNDP) Bosnia and Herzegovina

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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 9th March 2007 year the EU adopted the Energy for a Changing World package, committing unilaterally to reduce its CO2 emissions by 20% by 2020 year, 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 there to 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 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 year, reducing the CO_2 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 (EC) 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 for 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 CO_2 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 citizens awareness 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 the global level, in particular within the UN Framework Convention on Climate Change (UNFCCC). Our active involvement in the CO_2 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 FORMALISE THEIR CONTRIBUTION TO THE COVENANT.

I INTRODUCTION

Within the global activities the UN has started with the operation acting and influence on problems of climate change in 1992 year by forming the UN Framework Convention on Climate Change (UNFCCC). Bosnia and Herzegovina acessed and ratified this Convention in 2000 year.

In accordance with the UN Framework Convention on Climate Change (UNFCCC) instructions whose signatory is also Bosnia and Herzegovina, under organization of UNDP B&H and GEF financial means, was chosen the expert team and 50 local experts from 14 relevant fields, which professionally and in accordance with international standards developed The Initial National Communication Report of Bosnia and Herzegovina under the United Nations Framework Convention on Climate Change (INC). INC was completed in October 2009 year and after that it was adopted by The Government of the Republic of Srpska. Federal Ministry of Enviroment and Tourism also verified this report, and was adopted by the Council of Ministers of Bosnia and Herzegovina. The obligation of each state is to submit its national reports to the UNFCCC Secretariat. By preparing, verifying and sending its INC, Bosnia and Herzegovina has become a full participant in the global process of negotiation to climate change adaptation and its mitigation. In addition to the conclusion that climate change is caused by human activities and as such can be mitigated or prevented through appropriate measures, on almost 200 pages of INC was presented a factual overview of the climatic factors, specific circumstances in Bosnia and Herzegovina, calculation of the greenhouse gasses, vulnerability and adaptation to climate change, as well as the estimation of the potential for mitigating climate change. The document also explains the other relevant circumstances, restrictions and shortcomings, international cooperation, concludes with general recommendations and further steps. Using these data and recommendations from the INC are made real conditions for developing long-term national development strategy and its implementation at both macro and micro level. In accordance with the guidelines from this report, Bosnia and Herzegovina should, at the state and the entity level, develop appropriate legislative framework, long-term development policy and create preconditons for sustainable development. The responsibility for the preparation of this report, which is of crucial importance for Bosnia and Herzegovina as a whole, was the Ministry for Spatial Planning, Civil Engineering and Ecology of the Republic of Srpska in its capacity as Focal Point. The Ministry is also responsible for the further implementation of the guidelines laid down in this document and preparation for the development of the Second National Communiction Report. The process of European integration will demand the series of legislative and strategic changes in relation to adoption of the agreement and legislative of the European Union.

The European Union (EU) leads the global fight against climate change and it established the main priorities. Its ambitious goals are expressed in " The EU policy package on climate change and renewable energy", which obliges member states to reduce its CO2. emission for at least 20% by 2020 year. The EU has motivated the European cities, by developing the decision 20:20:20, to get involved actively, within the "European Mayors Agreement", in realization of the set goals. Throughout this period it is tend to suppress negative trends of climate change, in which cities and urban areas are considered as serious causes. In Poznań at the end of 2008 year at the regular annual conference of the UNFCCC, was concluded that "cities produce 80% of overall world's greenhouse gas."

The signatories of the Convenant of Mayors has contributed this strategy by their formal committment to go even further than the main goal through implementation of their sustainable energy action plans.

The Convenant of Mayors is an agreement by which cities support:

- The EC 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 EC role to assume co-ordination of the EU Conference of Mayors for a Sustainable Energy Europe;
- The EC declared intention to facilitate the exchange of experience among the participating territorial units, the provision of guidelines and benchmark examples for a 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 EC support providing for recognition and citizens' awareness of the cities and towns taking part in the Convenant 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;

Trebinje Municipal Assembly at the session held on 30th December 2010 year has reached the DECISION of adopting *The Covenant of Mayors Initiative* about CO_2 emission reduction by 2020 year, which authorizes the mayor of Trebinje municipality to join the signing procedure of *the Convenant of Mayors* with the European Commission.

II OBJECTIVES

General objectives correspond to those declared in the very European Cities Agreement and as such have character of the long-term planning document. On the other hand, they are harmonized with existing development documents of Trebinje, the Republic of Srpska and Bosnia and Herzegovina and offer new initiatives for a radical change in philosophy and absolute acceptance of sustainable development trends.

The set objectives are such that they can clearly and measurably show all the changes of the determined objectives within Trebinje, but also the tendency of expansion to the neighbouring towns and areas.

III WHAT IS SUSTAINABLE ENERGY ACTION PLAN?

Sustainable Energy Action Plan (SEAP) is a strategic and an operational document that defines overall framework for objectives by 2020 year, or the document that shows how the local authorities will reach emission reduction by 2020 year. The Action plan uses the results of the previously prepared Baseline emission inventory state (BEI) to identify the best areas of actions and opportunities for reaching the local authority CO_2 reduction target. The document defines concrete reduction measures, together with time frames and assigned responsibilities. The deadline for making Sustainable Energy Action Plan- SEAP, including Baseline emission inventory state (BEI) is one (1) year from the date of signing the Convenant of Mayors with the European Commission.

Therefore, the Action plan is the key document that shows how the local authorities will reach its CO_2 reduction target for 20% by 2020 year, and in regard to that that the Convenant covers the entire town area the Sustainable Energy Action Plan comprises activities for both, private and public sector.

The European Commission has uniliterally committed to recognize the cities involved in the Covenant and to promote their visibility. The Commission has established and financed the Convenant of Mayors office, which provides technical and promotional support, including implementation of monitoring and supervising instruments, mechanisms which support exchange of "know-how" between cities and regions and instruments for replication and multiplication of successful techniques/measures. The Commission also committed to implement guidelines and benchmarks of reference point for the possible implementation and to connect possible activities and networks which support the role of the local authorities in the area of climate protection. Joint Research Centre- JRC undertook these tasks in close cooperation with the Convenant of Mayors office. Basically, Sustainable Energy Action Plan comprises actions of the following areas:

- civil engineering, including new constructions and primary rehabilitation,
- municipal infrastructure (urban heating, public lighting, etc.),
- land use and urban planning,
- decentralized sources of renewable energy,
- public and private transport and traffic,
- civilian and, in general, society participation ,
- rational energy use by citizens, consumers and economy.

Reduction of greenhouse gases related to relocation of industry is excluded.

The measures for energy efficiency, renewable energy and other activities related to energy are presented through different areas of acting of the local authorities. Sustainable Energy Action Plan will be presented to civil society and given to the public discussion. This plan, with a high degree of citizen participation, possibly will be long-term, constant and successful in reaching set goals.

The involvement of the local authorities networks is the central element of the Covenant of Mayors office. It was established on the basis of Intelligent Energy Europe, it consists of a team of professionals, whose task is to give support to the network within the Covenant Framework, support the promotion of the Convenant, monitor the Covenant implementation, technical support, support to networking with other Covenant participants and other relevant EU initiatives and strategies.

IV MAIN ACTIVITIES

The activities defined by this Action plan are predicted up to 2020 year, and are divided into certain sectors and subsectors according to propositions of "The Convenant of Mayors of European cities". In a wide range of the activities, that should contribute to the full realization of the set goals, the most important segments are related to: spatial planning and buildings, transport, waste disposal and waste water treatment, public lighting, renewable energy sources as well as SEAP promotion activities.

Regarding that the activities will take place at least by 2020 year, does not exclude the possibility of other segments.

1. LEGISLATIVE FRAMEWORK FOR DEVELOPMENT OF TREBINJE MUNICIPALITY SUSTAINABLE ENERGY ACTION PLAN-SEAP

One of the important preconditions for successful application of Trebinje municipality Sustainable Energy Action plan development is its full compliance with relevant legislation at entity and state level, i.e. the Republic of Srpska and Bosnia and Herzegovina, but also with all offical documents adopted by the Muncipal Assembly. Moreover, the signed and ratified international Treaties also represent a part of the internal legal order and in this sense especially is emphasized the Energy Charter Treaty, with the Protocol on Energy Efficiency and Related Enviromental Aspect (PEEREA), the Treaty establishing the Energy Community, and the Stabilisation and Association Process Agreement.

1.1. Relevant legislation and the European Union acts

The main legislative acts that regulate the development of an energy sector at the level of the European Union are the following (arranged chronologically):

- White Paper An Energy Policy for the European Union, January 1996;
- Energy for the Future: Renewable Sources of Energy, White Paper for a Community Strategy and Action, November 1997;
- Green Paper "Towards a European Strategy for the Security of Energy Supply“, November 2000;
- Green Paper on Energy Efficiency or Doing More with Less, June 2005;
- Green Paper An European Strategy for Sustainable, Competitive and Secure Energy Supply, March 2006;
- Action plan for Energy Efficiency: Realising the potential – Saving 20% by 2020, October 2006;
- The proposal for European Energy Policy, January 2007

The proposal of the European Energy Policy sets four main requirements by 2020 year:

- reduction of greenhouse gas emission of developed countries for 20%
- energy efficiency increase of 20%
- renewable energy source share increase to 20%
- increase of biofuel share in traffic to 10%

The next directives regulate the area of renewable energy sources use and they are based on the main legislative acts of the EU, which are:

- Communication on Alternative fuels for Road Transportation and on a Set of Measures to Promote the Use of Biofuels, November 2001 year;
- Directive 2009/28/EC on the promotion of the use of energy from renewable sources and amending and subsenquently repealing Directives 2001/77/EC and 2003/30/EC.

The European Union Directives which directly or indirectly regulate the area of the energy efficiency are:

- Directive 92/75/EEC on the indication by labelling and standard product information of the consumption of energy and other resources by household appliances;
- Directive 93/76/EEC to limit carbon dioxide emissions by improving energy efficiency;
- Directive 2002/91/EC on the energy perfomance of buildings;
- Directive 2003/87/EC for establishing a scheme for greenhouse gas emission allowance trading within the Community;
- Directive 2004/8/EC on the promotion of cogeneration based on a useful heat demand in the internal energy market;
- Directive 2004/101/EC for establishing a scheme for greenhouse gas emission allowance trading within the Community, in respect of the Kyoto Protocol´s project mechanisms;
- Directive 2006/32/EC on energy end-users efficiency and energy services.
- The EU Directives that directly or indirectly regulate area of the enviroment are:
- Directive of the Council of the European Union 1985/337/EEC of 27th June 1985 year of the assessment of the effects of private and public projects on the enviroment, with amendments from 31st December 2004 year; implementation by the Treaty enforcement;
- Directive of the Council of the European Union 1999/32/EC of 26th April 1999 year relating to a reduction in the sulphur content of certain liquid fuels- implementation by 31st December 2011 year;
- Directive of the European Parliament 2001/80/EC and the Council of 23rd October 2001 year on the limitation of emission certain pollutants into the air from large thermal power plants (≥ 50MW)- implementation by 31st December 2017 year;
- Article 4 (2) of Directive of the Council of the European Union 79/409/EEC of 2nd April 1979 year on the conservation of wild birds; implementation-by the Treaty enforcement;
- Endavour to accede the Kyoto protocol and to implement Directive 96/61/EC of 24th September 1996 year on pollution prevention and control.

1.2. Legislative framework and the regulations of the Republic of Srpska and Bosnia and Herzegovina energy sector

By ratification of the Agreement on the Energy Community for South Eastern Europe, B&H and thus the Republic of Srpska, have overtaken the obligation to align their legislation with the legal inheritance of the European Union in the area of electric power, where provisions of B&H and the Republic of Srpska should be in full conformity with the provisions of the Directive 2003/54 on the Internal Energy Market and Directive 2001/77 on the promotion of electric power produced from renewable energy sources in the inner market. These provisions have become mandatory on 1st July 2007 year. It should be mentioned that one of the most significant events of energy sector in Europe is the recent adoption of the new EU regulations of the EU Third Internal Energy Market Legislative Package. Therefore, it is expected in the future all relevant entities to accelerate activities within their jurisdiction.

1.2.1. Energy policy and planning of the Republic of Srpska energy sector development

Adoption of energy policy and planning of the Republic of Srpska energy sector development are responsibility of The National Assembly, which, by the Government 's proposal, makes the energy development Strategy for the period of 20 years. For the implementation of the energy development Strategy of the Republic of Srpska is in charge the Government of the Republic of Srpska, which in action plans defines measures, activity performers and terms of realization of the energy policy, as well as the way of cooperation with the local authorities in the area of planning of energy sector development and cooperation with energy entities in the sector of electric power, gas and crude oil, other entities in Bosnia and Herzegovina and international institutions. Local authorities are obliged to harmonize their development documents with the energy development Strategy. On the basis of the energy development Strategy, local authority plans and programmes, energy entities set out programmes and plans for construction, maintenance and use of energy facilities, as well as other needs in performing energy activities, taking into account the obligations arising from the international agreements.

By the Strategy, the Republic of Srpska energy development by 2030 year focuses on the use of local resources, inclusion renewable energy sources in meeting the energy needs, the introduction of incentive measures of energy efficiency, as well as application of modern energy technologies. It is required at the same time the preservation of the enviroment and reduction of energy sector hazardous impact to a minimum.

The Government of the Republic of Srpska makes the annual energy balance of the Republic of Srpska by the means of which is planned annual need for energy, sources and types of energy, as well as measures to meet those needs. The content of the energy balance, content, deadlines and manner of data delivery which are necessary to be delivered to the Ministry in charge of energy by the authorities (republic bodies and local authorities) and energy entites for creation of annual energy balance, is regulated by the special Book of Rule issued by the Minister in charge of energy.

1.2.2. Renewable sources, energy efficiency and cogeneration

The basis of the legal framework by which arrangement of renewable energy sources has begun, energy efficiency and cogeneration in the Republic of Srpska are contained in **the Law on energetics and the Law on electric power.**

The **Law on energetics** defines that the use of renewable energy sources and efficient cogeneration is of the general interest for the Republic of Srpska. Furthermore, it stipulates, a duty of issuing the decree on measures to increase electric power generation and consumption from renewable sources and cogeneration, and increased share of biofuels consumption in the total transport fuel consumption. The competent Ministry analyzes the result of measures at the annual level and suggests new measures to improve their cooperation with the Regulatory Commission for Energy of the Republic of Srpska (Regulatory Commission).

The Regulatory Commission is responsible for adoption of the Rule Book of the system to encourage electric power generation by using renewable energy sources and

cogeneration,which also adopts the same Rule Book based on the Government acceptance.

Incentives funds for energy generation by using renewable sources of electric power and cogeneration,will be provided through end-users tarriff for electric power. Institutional structure for operational implementation of the incentive system is determined and/or established by the Government.

1.2.3. Energy laws and sublegal regulations of the Republic of Srpska

Positive legal framework which regulates the Republic of Srpska energy sector, in addition to the Republic of Srpska Constitution ("The Offical Gazzette of the Republic of Srpska no. 21/92, 28/94, 8/96, 13/96, 15/96, 16/96, 21/96, 21/02 and 30/02"), as a fundamental act of the Republic of Srpska, which jurisdiction for this area also arises from, primarly consists of :

- The Law on Energy ("The Offical Gazzette of the Republic of Srpska", no. 49/09),
- Electricity Law ("The Offical Gazzette of the Republic of Srpska", no. 66/02, 29/03, 86/03, 111/04, 60/07, 114/07, 8/08, 34/09 and 92/09),
- Gas Law ("The Offical Gazzette of the Republic of Srpska", no. 86/07),
- The Law on Oil and Oil Derivates ("The Offical Gazzette of the Republic of Srpska", no. 36/09)
- The Law on Mining of the Republic of Srpska ("The Offical Gazzette of the Republic of Srpska" no. 107/05),
- The Law on Geological Survey of the Republic of Srpska ("The Offical Gazzette of the Republic of Srpska", no. 51/04),
- General Conditions for Electricity Delivery and Supply ("The Offical Gazzette of the Republic of Srpska", no. 85/08),
- The Book of Rule on Tarriff Methodology and Tarriff Proceeding with Annexes ("The Offical Gazzette of the Republic of Srpska", no. 61/05),
- The Book of Rule on Tarriff Methodology in the System of Transport, distribution, storage and supply of natural gas ("The Offical Gazzette of the Republic of Srpska", no.09/09),
- The Book of Rule on Methodology for Defining Recompense for Connection to Distrubition Network with the Request Form ("The Offical Gazzette of the Republic of Srpska", no.123/08),
- The Book of Rule on Acquiring Qualified Customers Status ("The Offical Gazzette of the Republic of Srpska", no.88/06),
- The Book of Rule on Issuing licences ("The Offical Gazzette of the Republic of Srpska", no. 04/09),
- The Book of Rule on Classification and Categorization of Mineral Resource Reserves and Book keeping ("The Offical Gazzette of the Republic of Srpska", no. 99/08),
- The Book of Rule on Reporting ("The Offical Gazzette of the Republic of Srpska", no. 61/07),
- The Book of Rule on Confidential Information ("The Offical Gazzette of the Republic of Srpska" no. 10/07),
- The Book of Rule on Public Discussions in Solving Lawsuits and Appeals ("The Offical Gazzette of the Republic of Srpska" no. 71/05),

- The Book of Rule on issuing a certificate for generating facility ("The Offical Gazzette of the Republic of Srpska" no. 25/11),
- The Republic of Srpska Goverment Decree on generation and consumption of energy from RES ("The Offical Gazzette of the Republic of Srpska" no. 28/11 and 39/11).

With energy sector are closely connected the regulations regulating the concession regime i.e. conditions under which are local and foreign entities awarded the concessions for survey and use of natural resources as well as construction of infrastructure (energy) facilities. They are:

- The Law on Concessions ("The Offical Gazzette of the Republic of Srpska", no. 25/02, 91/06 and 92/09),
- The Law on Public-Private partnership in the Republic of Srpska ("The Offical Gazzette of the Republic of Srpska", no. 59/09 and 63/11),
- The Law on Spatial planning and Construction ("The Offical Gazzette of the Republic of Srpska", no. 55/10)

The legislation of the Republic of Srpska energy sector consists of the the Law on Energy, the Electricity Law, the Gas Law, and the Law on Oil and Oil Derivatives, as well as regulation acts made on the basis of the same.

The Law on Energetics as the main act which regulates basis of energy policy of the Republic of Srpska, the adoption of energy development strategy, plans, programmes and other documents for its application, the basic questions of regulation and performance of energy activities, the use of renewable energy sources and conditions for energy efficiency realization, represents a base for ensuring legal assumptions of electric power generation and sure and quality energy supply of customers by the principles of the market competitiveness and sustainable development, by efficient energy use and protection of enviroment.

The Law on Energetics has been applied since 1st September 2009 year. By the Present law was established the legal base for establishment and management of energy policy and planning of energy development. Energy policy and planning of energy development of the Republic of Srpska is implemented through the Republic of Srpska energy development Strategy and by action plans to implement Strategy. The same action plans determine the measures, activity perfomers, and terms of realization of energy policy, as well as the way of cooperation with local authorities in the area of planning of energy sector development and cooperation with energy entities in the sector of electric power, gas, crude oil and other entities in Bosnia and Herzegovina and international institutions.

The Present law defines the following energy activites:

- electric power generation, distribution, supply and trade,
- crude oil derivatives production, transport by crude oil pipe-lines and crude oil derivatives by production lines, crude oil and crude oil derivatives transport by other means of transport, storage of crude oil and its derivatives, crude oil and its derivatives trade,
- natural gas transport, management of natural gas transport system, storage and management of natural gas storage system, distribution of natural gas and management of the natural gas distribution system, natural gas supply and natural gas trade,
- biofuel generation, storage and trade and
- heat energy generation, distribution and management of distribution system for heat energy, supply and trade of heat energy.

The Electricity Law with sublaw and the acts passed on the basis of it represents the legal framework that regulates electric power sector of the Republic of Srpska.

The Present law establishes the rules for electric power generation, distribution, supply and trade in the area of the Republic of Srpska and trade on behalf of the Republic of Srpska, and regulates establishment and operation of electric power system in the Republic of Srpska.

The aim of the Law is to define the conditions necessary for rational and economic development of generation, distribution, supply and trade electric power activities in the area of the Republic of Srpska and to promote companies that will provide public services and ensure interrupted supply of consumers with electric power. The Law regulates the areas of electric power policy, performance of electric power activity, regulation of performance of electric power activities, organization and work of the Regulatory Commission for electric power, electric power generation, distribution and access to distribution network, status of electric power customers, licences issuing, connection to electric power network, suspension and limitation of electric power supply, construction and maintenance of electro power facilities as well as supervision of the Law implementation .

The Law regulates the following electric power activities: electric power generation, distribution and trade of electric power and electric power supply. The mentioned activities are performed by the companies for those activities which are established and operate in accordance with the Law on Companies of the Republic of Srpska. In the future it is planned to pass a new legislation that will enable citizens and legal entities to generate electric power, with the possibility of placing overcapacity to the market.

1.2.4 Energy laws and sublegal regulations of Bosnia and Herzegovina

The main legislative acts which regulate the development of energy sector in Bosnia and Herzegovina are as follows (arranged chronologically):

- Law on Transmission, Regulator and System Operator of Electricity in BiH ("The Official Gazette of Bosnia and Herzegovina", no. 07/02 and 13/03),
- Law on Establishment of the Company for Transmission of Electricity in BiH ("The Official Gazette of Bosnia and Herzegovina", no. 35/04),
- Law on Establishment of an Independent System Operator in B&H ("The Official Gazette of Bosnia and Herzegovina", no. 35/04),
- Network codex ("The Official Gazette of Bosnia and Herzegovina", no. 48/06 and 37/11),
- Market Rules ("The Official Gazette of Bosnia and Herzegovina", no. 48/06),
- Decision on Scope, Conditions and time schedule of electricity market opening in B&H ("The Official Gazette of Bosnia and Herzegovina", no. 48/06 and 77/09),
- Methodology for creation of tariffs for the electric power transmission service, of the independent system operator and auxiliary services ("The Official Gazette of Bosnia and Herzegovina", no. 46/05 and 17/07).

2. GEOGRAPHIC POSITION AND NATURAL CHARACTERISTICS OF TREBINJE MUNICIPALITY[1]

2.1. Position of Trebinje municipality

Trebinje is the most southern town of the Republic of Srpska and Bosnia and Herzegovina. The most famous man from Trebinje, Jovan Dučić, considers it the Mediterranean town. It is situated in the river Trebišnjica valley and at the foot of mountain Leotar, at the borders of three countries- Bosnia and Herzegovina, Montenegro and Croatia. The altitude of the urban area of the municipality is about 275 m.

Today Trebinje municipality covers an area of 904 km^2. According to the estimations of Trebinje General urban plan 2002- 2015 year in the area of Trebinje municipality has lived 30.627 inhabitants whereof 26.003 of them in the urban part of the town. [2] Some estimations show that even less than 10% of inhabitants live in the rural area.

2.2. Traffic connection

Trebinje is located **at the important crossroad**. It is 27 km away from Dubrovnik, 38 km from Herceg Novi, 70 km from Nikšić, 115 km from Mostar, 120 km from Podgorica, 230 km from Sarajevo, 360 km from Banja Luka and 480 km from Belgrade. It is 152 km away from the port Bar, and 120 km from the port Ploče. The most important road routes are Belgrade-Dubrovnik and Mostar-Podgorica. The nearest airports are Čilipi (about 40 km), Tivat (60 km), Mostar (115 km) and Podgorica (120 km). It was planned to be built the airport in Zubci near Trebinje in the next five to six years and also the construction of the Adriatic-Ionian highway, what would significantly improve the strategic position of Trebinje.

2.3. Climatic characteristics

Due to its climatic conditions and abundant precipitation, the area of Trebinje municipality is **the richest water areas** in the Balkans and Europe. The largest water resource represents a catchment area of the river Trebišnjica that includes 4,457 km^2, which was explored in detail. Water, as a primary natural resource of this area is used multipurpose: to supply population with water, for energy plants and electric power generation, industrial and service activities and for quality irrigation of karst fields (poljes) fertile soil of the river Trebišnjica valley.

The geographical position and relief of Trebinje municipality caused **special climatic characteristics** appropriate for agriculture production. The wider area of the municipality is characterized by two main climate types: Mediterranean and highland mountain (slight variant of moderate-continental climate). The variant of Mediterranean

[1] Extract from Development Strategy of Trebinje municipality 2009-2017 year
[2] General urban plan of Trebinje 2002-2015 (Abstract), Trebinje municipality, 2001 year

and moderate-continental climate is characteristic for the greater part of the municipal area. It is characterized by very long, hot and dry summers and mild, short and rainy winters. The average annual air temperature is about 14,5^{o} C, while the average annual precipitation is from 1600 to 2800 mm. The municipality is characterized by an abundance of hot days (260 sunny days a year) and mild but wet winter. Highland moderate-continenatal climate of this area is actually modified Mediterranean climate with mild variants of moderate-continental and mountain climate, and it involves the greater part of the municipality which is above 400 m altitude. (it has some colder winters and fresher summers).

The catchment area of the river Trebišnjica provides opportunity for construction of 7 hydro power plants. Until today 4 hydro power plants has been built (Trebinje 1 and 2, Dubrovnik-Plat, and HPP Čapljina).

2.4. Mineral resources

By previous research has been verfied findings of smaller amount of bauxite and bitumen, without any bigger importance and exploitation feasibility. Significant reserves of quality building stone exist at 15 sites along entire valley of the river Trebišnjica, by the rim of karst fileds (poljes).

Siga- a rare type of building stone which has aesthetic value in facilities construction is located on several localities along the valley of the river Sušica –the left tributary of the river Trebišnjica (Lastva-Jazina).

Gravel and sand as a building materials, due to spread of calcareous-dolomite rocks, are located on more localities. Today the exploitation is done at the locality of Zubačko polje. The estimated area of deposit is about 700 ha.

2.5. Vegetation characteristics

According to enviromental vegetation classification per regions B&H belongs to Mediterranean-the dinaric area, sub-Mediterranean area and region with evergreen elements. Thanks primarily to strong influence of Mediterranean climate, as well as diversity of relief and soil types in the area of Trebinje has developed specific plant communities of sub-Mediterranean zone but also the communities specific for coastal area and whose north border of spreading in the Republic of Srpska is the area of Trebinje (holm oak (Quercus ilex) communities in Tvrdoš). This makes this zone extremely important for biodiversity of the whole country and in accordance with that it requires special protection measures. The area of pubescent oak forest in Trebinje forest is put under protection regime by the Spatial plan of the Republic of Srpska.

The Trebinje area is in the expansion zone of climatogene communities of hornbeam (Carpinteum orientalis adriaticum). It belongs to the order of thermophilous, basiphilous, neutrophilous forest and scrub oak (Quercetalia pubescentis), i.e. respectively connection of black and white elm (Ostryo – Carpinetum orientalis). Pubescent oak forests are rarely preserved as high, except in the mainly private parts and the part of the already mentioned Trebinje forest, so that there are mostly degradation stages in a sense of low forests, scrubs and shrubbery, with transition into stone gardens which represent the most common type of forest soil in this area.

In the layer of trees there are pubescent oak (Quercus pubescens), oak (Quercus cerris), and the Macedonian oak (Quercus trojana), while hornbeam (Carpinus orientalis), Montpelier maple (Acer monspesulanum) and black ash (Fraxinus ornus) belong to the layer of lower trees and bushes. As edificators of subassociations appear Petteria ramentacea, Philyria sp., Juniperus oxycedrus (typical for the zone of Draženska Gora) – Querco – carpinetum orientalis juniperitosum oxycedri).

By further antrophogenic degradation hornbeam forests change into rocky grass communities from the class Brachypodio-Chrysopogonetea. For the grass communities of this area is characteristic that they are abound in medicinal species such as everflower, sage, wall germander and others (in a great number and coverage).

As the most regressive stage in this area appears fire hazard areas and karst (mainly as a result of fire). The most difficult situation is on mountain Leotar which is almost completely devastated by fire in the last few years, and forest vegetation remained only in the form of smaller lines.[3]

In 2001 year 68,648.6 hectare of Trebinje municipality was covered by forest, namely: high forests 2.909,60 hectares, sportous forests 17,093.00 ha, undergrowths 31,552.70 ha and barren land and the others 17,093.00 ha. Total estimated reserve of wood mass is 1.934.293 m^3 as follows: 430.266 m^3 of high forests, 981.927 m^3 of sprouts forests, 522.100 m^3 of undergrowths. [4]

[3] General urban plan of Trebinje 2002-2015 (Abstract), Trebinje municipality, 2001 year, p. 20
[4] The Centre for karst management data-Trebinje

3. ACTION PLAN MAIN ACTIVITIES BY 2020 YEAR

By sustainable energy Action plan of Trebinje municipality is planned to achieve reduction of greenhouse gas emission for at least 22% by 2020 year with realization of series of activities. In accordance with defined form of the mentioned Action plan by "The Convenant of Mayors of European cities" project activities are grouped into eight subgroups.

Priority activities of the Action plan are in sectors: spatial planning, buildings, transport, renewable energy sources, public lighting and waste management and waste water treatment.

3.1. Spatial planning and buildings sector

In the building sector the greatest attention is given to the activities of increasing energy efficiency of the existing facilities and construction of new facilites in accordance with principles of energy efficiency. By the plan is predicted from the municipal budget and available funds to ensure sufficient means for the existing facades reconstruction, installation of new windows and reconstruction of the existing heating and cooling systems, at the construction facilities owned by the municipality or where the municipality has significant impact in management. Parallel to these activities is to establish the information system that should provide monitoring of the energy-generating products consumption in the mentioned facilities. Private and legal entities and potential investors will be affected by work to increase their knowledge and awareness of investment justification into energy efficiency measures and savings achieved by those measures.

In the field of spatial planning management of the area of Trebinje municipality activities will be directed toward integration of the energy efficiency principle into spatial planning documents and acts, and the pass of the procedures that will define ways in which the mentioned principles will be integrated into all procedures taking place within the Trebinje municipality Administrative service. Through reforestation activities, performed within the Centre for karst management and arrangement of town park and urban green areas, it will be provided larger areas covered with forest.

3.2. Transport sector

In the transport sector is planned rehabilitation of the existing roads, improvement of traffic signal lights, and making better conditions for the use of cars on hybrid or electric drive. Taking into account trend of introducing European environmental standards for fuel and drive generator units for motor vehicles, it could be said that in this sector will come to significant reduction of CO_2 emission by 2020 year.

3.3. Sector of waste disposal and waste water treatment

Waste disposal at the town dump site and an open waste combustion is a significant source of CO_2 emission, CH_4 and N_2O. By the Action plan is planned rehabilitation of the existing dump site and construction of the sanitary, arranged dump site in accordance with the valid eviromental standards and examples of good practice.

Trebinje municipality plant for waste water treatment is the source of methane gas, as products of the mentioned process. In the future it should be taken into consideration an opportunity of methane gas exploitation produced in the mentioned plant.

3.4. Public lighting sector

Electric power consumption in the sector of the public lighting records significant growth. In order to reduce electric power consumption, by the Action plan were planned activities to replace exisiting mercury light bulbs with more efficient natrium ones, and installation of new LED lighting modes.

3.5. Renewable energy sources sector

The area of Trebinje municipality has favourable conditions for the exploitation of hydro, wind and solar energy. Hydro energy potential is significantly used through construction of a number of hydro power plants on the river Trebišnjica. However, through the installation of additional generator at the dam "Trebinje 2", it would additionally be used water that is discharged into the river bed for generation of electric power. Besides, it is planned by 2020 year to be found investors interested in construction of wind power plants at the rim of mountain Leotar, and it is also planned installation of solar and photovoltaic systems on private houses and commercial facilities.

4. GREENHOUSE GAS INVENTORY

4.1. Introduction

As the reference year for making Trebinje municipality baseline inventory of CO_2 emission was chosen 2001 year. There were two main criteria in choosing the reference year, at the first place data availability necessary for CO_2 emission calculation, and the fact that the EU as the reference year chose 1990 year and the desire not to make big time distance in relation to that year.

The data were collected for three sectors of direct energy-generating products consumption such as for buildings, public lighting and traffic, while baseline inventory of CO_2 emission, beside these three sectors, included the emission resulted from waste and waste water treatment. Baseline inventory includes direct emissions (obtained by fuel combustion, waste and waste water treatment) and indirect emissions (from electric power consumption and heat power consumption) as a result of anthropogenic activities.

The development of Baseline emission inventory of CO_2 of Trebinje municipality was done in accordance with recommedations and provided methodologies of the Intergovermental Panel of Climate Change-IPCC. This Panel was established by the United Nations Enivorment Programme-UNDP and the World Meterological Organization-WMO as the executive body for the implementation of the United Nation Framework Convention on Climate Change-UNFCC. B&H ratified the Kyoto Protocol on 16th April 2007 year, and it came into force on 15th July 2007 year, by which it undertook the obligation of monitoring and reporting on emission of harmful substances into the atmosphere according to the IPCC protocol, and on the basis of which was made the Baseline emission inventory of CO_2 of Trebinje municipality.

4.2. Energy-generating products consumption in Trebinje municipality

Trebinje municipality Baseline inventory of CO_2 emission for the 2001 year is, in greater part, based on the data of energy-generating products consumption in building, public lighting and traffic sector collected from municipal administrative services, Elektrohercegovina Trebinje and individual institutions in Trebinje municipality. From objective reasons, some of the data could not have been obtained, so were used the values obtained by estimation based on the data from previous years.The consumption of individual energy-generating products for all three sectors is shown in the Table 4.1 and Figure 4.3.

Table 4.1: Share of energy-generating products in total energy consumption of certain sectors

Energy-generating product	Energy-generating products consumption in MWh				
	Buildings	Public lighting	Traffic	Total per energy-generating products	Share per energy-generating products
Fuel oil	392.00			392.00	0.19%
Diesel	8,766.01		29,223.00	37,989.01	18.45%
Fuel	244.66		24,842.00	25,086.66	12.18%
Coal	8,268.00			8,268.00	4.02%
Wood	41,414.49			41,414.49	20.11%
Electric power	91,513.05	1,240.29		92,753.34	45.05%
TOTAL	150,598.21	1,240.29	54,065.00	205,903.50	100.00%
Share of each sector %	73.14%	0.60%	26.26%	100.00%	100.00%

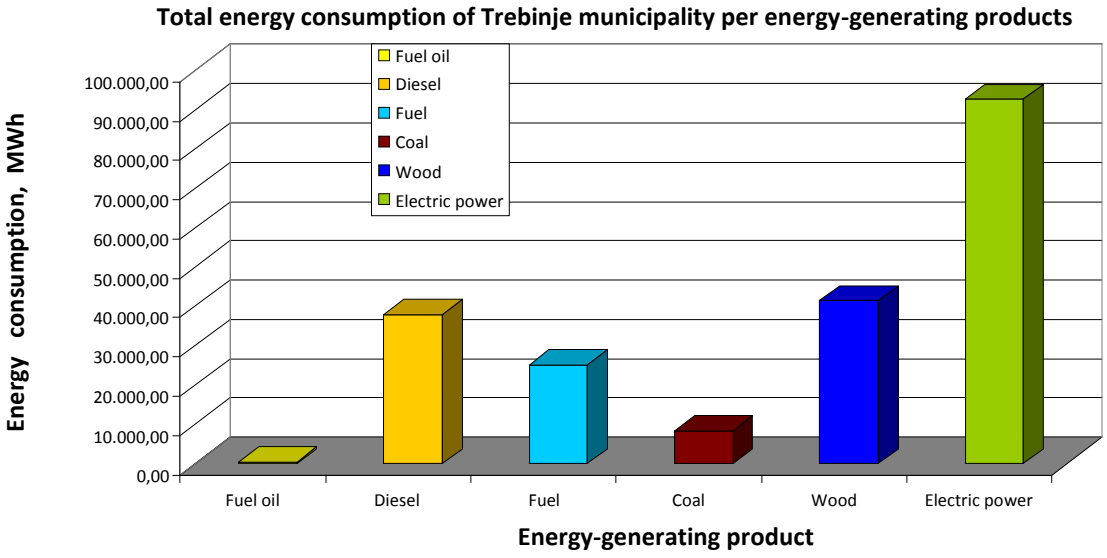

Figure 4.1: Structure of energy consumption per energy-generating products

According to data collected, through the use of different types of energy-generating products, Trebinje municipality consumed 205.903,50 MWh in 2001 year. From the Table 4-1 and the Figure 4-1 it obviously dominated electric power consumption in the amount of 92,753.34 MWh, what makes 45.05 % of totally consumed energy in Trebinje municipality. The other two dominant energy-generating products are wood 41.414,49 MWh with share of 20.11% and diesel 37.989,01 MWh with share of 18.45% in total energy-generating products consumption.

The building sector of Trebinje municipality in 2001 year consumed 150,598.21 MWh what makes 73.14% of totally consumed energy. In the second place is the traffic sector with 54.065,00 MWh or 26.26% of totally consumed energy of the muncipality of Trebinje in 2001 year. On public lighting goes 0,60% of totally consumed energy or 1.240.29 MWh.

It is important to mention that of totally consumed electric power in 2001 year 20.860 MWh refers to the distribution losses. It was estimated that approximately 50% of losses referred to electric power theft, which is essentially actual consumption, and the rest belongs to the technical losses

The coal data are submitted in tons, while wood data in m^3 so it was necessary to convert them into equivavalent energy values. The conversion was done according to the IPCC methodology from 2006 year. According to available data coal in Trebinje municipality is used exclusively for heating. The most used is lignite from the coal mine Banovići or Miljevina with low content of tar, according to which was chosen the mass conversion factor in energy of 5,3 value. [5]

The estimation of fuel wood consumption in Trebinje municipality is based on the data from Bosnia and Herzegovina Energy Sector Development Study, where while the study has been developed was done a detailed systematic analysis of energy-generating products consumption for residential facilities heating. The most used types of fuel wood are oak and beech. Based on the data of consumed volume, average specific wood weight with humidity 15-20% (oak,beech) of 760 kg/ m^3, and mass unit conversion coefficient in energy of 1,95 MWh/t, was obtined total energy value of 41.414,49 MWh.

[5] How to Develop a Sustainable Energy Action Plan (SEAP) – Guidebook, European Union, 2010, p.82

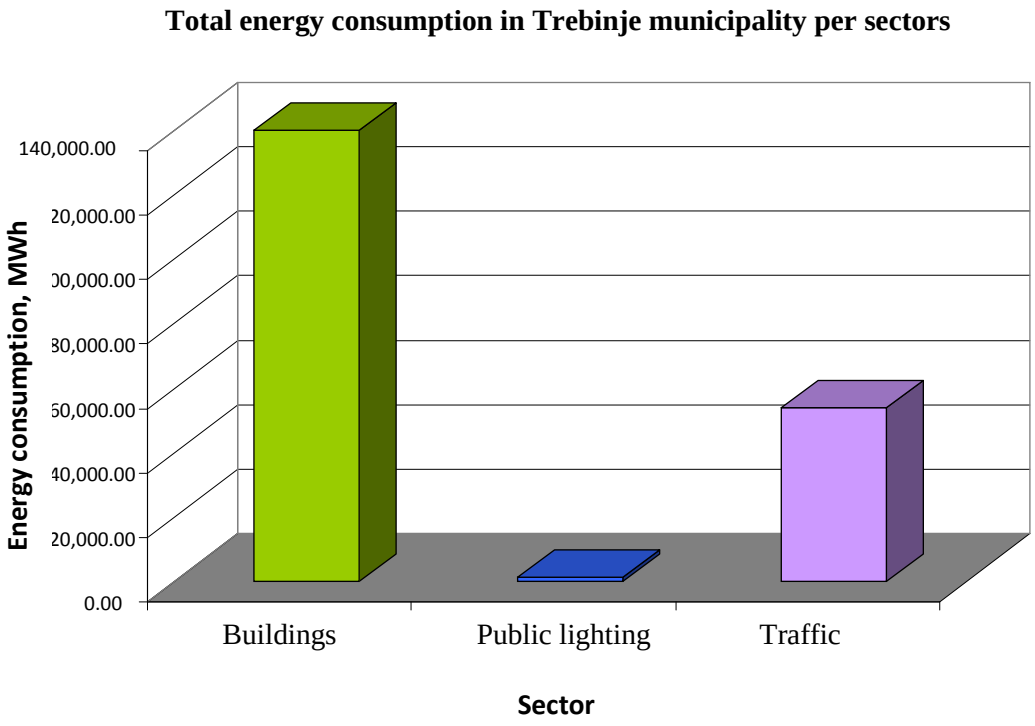

Figure 4.2: Structure of energy consumption per sectors

In Figure 4-2 is shown distribution of total energy consumption in Trebinje municipality per sectors. It is obvious that the greatest energy-generating product consumer is the building sector with 73,14% of total energy consumption.

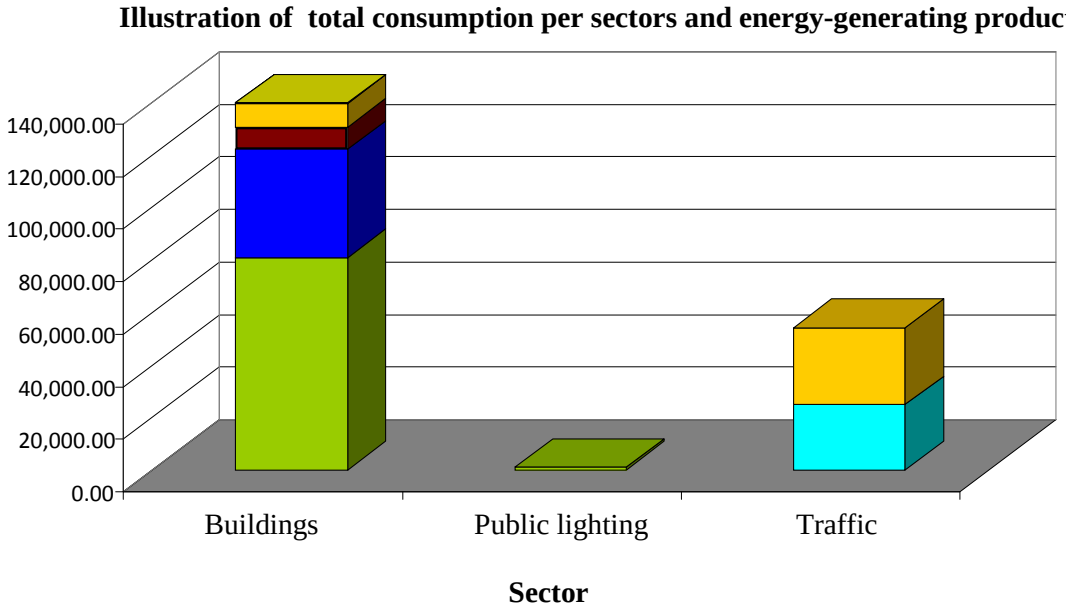

Figure 4.3: Distribution of sector energy consumption per energy-generating products

Electric power consumption in the building sector is 91,513.05 MWh which is 98.66% of total consumed electric power in Trebinje municipality, while the rest goes on public lighting sector. In percentage the consumption of electric power in the building sector, compared to the other energy-generating products consumed in that

sector is 60.77%. The second most frequently used energy-generating product in the building sector is fuelwood with 41.414,49 MWh or 27.49%, i.e. 20.11% of the total electric power in Trebinje municipality. The traffic sector participates with 26.26% in the total energy-generating products consumption. In 2001 year in the transport sector dominated two energy-generating products, fuel and diesel in the amount of 24,842.00 MWh, and 29,223.00 MWh.

4.3. CO_2 emission of Trebinje municipality

Calculation and monitoring of the total CO_2 emission in Trebinje municipality was obtained on the basis of collected data of total electric power consumption. Distribution of issuers was also done according to different sectors, except that it was added CO_2 emission generated in the processes of waste water and communal waste treatment.[6]

[6] How to Develop a Sustainable Energy Action Plan (SEAP) – Guidebook, European Union, 2010, p. 83

4.3.1. Reference inventory of CO2 emission in the building sector

All CO_2 emission results in two ways, directly through fuel combustion and indirectly through the use of electric power. The greatest consumption of energy-generating products in the building sector goes onto energy used for heating and cooling. This energy is obtained through fossil fuels and fuelwood combustion and in one part from electric power. Emission from fuel combustion is obtained by multiplying the standard emission factors and consumed electric power. For energy consumption was taken emission factor for Bosnia and Herzegovina, recommended by the EBRD. [7]

Table 4.2: Share of energy-generating products in total CO_2 emission in the building sector

CATEGORY	CO_2 Emission						
	Electric power	Fuel oil	Diesel	Fuel	Coal	Wood	TOTAL
Buildings and companies owned by town	1,072.13	31.25	33.74	0.00	256.73	17.92	1,411.78
- TOWN ADMINISTRATION	312.50						312.50
- HEALTH AND NURSING INSTITUTIONS	476.15				110.03		586.18
- CULTURE	118.26		33.74				152.01
- SPORTS FACILITIES	165.21	31.25			146.70	17.92	361.08
Public adminstration buildings, commercial and service activities	12,472.52	0.00	428.55	49.67	770.20	8.96	13,729.90
- EDUCATION	258.54		19.51		130.76	0,00	408.81
- JURISDICTION	70.18				62.41		132.59
- STATE GOVERNMENT BODIES	60.64				12.38		73.02
- HEALTH SERVICE	242.60		33.73				276.32
- OTHER INSTITUTIONS	11,840.56		25.23	40.50			11.906.29
Residental facilities	53,180.59				1833.80	16,663.16	71,677.56
TOTAL BUILDING SECTOR	**66,725.24**	**31.25**	**462.29**	**49.67**	**2,860.73**	**16,690.04**	**86,819.23**
Industry	9,322.11	78.12	1878.23	11.25	0.00	0.00	11,289.70
TOTAL BUILDING SECTOR	**76,047.35**	**109.37**	**2,340.52**	**60.92**	**2,860.73**	**16,690.04**	**98,108.93**

[7] Electricity Emission Factors Review, European Bank for reconstruction and Development, 2009, p. 2

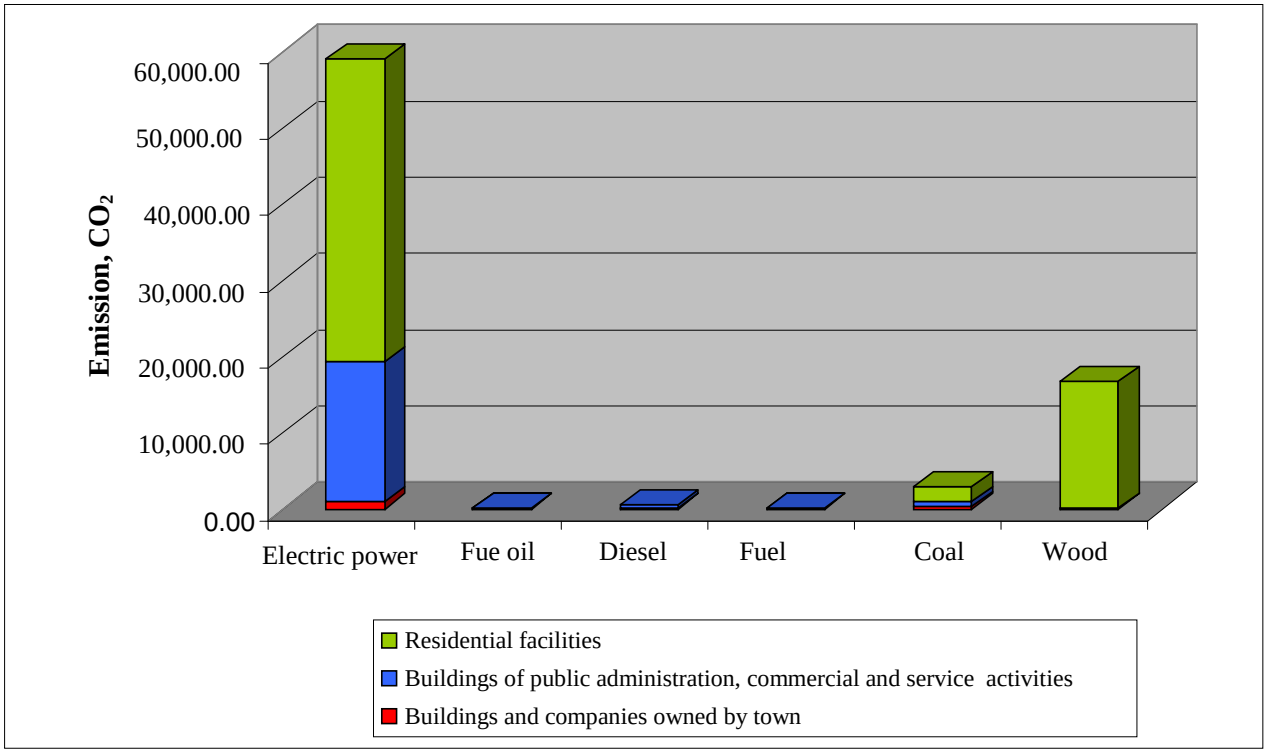

Figure 4.4: Distribution of sector CO2 emission per energy-generating products

It is obvious from the Table 4-2 and the Figure 4-5 that the greatest share in CO_2 emission indirectly makes electric power with a share of 75,51%, while the rest of the emission comes from combustion of different fuels. According to the sectors, the greatest issuer represents residential sector with 82.56% of CO_2 emission. According to the calculation, the use of fuelwood is the second largest source of CO_2 emission within residential sector. Conversion factor to calculate emission of fuelwood use varies depending on type of logging. In the case of Trebinje municipality was taken the maximum value of factor, because it is, solely, of non-selective forest logging. Buildings of public administration, commercial and service activities participate in the emission with the percentage of 15.81%, while the rest of 1,63% relates to the buildings owned by Trebinje municipality, what is obvious in Figure 4-6.

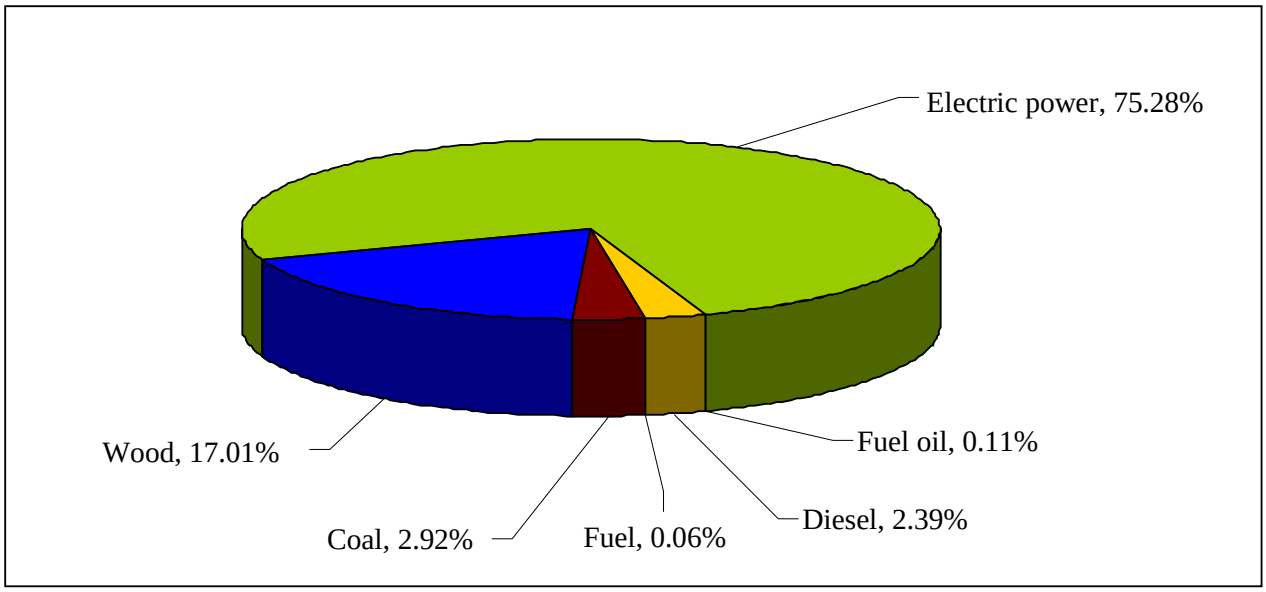

Figure 4.5: Distribution of CO_2 emission per energy-generating products

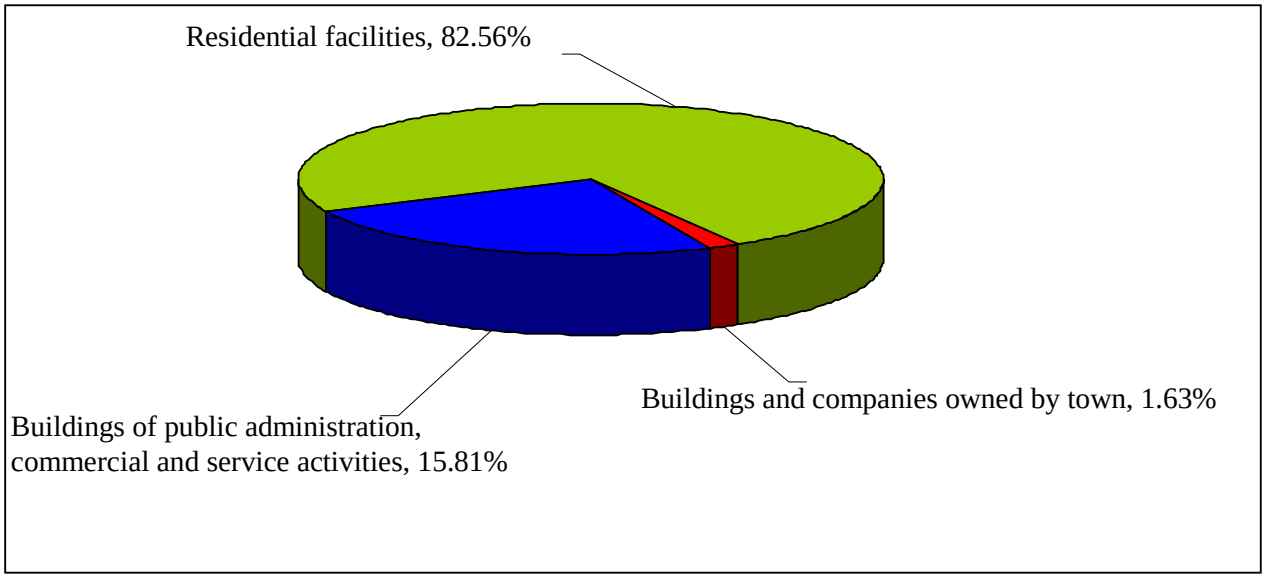

Figure 4.6: Distribution of CO_2 emission per sectors

4.3.2. Reference inventory of CO_2 emission of the traffic sector

Number of registered vehicles in Trebinje municipality was obtained on the basis of data extrarpolation on the number of vehicles movement in 2003 and 2010 year. According to that calculation the number of registered vehicles in 2001 year was 6891. The main characteristic of the entire fleet of Trebinje municipality is relatively high average age of the vehicles which is 12 years. The structure of the entire fleet is shown in the Figure 4-7.

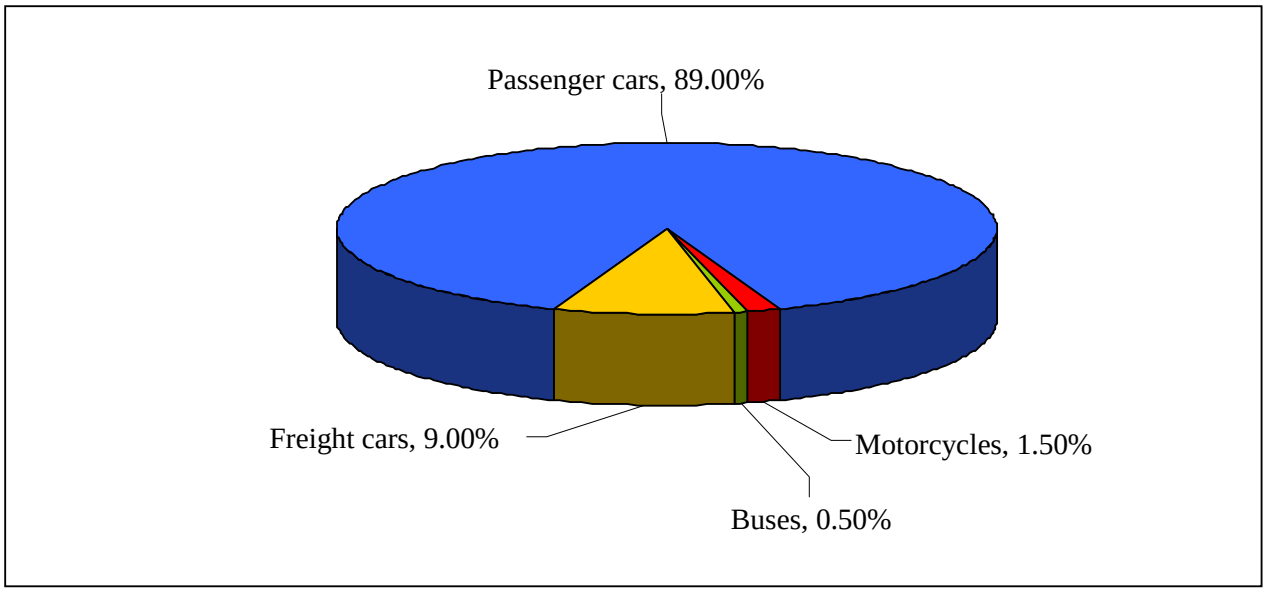

Figure 4.7: Trebinje municipality fleet structure

CO_2 emission in traffic sector was obtained on the basis of multiple of standard emission factors and the assumed energy fuel sizes, and all in accordance with the IPCC methodology. Calculation of the quantity of fuel used has done on the basis of recommendations for data collecting on road transport from the second part of the SEAP manual.

4.3.3. CO2 emission of the vehicles owned by Trebinje municipality

Trebinje municipality had in its possesion 3 passenger cars in 2001 year (2 vehicles with diesel engine and 1 with fuel engine). The total number of passed kilometres in 2001 year for these vehicles was 105.000, what is 35.000 kilometres per vehicle annually.

Table 4.3: Share of energy-generating products in total CO_2 emission in traffic sector

Fleet owned by the town	Quantity of fuel consumed		Emission
	l	MWh	T CO2
Fuel	3360	31	7,72
Diesel	4830	48	12,82
TOTAL	**8190**	**79**	**20,54**

4.3.4. CO_2 emission of private and commercial vehicles

In the territory of Trebinje municipality in 2001 year was 6891 registered vehicles. Registered vehicles are characterized by relatively high average age which is 12 years. As for the types of motor fuel, 47% of vehicles have diesel engine, and 53% fuel engine. According to the fleet structure, 89% of the registered vehicles are passenger cars, and about 9% are freight cars, 0,5% are buses and 1,5% are motorcycles.

Table 4.4: Total fuel consumption and equivavalent CO_2 emission of private and commercial vehicles

Category	Number of vehicles in 2001 (Estimate)	Fuel consumption, MWh	t CO2 emission
Passenger cars	6131	38428	9839.61
Freight cars	620	14473	3864.19
Buses	34	788	210.35
Motorcycles	103	298	74.17
TOTAL	**6888**	**53987**	**13988.32**

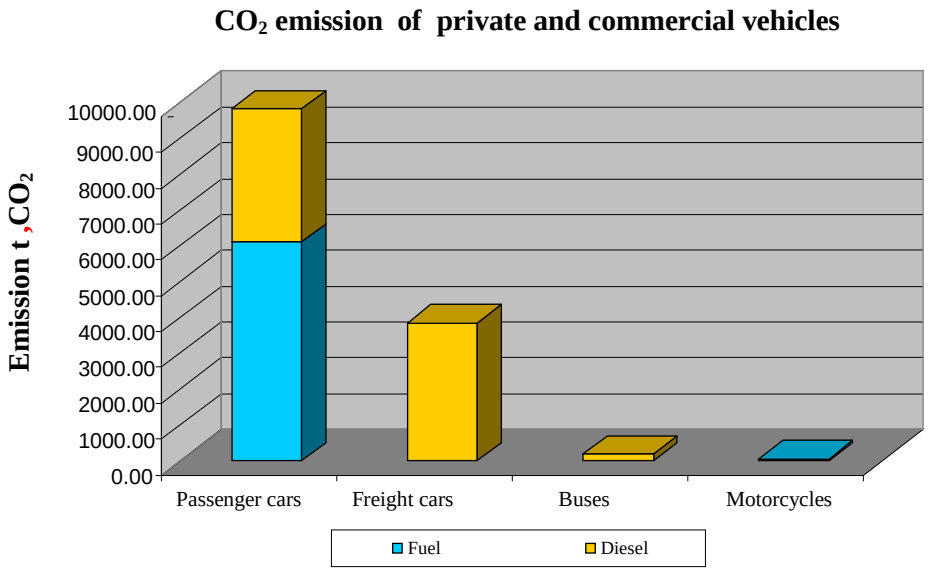

Figure 4.8: Distribution of CO_2 emission per type of motor fuel and vehicles type

4.3.5. Total CO_2 emission of Trebinje municipality traffic sector

Overall fuel consumption and emission equivalent is given in the Table 4.5.

Table 4.5: Total fuel consumption and equivalent CO_2 emission of Trebinje municipality traffic sector

Subsector	Number of vehicles	Energy consumption, MWh			t CO_2 emission		
		Fuel	Diesel	TOTAL	Fuel	Diesel	TOTAL
Vehicles owned by Trebinje municipality	3	31	48	79	7,72	12,82	20,54
Private and commercial vehicles	6888	24811	29.175	53986	6177,94	7790,73	13967,66
TOTAL	**6891**	**24842**	**29223**	**54065**	**6185,66**	**7802,55**	**13988,20**

The vehicles owned by Trebinje municipality in 2001 year participated with 0,15% in total number of vehicles registered in Trebinje municipality, while the rest went on private and commercial vehicles.

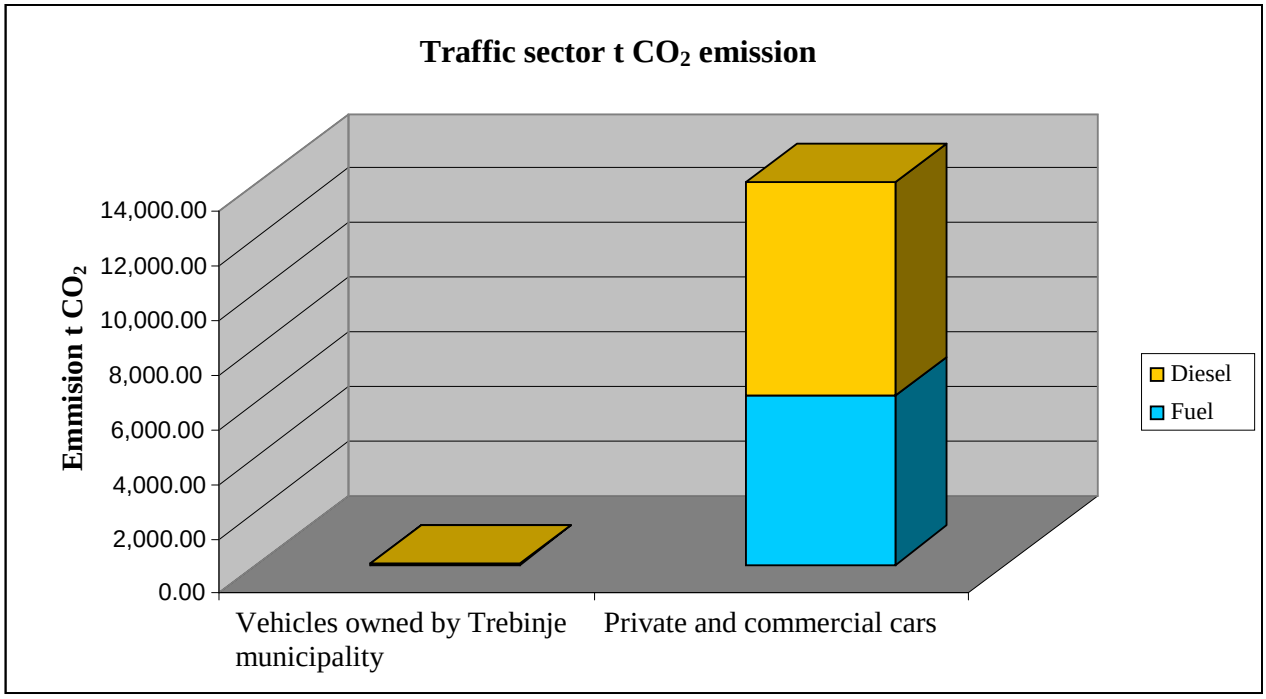

Figure 4.9: Distribution of CO_2 emission per type of motor fuel and traffic subsectors

4.3.6. CO_2 emission reference inventory of the public lighting sector

Public lighting is based on electric power consumption so CO_2 emission is of indirect character. In Table 4-6 is shown comparative overview of electric power consumption and equivalent CO_2 emission in Trebinje municipality public lighting sector in 2001 year.

Table 4.6: CO_2 emission in public lighting sector

	Electric power consumption	Emission factor	Emission
	MWh	tCO2/MWh	tCO2
Public lighting	1,240.29	0,831	1,030.68

4.3.7. Reference inventory of CO_2 emission from waste and waste water treatment

Total CO_2 emission resulted from waste and waste water treatment is 5,697.54 tons of CO_2. The methodology used to calculate CO_2 emission, resulted from an open combustion of communal waste and waste water treatment, was defined in 2006 year by the IPCC.[8]

4.3.8. Reference inventory of CO_2 emission from waste treatment

The calculation of CO_2 emission is based on the data from different types of sources obtained by evaluation. By Trebinje General urban plan 2002-2015 year was estimated that in Trebinje municipality live 30.627 [9] inhabitants, whereof in the urban area, where is generated most of communal waste, live 26.003 inhabitants. By an open combustion of communal waste the most emitted into the atmosphere are CO_2, CH_4, N_2O. How is the reference inventory exclusively for CO_2 emission, the emission of other two combustion products will be expressed in equivalent CO_2 values.

Population of Trebinje municipality generated in 2001[10] year 7000 tons of communal waste. Of that amount 6000 tons or 12000 m^3 was collected and disposed. By the structure[11], 48% of the collected waste is organic waste which can be seen in the Figure 4.10.

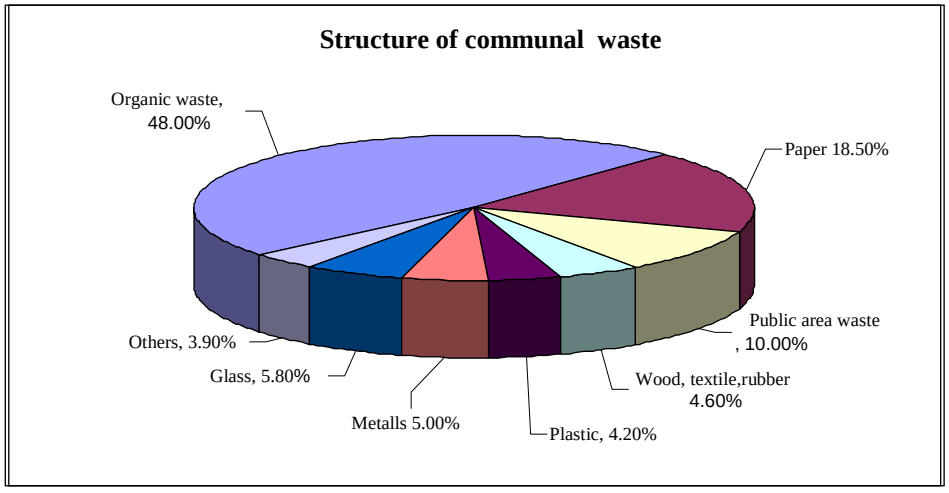

Figure 4.10 Structure of collected communal waste

[8] IPCC 2006, 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Published: IGES, Japan.

[9] General urban plan of Trebinje 2002-2015, Trebinje municipality, The Institute for Urbanism of the Republic of Srpska, Banja Luka

[10] Data taken from Joint stock company " Komunalno"-Trebinje

[11] Waste management for the local dump site "Obodina" near Trebinje, February 2008 year, Civil Engineering Institute "IG", ltd Banja Luka

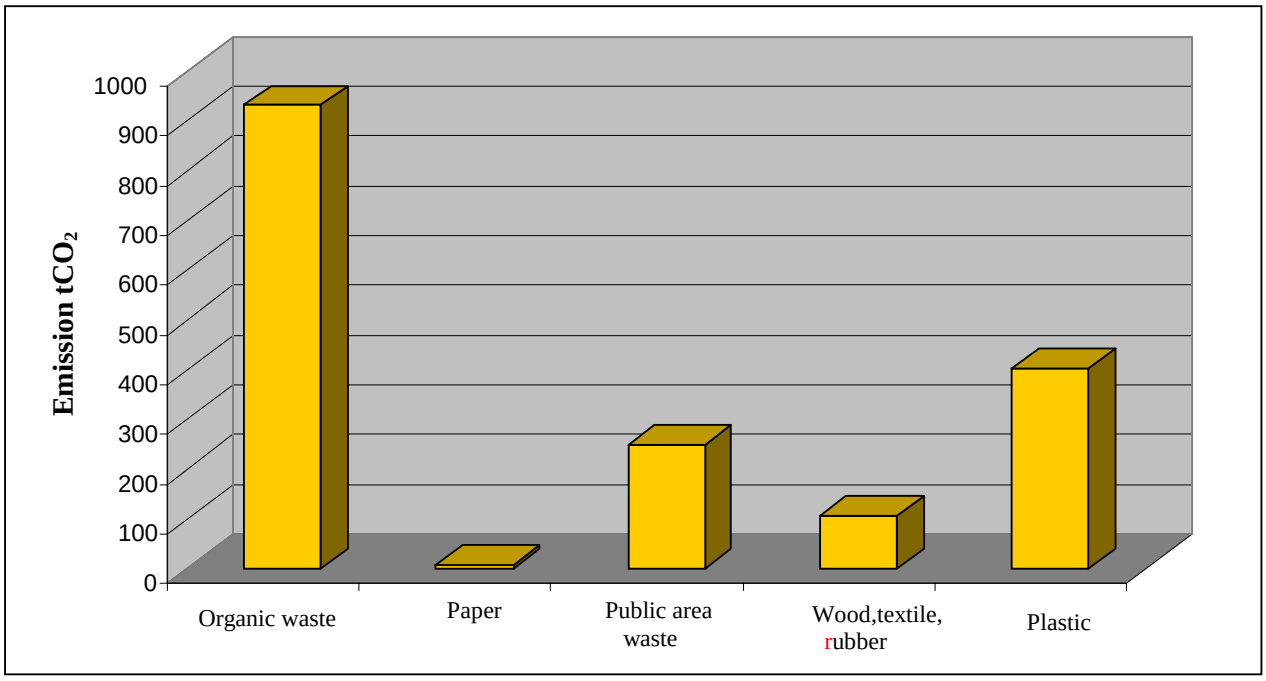

Figure 4.11: Share of CO_2 emission per communal waste structure

By the calculation was obtained total CO_2 emission from an open waste combustion which is 3021 tons of CO_2. By combustion is directly obtained 1713 tons of CO_2, while 1029 tons of CO_2 represents equivalent to 49 t of CH_4 obtained by combustion and 279 t represents equivalent to 0,9 t of N_2O obtained by combustion.

4.3.9. Reference inventory of CO2 emission from waste water treatment

By the calculation of CO_2 emission resulted from waste water treatment was also used the methodology recommended by the IPCC. The plant for waste water treatment in 2001 year processed [12] 1.525.466 m^3 of waste water, whereas the biochemical oxygen consumption (BPK-BOD) [13] was 0,174 kg/ m^3. CO_2 and N_2O emission as products of waste water treatment was negligible, while emission of CH_4 was siginificant, and in 2001 year was 127,41 t of CH_4 what is equivalent to 2.675,54 t of CO_2.

4.3.10. Total CO_2 emission of Trebinje municipality

Reference inventory of CO_2 emission of Trebinje municipality includes direct CO_2 emissions caused by fuel combustion and indirect CO_2 emission from electric power consumption from the building sector, public lighting and traffic, as well as emissions from waste and waste water treatment. In Table 4-7 is shown CO_2 emission per diferent sectors and energy-generating products.

[12] Data taken from joint stock purification company "Vodovod"-Trebinje, March 2011 y.
[13] Work analysis of the purification devices in Trebinje, 2002 y.

Table 4.7: CO_2 emission per sectors and energy-generating products

Energy-generating product	CO_2 emission					
	Buildings	Public lighting	Traffic	Waste & waste water treatment	Total per energy-generating products	Share per energy-generating products
Fuel oil	109.37				109.37	0.09%
Diesel	2340.52		7803		10143.52	8.54%
Fuel	60.92		6186		6246.92	5.26%
Coal	2860.73				2860,73	2.41%
Wood	16690.04				16690,04	14.05%
Electric power	76047.35	1030.68			77078.03	64.87%
Waste and waste water				5697.54	5697,54	4.79%
TOTAL	**98108.92**	**1030.68**	**13989**	**5697.54**	**118826.14**	**100,00%**
Share of individual sector %	82.57%	0,87%	11,77%	4,79%	100,00%	100,00%

In Figure 4-12 is shown distribution of total CO_2 emission per energy-generating products, and in Figure 4-13 distribution of total CO_2 emission per sectors.

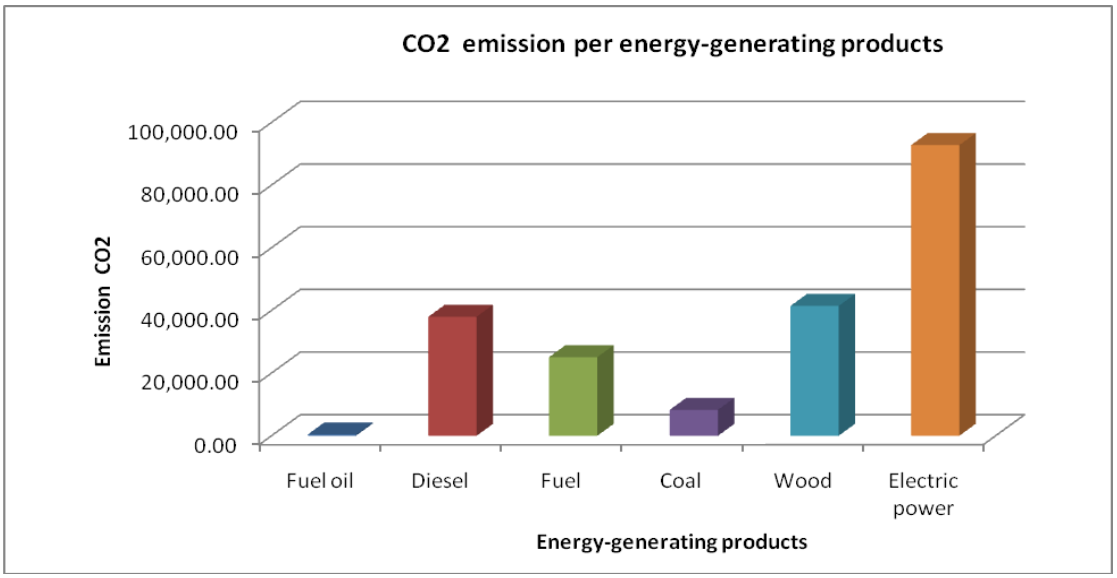

Figure 4.12: CO_2 emission per energy-generating products

Total CO_2 emission of Trebinje municipality in 2001 year was 118.826,14 t of CO_2. Consumption of energy- generating products by the building sector is much higher than the traffic sector so the ratio of emissions is on the side of building sector with 98.108,92 tons in relation to CO_2 emission of 13,989.00 tons of the traffic sector.

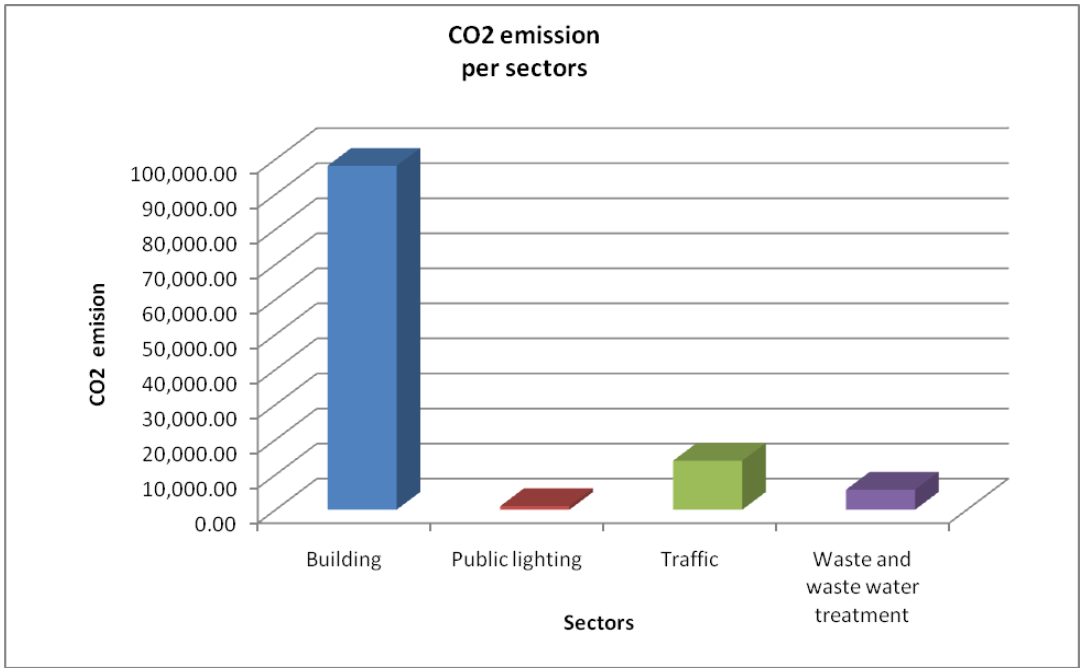

Figure 4.13: CO_2 emission per sectors

In 2001 year the most dominant energy-generating product, per consumption, as well as per CO_2 emission in Trebinje municipality, was electric power. Electric power participates in total emission with 77,078.03 tons of CO_2 or 64.87%. Beside electric power dominates the use of wood with 16.690,04 tons of CO_2 or 14.05%, and diesel which participates with 10,143.52 tons of CO_2 or 8.54% and fuel with 6,246.92 tons of CO_2 or 5.26%. It is also significant the emission from waste and waste water treatment in the total amount of 5,697.54 tons of CO_2 or 4,80%.

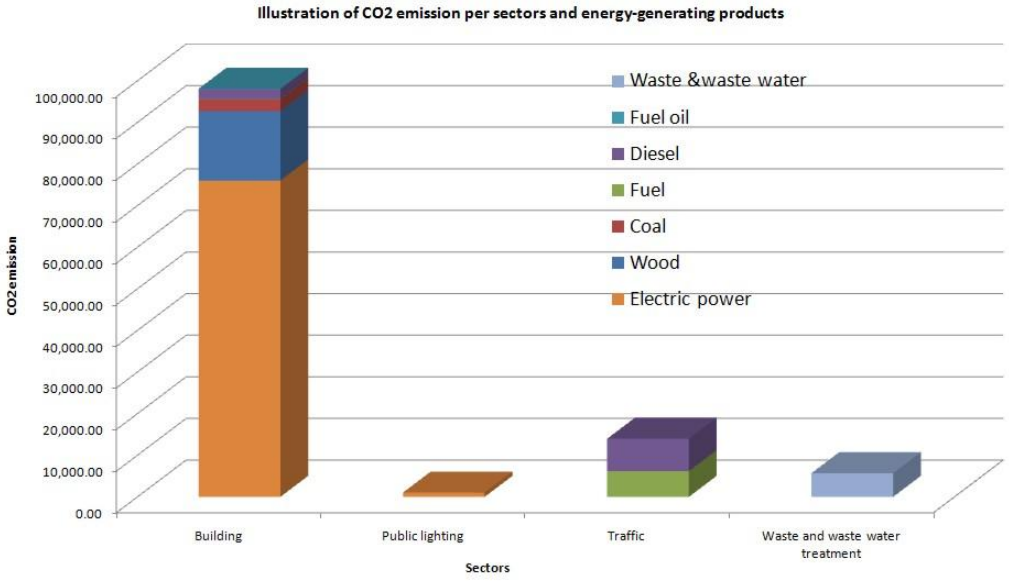

Figure 4. 14: Illustration of CO_2 emission per sectors and energy-generating products

Building sector as the largest CO2 emission generator, is at the same time the largest electric power consumer. This sector, also, accounts for total consumption of fuelwood.

SPATIAL PLANNING AND BUILDINGS

5. 5. SPATIAL PLANNING AND BUILDINGS

5.1. Characteristics of the existing urban area

Trebinje is located in the furthest southeast of Bosnia and Hezegovina and it represents the regional centre in the network of settlements, and by the Spatial plan of the Republic of Srpska Trebinje was given the function of primary regional centre of Trebinje-Srbinje region.

- Town position at the border of three countries (Montenegro to the east, and Croatia to the south) caused specific historical town development in economic, military-strategic, touristic and cultural sense.
- Physical geography position at the turn of the high mountain ranges, in the hinterland to the coast in the south, led to the changed Adriatic/Mediterranean climate.
- The morphology of the terrain and the river Trebišnjica flow influenced formation and development of spatial structure of settlements, so the very town centre was formed in the flattened, wider coastal zone of the river Trebišnjica flow, and residental settlements with dominant individual housing at the contact zone, i.e. at the foot of surronding hills and along major traffic routes-to Mostar, Nikšić, Herceg Novi and Dubrovnik.
- Demographic processes, especially in the wartime 1992-1995 year influenced the change of population structure and the way of town spreading. The achieved level of Trebinje urban development is thus the result of mentioned influences and their interrelations.

5.1.1. The continuity of the urban development

In terms of historical heritage, it can be seen the most dominant periods in the town which today define architectural image of Trebinje:

- Medieval complex within the walls of the Old town;
- Buildings from the period of Austro-Hungarian rule ;
- Buildings from the period of Kingdom of Yugoslavia;
- Facilities from the period after the Second World War;
- Construction after the civil war 1992-1995 year.

The town centre has in the greatest measure characteristics of the period until the Second World War, with the strong influence of coastal construction. The expansion of the town and increase of development of the existing urban structure followed after the Second World War. The greatest part of such construction is on the left bank of the river Trebišnjica, blocks of collective residential construction. Settlements with individual housing, from the same period of construction supervene the very town centre, but often with irregular and often incomplete urban matrix and infrastructure equipment. Newer construction, after 1995 year includes certain facilities of central functions and collective housing in town centre and especially individual construction in the suburb.

5.1.2. Functional zones

The central town zone is characterized by a mixture of central functions: business and commercial activities, tertiary activities, individual and collective housing, institutional facilities, education, health service, culture, sport and recreation facililities, religion facilities, park and green areas. Moving away from the centre, this diversity decreases in favour of housing. In the collective housing blocks built after 1960 year, regarding that time regulations, there is a reliable infrastructure equipment, educational facilities, commercial and teritary activities. In the blocks, of individual housing, built in accordance with then housing policy, there are only sporadically trading services, in the form of smaller facilities for the basic supply of population. Beside the lack of accompanying facilities, the characteristic of this zone is presence of agricultural land at individual parcels, poor infrastructure equipment, inadequate street regulation, or a general decrease in the urban level.

5.1.3. Population density and compatibility of the urban development

On the basis of valorisation from 2001 year, the very urban area of Trebinje had 24100 inhabitants, whereof individual housing included 15800 inhabitants, and collective housing 8300 inhabitants. Outside the inner town area population was 2700, and the total number of inhabitants in the area covered by the General urban plan, was about 26800.

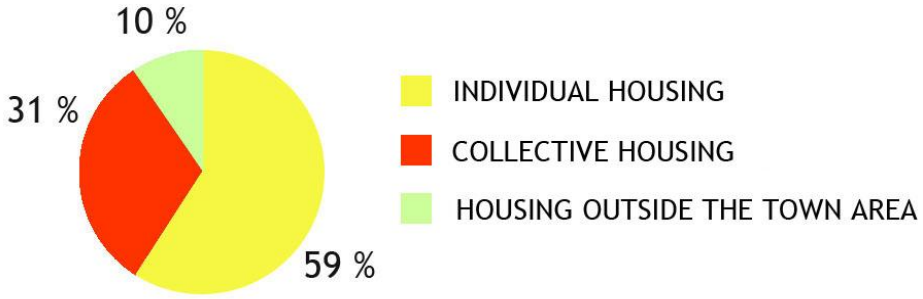

Figure 5.1: Structure of housing type

Since the town Trebinje covers the area of 10027 ha, the average population density in the town in 2001 year was 2.67 inhabitants/hectare.

The highest population density in the town area have collective housing blocks (Bregovi, Ložiona,Gradina, Gorica, Tini) with 150-220 inhabitants/hectares. According to data from 1996 year, density of population of Trebinje municipality was 35,14 inhabitants/km^2.

The regularity of the urban matrix can be seen in:

- town centre, where we have closed blocks and strong street regulation, the regulated public and green areas,
- collective housing blocks built after 1960 year, with residential buildings as individual facilities, or in a sense of lamellas, defined traffic regulation, resolved accesses and parking,

- partially in town parts with individual housing (Police, Abrazovina (Banje), Gorica and Hrupjela), where there are certain regularities in respect of street regulation and positioning of facilities on a parcel, so those parts of settlements are formed in a sense of individual houses on individual parcels, following the roads and morphology of a terrain.

Availabity of the most important contents and services in this part of the town is on satisfactorily level, either due to a central position in town or to planned construction after 60's. In the other parts of town, where individual housing is dominant purpose of areas, it occured dissipation of urban matrix and uncontrolled expanding of town, due to non-existence or disrespect of the legal frameworks and planning documents, as well as socio-economic circumstances after 90's. Inevitably, there is lack of the accompanying contents and poor connection to the town centre which is reduced to the use of individual vehicles, because the public transport is not established in Trebinje yet. It is clear that there was an expansion of the town beyond the one centre servicing border. That is one of the basic starting point in defining The Plan of organization, regulation and use of space in the General urban plan of Trebinje 2002-2015 year.

5.2. General goals of development due to the General urban plan of Trebinje 2002-2015 year

Goals and guidelines defined by the General urban plan of Trebinje 2002-2015 year represent the base for energy efficient urban planning and make of detailed spatial-planning documents. Some of the goals which directly affect town urban development, in accordance with energy responsible behaviour, is already partially or completely implemented into practice such as:

- “Utilization of the existing unused facilities and areas“
- “Relocation of the industry from town centre and development of working activites suitable for the town centre and very town centre“
- “Change of the road network in order to improve the availability of town centre to main routes, and the more direct connection of the urban settlements“

Some of the guidelines that should be followed when making detailed spatial-plan documents are:

- “Reconstruction and making dense the centre of a narrow urban region, especially degraded parts of the narrow urban region.“
- “Increase of urban standards and made suburban settlements by the construction of a necessary technical and social infrastructure. “
- “Introduction of a public transport system in the form of town and suburban transport“
- “The establishment of 3 new secondary urban centres in Gorica, Draženska Gora and Bihovo, where public activities are planned.“
- “Enviroment protection through protection of unrenewable resources, energy saving and use of the “cleanest“ possible technologies, waste reduction and its recycling, etc.
- “When designing the planned facilities apply modern materials with low coefficient of heat permability, as well as the application of modern world trends, and consumption of alternative energy sources (solar systems), as well as

heat pumps, which in the winter period provide necessary heating, and in the summer period cooling energy. “

5.3. Integration of energy efficient criteria in the urban development and planning

Upon developing detailed spatial-planning documents, beside guidelines given in the General urban plan of Trebinje 2002-2015 year, it is also necessary to determine the number of measures, i.e. energy planning criteria, in order to achieve as easier as possible implementation of the projects related to the energy efficient consumption of energy in the buildings.

Factors influencing the “healthy“ urban planning are:

- population density,
- compact urban solutions,
- urban zoning and balance of functions (housing,services, employment),
- controlled planning of urban growth,
- blending of functions in certain spatial units,
- functional network of road routes and establishment of “car-free zones“
- preservation of the existing and forming of new green areas,
- controlled infrastructure in the function of urban contents,
- sustainable construction (facility shape and orientation, vegetation around buildings, green roofs, the proportion between width, length and height, the proportion of glass surfaces on the facades, etc.).

Energy efficient urban planning and reduction of CO_2 emission are involved in the early stages of new facilities designing, but also the renovation of old buildings that, thus minimize energy consumption and examine methods for better integration of renewable energy sources, new technologies for energy saving and rational use of energy. The development process of“healthy“ urban tissue begins from planning documents and number of legislative measures. So the steps to be taken are next:

- respect to the existing General urban plan,
- development of the regulation plans and urban projects in accordance with energy efficient planning,
- citizens and institutions public awareness raising on the necessity for energy efficient solutions application,
- development of project and studies related to energy efficiency and their application,
- adoption of new and more rigid compliance with the existing regulations in the field of construction.

5.4. Buildings

5.4.1. Characteristics of the existing facilities

The condition of built facilities in the town Trebinje can best be seen the through classification according to the period when they were built, and socio-economic circumstances in which they arose.

5.4.1.1. Medieveal complex within the walls of the Old town

The facilities located within the walls of the Old town, together with facilities on the slope Sunčani Brijeg (Krš) are the oldest, and have the smallest standing. Considering that they request special treatment of preservation and protection, they at this time cannot be the subject of further analysis.

5.4.1.2. Buildings from the period of Austro-Hungarian rule and the period of the Kingdom of Yugoslavia

Although very old, these facilities are characterizied by a quality construction, regarding the use of material and construction, so in terms of funcionality and outlook. Despite that, life expectancy of these facilities is too long to keep satisfactory level of preservation and in order to respond to all changes that have occured in a lenghty time period. Today needs and standards are on rather higher level, and the market of material and construction technicques are highly developed and offer an opportunity for rehabilitation and reconstruction of these facilities. Outer walls are of full bricks and have no thermal insulation layer, so the role of thermal insulators overtake the very thickness of a wall, what is insufficent for current standards. On some facilities were changed the windows or were carried out repairs of roofs, but those are just partial measures which do not solve the problems of heat permeability of these facilities envelope.

5.4.1.3. Facilities from the period after The Second World War

Afterwar construction in momentum of the country development, a newly established socioeconomic system and policy of equality, marked all the cities in the territory of such time country. In that period in Trebinje were built facilities which more belong to the modern than to socrealistic architecture, so they well integrated into the existing urban matrix. This was supported by natural and created town potential, and Trebinje has kept an identity and spirit of the place. Planned construction, standards setting up and the Book of Rule in construction, and economic stability, influenced on town urbanization and general growth of life quality. New materials and construction techniques responded the need for a rapid construction, while the questions of heat permeability of a building envelope and energy efficient construction in general, were neglected. There were not for a long time standards to obligate on such attitude toward construction, and there were built facilities with poor thermoinsulated layer or without it. If we take into account the age of those facilities, and very often poor maintenance,

the conclusion is that the most of them today cannot respond the temporary needs for comfort heat, because of building envelope poor quality, as well as bad state of installations. Something better situation is with the facilities built from the end of 70's and early 80's, and they represent suitable potential for improvement of the envelope energy efficiency.

5.4.1.4. Construction after the civil war 1992-1995

Intensive construction, characteristic for afterwar period, was after 1995 year completely different from the one of the previously described period. The change of social constitution brought major changes in terms of property possession and economic power that passed into private hands. Although regulations, materials and construction techniques progressed, a decisive role in poor construction quality had small budget of projects and bad performance of works. Residential-commercial facilities and single family houses were mostly built. Thermal insulation layer in a building envelope has become a standard, while quality of facade joinery is often very bad, and thermal insulation either inconsistently or poorly performed. This is especially true for individual construction, where due to the need for faster solution of existential questions, appears a large number unfinished houses. They that way give great opportunity for their proper finishing, with compliance of regulations in relation to energy saving, that would provide users with necessary comfort and bring great saving to the house budget.

It can be concluded that the reasons for the current state of the facilities built in Trebinje following:

- Technical standards for building envelope construction are outdated;
- Technical standards for heating installations are outdated;
- Inadequate control of construction quality, especially in the area of private family houses;
- Poor maintenance of buildings and installations;
- Legal regulation for the sector of collective residential construction are undefined;
- Land registries are incomplete.

5.4.2. The connection between construction quality and facilities energy efficiency

Building sector is responsible for 40% of total energy consumption in Europe. At that, the greatest part goes on households, and in households on heating and cooling.

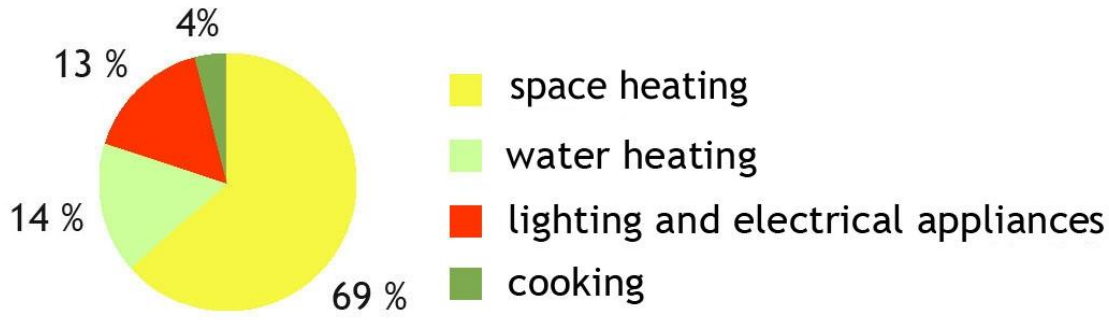

Figure 5.2: Household consumption structure

In defining mechanisms for achieveing greater electric power efficency in building sector, it is first important to define causes of heat losses. The greatest heat losses which appear on an average building are:

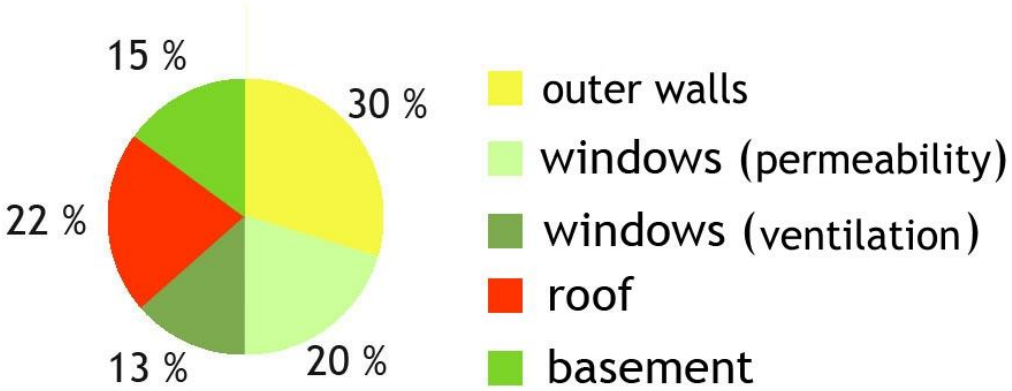

Figure 5.3: Structure of heat energy loss in residential facility

Stated energy losses relate only to the building envelope, and are not the only parameters that affect energy efficiency of a facility. There is also:

- facility position in relation to the sunshine and windrose,
- facility compact form,
- rooms allocation,
- method of heating and ventilation,
- state and preservation of installations,
- users habits.

Some of the parameters cannot be changed at the already built facilities, or their change is too big or unrewarding venture (facility position and form, rooms allocation,

etc.), while some facilities can be affected by measures to improve energy efficiency (facility envelope, installations, method of heating and ventilation, users habits). The most possibilities certainly offer facilities to be built, the only reason is not just that the measures for energy efficiency increase can be carried out on them easily, but also they can be built as low-energy or passive facilities.

5.5. Proposed activities related to CO_2 emission reduction in buildings

Successful implementation of energy efficiency measures in buildings is based on:

- change of legislative enviroment and compliance with the European regulations in the area of thermal protection and energy saving, and renewable energy sources application,
- an increase of thermal protection of the existing and new facilities,
- increase of system efficiency for heating, air conditioning and ventilation,
- increase of lighting system efficency and energy consumers,
- energy control and energy management in new and existing buildings,
- defining the target value of total annual consumption of a building per m2 or m3,
- introduction of "Energy passport" that would mark buildings according to annual energy consumption,
- continous education and promotion of measures for energy efficiency increase.

5.5.1. Individual measures for reduction of heat losses in the winter and overheating in the summer

- **Walls insulation**

Standard insulated facility has about 10 cm of thermal insulation on the outer wall and the coefficient of heat permeability U= 0.27 W/m^2K, low-energy facility of 15-20 cm thermal insulation has coefficient U= 0.20-0.15, and a passive facility with 25-30 cm of thermal insulation has U=0.10-0.13. It is recommended the outer wall to have U= 0.25-0.35 W/m^2K, that is about 10 cm of thermal insulation. Payback period for a wall without insulation, when 10 cm of insulation is added, for a brickwall is from 3-9 years, and for reinforced concrete wall from 2-5 years. In terms of enviroment, a brickwall of 25 cm with additional 10 cm of thermal insulation gives saving of a wall 108,8 kW/ m^2 annually, which means 35,70 kg of CO_2 / m^2 . A conrete wall of 18cm, with additional 10 cm of thermal insulation gives saving of a wall 229,60 kWh/ m^2 annually, which means 75,30 kg of CO_2 / m^2 .

- **Roofs insulation**

It is recommended the roof to have about 14 cm of thermal insulation, resulting in permeability coefficient U= 0.2535 W/ m^2K. The payback period for pent roof improvement is 2-4 and for flat roof 3-5 years.

In terms of enviroment, the improvement of a pent roof gives saving of a roof of 340 kWh/ m^2 annually, which means 111,5 kg of CO_2 per m^2. Improvement of a flat roof gives saving of 188 kWh/ m^2 annually, which means 61,70 kg of CO_2 per m^2.

- **Facade joinery**

Windows and outer doors on facilities must be of a high-quality and properly installed in order to avoid heat bridges. Good tightness, and prevention of the air penetration, brings great energy saving, up to 20%. Glazing should be done with 2 or 3 layer of glass. A typical heat permeability of a 1- layer glazing is 4.7 W/ m^2 K, and it can be reduced to 2.7 W/ m^2 K already with 2-layer glazing (more than 40% of energy consumption reduction per m^2 of glass). That can further be improved by using additional films (low emissivity argon filled glazing) even up to 1.1 W/ m^2 K and 0.7 W/ m^2 K for triple glazing.

Cheaper variant (but also weaker and short-term) is gluing of loe-e film on glass for emission reduction. Joinery profiles should also meet certain coefficients of heat penetration because 15-35% of losses and gains of a whole window go on frames.

- **Pipelines and heat reservoirs insulation**
- **Solar collectors installation**

Since Trebinje, due to the vicinity of the Adriatic sea and low altitude, has average annual air temperature of 14.2˚C and the actual duration of insolation of 2008 hours annually, it is very suitable for this system application. Thanks to them, it is possible to collect about 1000 κWh/ m^2 of heat energy annually. The pay back period is in average 7-8 years depending on a size and purpose of a solar hot water system.

- **Passive systems of energy use**

At application of passive system of energy use investments are minimal or there is no any, they just require studious design. That means: opening of the facilities towards the south, sun protection (blinds, screens, eaves,canopies, greening), wind protection, allocation of bedrooms and auxiliary rooms in a facility to the north and daily zones to the south, compact volume of a building, a possibility of twosided airing, a possibility of air preheating, before entering a room, appropriate surface of an opening on a facility (1/7-1/10 net area of a facility at residential facilities). Energy gains that could be achieved by proper orientation and facility shape go up to 15%.

- **Heating and cooling systems improvement**

Do an inspection, examination and sanitation/replacement of heating and cooling systems (boiler-rooms, substations and regulations) on built facilities, and in new facilities tend to low consumption and installion of integreated equipment for energy generation from renewable energy sources.

- **Lighting (incandescent; fluorescent; motion sensors)**

Compact fluorescent light bulbs convert electric power into light 5 times faster than light bulbs with filament wire, have lifetime from 4000-15000 hours while light bulbs with filament wire have an average lifetime of 1000 hours. They also do not give off harmful magnetic waves and are 100% recyclable. Thus lighting represents the most efficient saving for business sector. It can reduce lighting expenses up to 70%, and return on investment is usually bigger than 30%.

- **Electrical appliances efficency**

A label of energy class for electrical appliances became obligatory according to the Directive on energy efficiency marking for house appliances. It shows the average electric power consumption when using appliances and devices, and includes scale from A-G, where energy class A indicates appliance with the lowest consumption, i.e. the most efficient electrical appliance, and energy class G appliance with highest energy consumption, i.e. the least efficient electrical appliance. Appliances or devices are

classified into groups depending on the purpose, and each group has its own energy class that defines appliance or device energy efficiency.

- **Low-energy facilities and passive houses construction**

Low-energy facilities beside saving of electric power, and thus reduce expenses, also reduce CO_2 emission, which is very important for enviroment preservation. They have 4 times less electric power consumption than the existing newly built facilities, while the application of passive standards of construction reduce electric power consumption even 10 times.

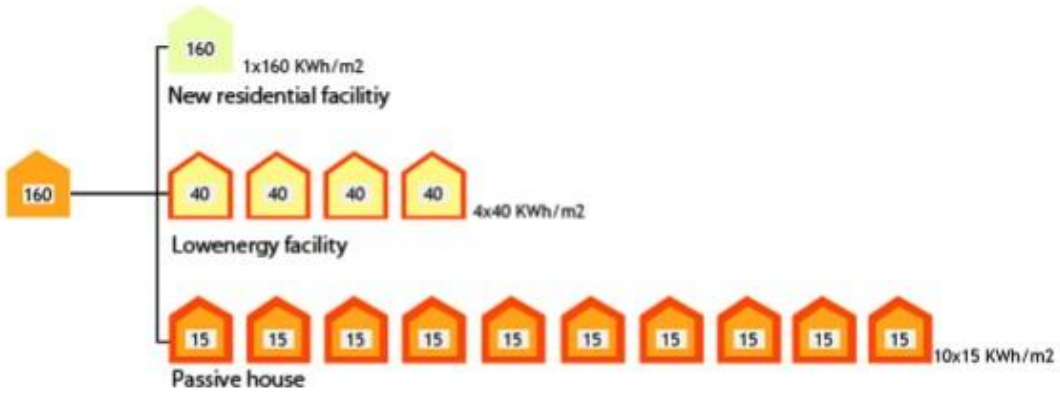

Figure 5.4: Comparison of consumption of three house types

5.5.2. Projects proposal for CO_2 emission reduction in the buildings

5.5.2.1. New facilities

The facilities to be constructed are the most favourable for the application of the mentioned measures of energy efficency improvement. The first step in implementation is development of a quality design documents, with strict respect of the highest standards, both in terms of urban conditions and in terms of conceptual design and the main design. It is therefore very important the design phase, and it should involve experts i.e. engineers, but it is also important the best possible informing and raise of users general public awareness, or investors, so the design documents to be in compliance with valid regulations and standards as well as best practices of the thermal insulation field. This also refers to the public and individual facilities.

5.5.2.2. The existing facilities being reconstructed

These facilities are very suitable for energy efficiency improvement, and will probably be the first from which will start implementation of measures, i.e. project development and work performance. They are at the same time the most numerous, so it is therefore first necessary to make an Energy Audit of a facility in order to identify the best options and prepare the investment plan. In relation to that will be carried out projects of investment maintenance, repair, remodelling or reconstruction, and all with strict respect of the highest standards.

5.5.2.3. Facilities in private property

The projects of energy efficiency increase on the facilites in private property depend on the needs and opportunites of the users/investors. As awareness and responsible behaviour towards efficient energy use are still not at the enough high level, it should be done a lot on energy efficiency promotion and point out all advantages of responsible behaviour toward energy use:

- reduction of energy-generating products consumption brings before all financial savings at all levels,
- improvement of life quality, higher quality housing,
- materials and equipment market development used to improve energy efficiency, and on the basis of that possibility to start your own business,
- prolongation of a building lifetime,
- greenhouse gases emission reduction.

Local authorities can contribute to this in more ways:

- negotiations with banks in order to provide suitable loans for the projects of energy efficiency increase,
- subsides for the materials and equipment market development used for energy efficiency increase,
- advice and cooperation on projects and introduction of the inspection to monitor standard application,
- its own example, i.e. development and implementation of the projects for energy efficiency improvement on the facilities owned by the town.

5.5.2.4. Public buildings

Local authorities should in any case be an example of proper and full implementation of the measures to improve energy efficiency. Therefore they shall be:

- adopted and consistently respected the highest standards,
- included experts from all areas related to energy efficency in energy development,
- work performance must be carried out with trained and qualified staff with close monitoring and inspection,
- specified a certain amount of renewable energy generation,
- demand an Energy study by analysis of all major options for energy consumption reduction,
- include predicted energy consumption as an important criteria in the tender (it should be calculated according to clear and well-defined standards),
- include price of energy consumption for the next 20-30 years in the tender criteria (not only construction price).

5.6. Literature

1. http://www.seea.gov.rs/ (accessed on 1st March 2011)
2. http://www.gradjevinarstvo.rs/TekstDetalji.aspx?ban=820&tekstid=1125 (accessed on 4th February 2011)
3. http://www.gradjevinarstvo.rs/TekstDetaljiURL/Optimizacija_energetskog_bilansa_gra%C4%91evinskih_objekata.aspx?ban=820&tekstid=1499 (accessed on 4th February 2011.)
4. http://www.breireland.ie/filelibrary/UK_PassivHaus_Primer.pdf (accessed on 5th February 2011)
5. http://www.energetska-efikasnost.undp.hr/index.php?option=com_content&view=article&id=187&Itemid=136 (accessed on 25th February 2011)
6. http://klima.mzopu.hr/UserDocsImages/0508_Zeljka_Hrs_Borkovic.pdf (accessed on 26th February 2011.)
7. Jovanović Popović, M. (2007). Obnova zgrada u kontekstu održivog razvoja. Orion art, Belgrade
8. Miloradović, N. (2009). Termički aspekti gradnje kuća. Građevinska Knjiga, Beograd
9. Pucar, M. (2006). Bioklimatska arhitektura.*IAUS*, Beograd
10. Pavlović, M., Radosavljević, J, Lambić, M. (2010.). Solarna energetika i održivi razvoj. *Građeviska Knjiga*, Beograd
11. Grupa autora (2002.). Urbanistički Plan Trebinja *2002-2015 (rezime)*. Urbanistički Zavod Republike Srpske a.d. Banja Luka
12. European Commission (2010). *How to develop a Sustainable Energy Action Plan (SEAP) - Guidebook*. Luxembourg: Publications Office of the European Union
13. Roland Leuck- Wirtschaftlichkeit der Gebäudedämmung (Economic of insulation of Buildings), Edith Antonatus - Sicherheit im Brandfall - Fassaden mit EPS/Neopor ohne Risiko (Fire security fasade of EPS/ Neopor). (предавање) *"Energetska efikasnost u domaćinstvima i zgradama"*. *Organizator*: Inženjerska komora Srbije i životne sredine i prostornog planiranja u saradnji sa Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ). 10.12.2010., Beograd
14. Albin Tornič, Goran Prolić. (lecture) *"Energetska efikasnost zgrada i JUB-ova rešenja u vidu termoizolacionih fasadnih sistema; prikaz odabranih primera sanacije fasada".Organizator*: Inženjerska komora Srbije i preduzeće JUB. 4th March 2011, Beograd


CO_2 absorbed by this tree is equal to
CO_2 emitted by air travel (in minutes)
9
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TRANSPORT

6. TRANSPORT

6.1. The characteristics of Trebinje municipality traffic system in terms of energy efficiency

The area of Trebinje municipality is characterized by the existence of only a road traffic system, while other forms of traffic are not represented. State of the traffic system can be described by its three constituent elements. They are: traffic infrastructure, public vehicles and the organization and regulation of traffic.

Traffic infrastructure of Trebinje municipality consists of highway, regional, local and uncategorized roads and town streets. The total length of traffic network is 511,40 km, whereof on highways go 92 km, on regional roads 55 km, local roads 170,50 km, uncategorized roads 143,90 km and town streets 50 km. All highways and regional roads have asphalt road surfacing, while of local and uncategorized roads one part of them also have gravel road surfacing. Town streets are,mostly, with asphalt road surfacing, but there are, mostly of a secondary and teritary level, with gravel road surfacing.

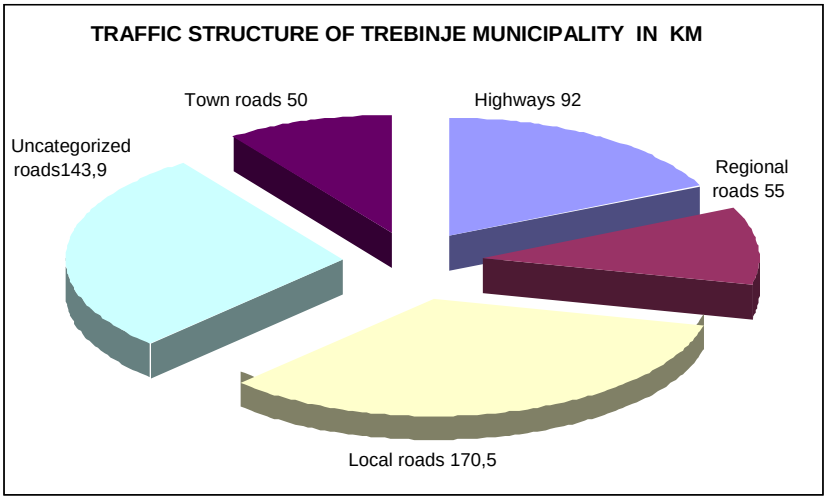


Figure 6.1: Traffic road infrastructure in the area of Trebinje municipality

According to the relevant records, there were 6891 of registered vehicles in Trebinje municipality in 2001 year. The fleet in Trebinje municipality is characterized by relatively high average age of vehicles, that is 12 years. As for the type of motor fuel, 47% of vehicles have diesel engines, and 53% of them have fuel engines.

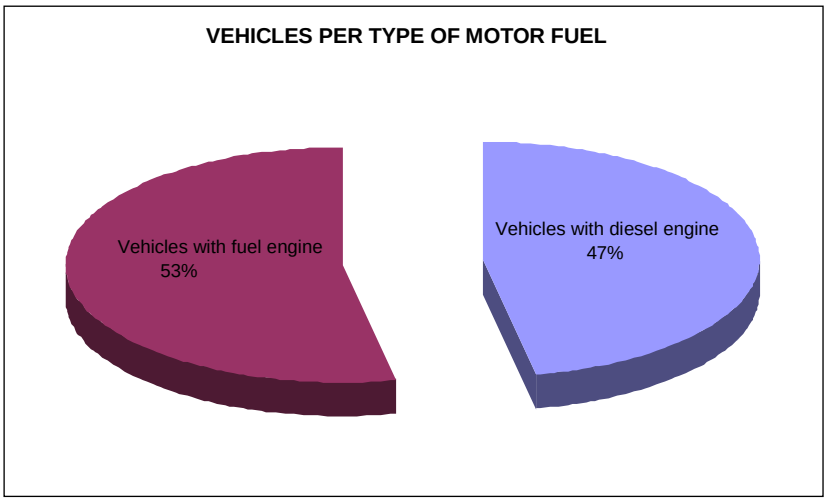


Figure 6.2: The fleet structure in Trebinje municipality per type of motor fuel

According to the fleet structure, 89% of the registered vehicles are passenger cars, about 9% of them are freight cars, 0,5% are buses, and 1,5% are motorcycles.

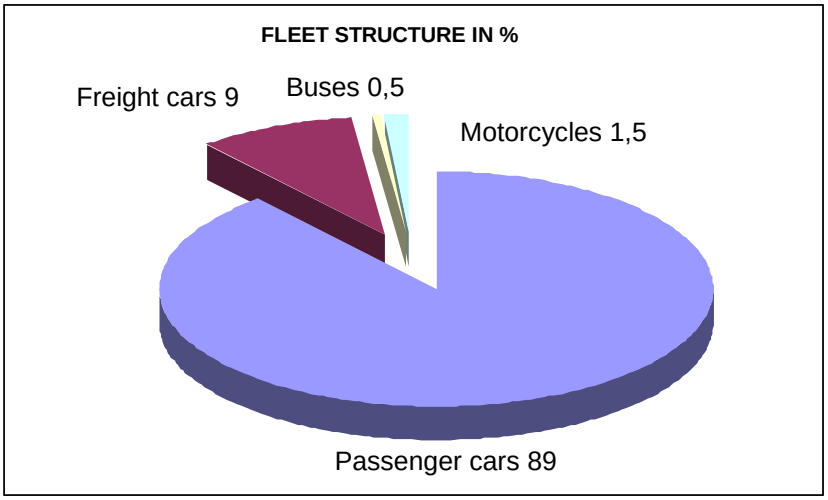


Figure 6.3: The structure of fleet registered in the area of Trebinje municipality

The organization and regulation of traffic is characterized by very low usage of modern information and technical resources. In the urban area of town Trebinje only four crossroads have traffic-lights, where it is not done coordination of signals (green wave).

Consumption of motor fuel and calculated energy consumption, for the base 2001 year, was calculated on the basis of the fleet number and structure, number of passed kilometres annually, average consumption and conversion factor for energy. In calculation of passed kilometres annually was taken that the vehicles owned by natural persons pass in average 6000 kilomteres, and those owned by legal entities 30000 kilometres, and vehicles owned by Trebinje municipality 35000 kilometres. In 2001 year there were 6366 of registered vehicles owned by natural persons and 525 vehicles owned by legal entities. Trebinje municipality had 3 registered vehicles (two on diesel and one on fuel).

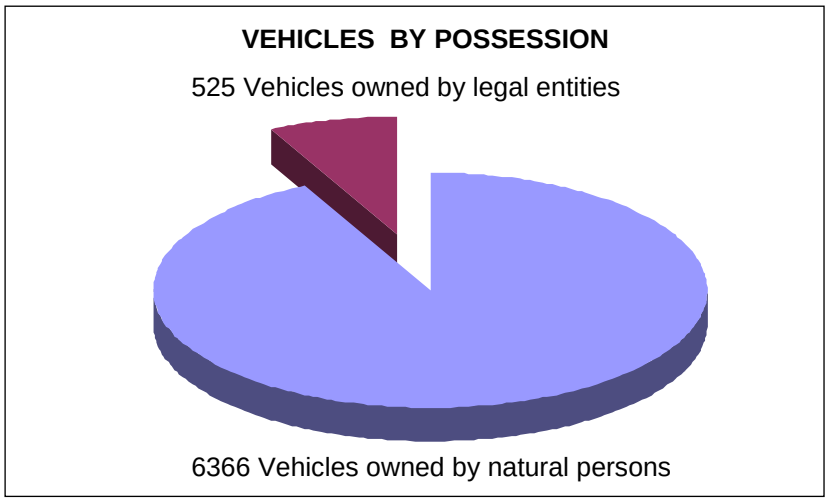


Figure 6.4: The fleet by possession in the area of Trebinje municipality

Based on these data it is obtained the total number of passed kilometres that are given in the following table.

Table 6.1: Overview of passed kilometers for 2001 year in km

Vehicles by posession	Passed kilometers
Vehicles owned by natural persons	38,197,445
Vehicles owned by legal entities	15,660,000
Vehicles owned by Trebinje municipality	105,000
TOTAL	**53,962,445**

The following table shows the average fuel consumption per vehicle categories and type of motor fuel they use shown in liters per passed kilometres.

Table 6.2: Average fuel consumption per motor vehicles categories in l/km

	Passenger c.	Freight c.	Buses	Motorcycles
Fuel	0.096	0.000	0.000	0.040
Diesel	0.069	0.298	0.292	0.000

In the following table were calculated passed kilometres of the fleet by structure and type of motor fuel shown in thousand of kilometres.

Table 6.3: The fleet passed kilometers per structure and type of motor fuel in 1000 km

	Passenger c.	Freight c.	Buses	Motorcycles	TOTAL
Fuel	27790	0	0	809	28600
Diesel	20236	4857	270	0	25362

In the following table was calculated total fleet fuel consumption by structure and type of motor fuel shown in thousand of litres.

Table 6.4: Fleet fuel consumption by structure and type of motor fuel in 1000 km

	Passenger c.	Freight c.	Buses	Motorcycles	TOTAL
Fuel	2668	0	0	32	2700
Diesel	1396	1447	79	0	2922

When fuel consumption is multiplied with a conversion factor it is obtained consumed energy shown in MWh for the fleet owned by natural persons and legal entities in Trebinje municipality. Conversion factor for fuel is 9,2 KWh/l, and for diesel is 10,0 KWh/l. Energy consumption shown in MWh is given in the following table.

Table 6.5: Energy consumption in MWh per vehicle type and motor fuel

	Passenger c.	Freight c.	Buses	Motorcycles	TOTAL
Fuel	24545	0	0	298	24842
Diesel	13963	14473	788	0	29223
SUM					54065

Energy consumption for 3 vehicles that municipality Trebinje had in possession in 2001 year (one car consumed fuel, and the other two diesel) given in the following table is in MWh.

Table 6.6: Energy-genereating product consumption in MWh for vehicles owned by Trebinje municipality -2001 year

Fuel	31
Diesel	48
TOTAL	79

By adding the obtained values, we come to the total consumption of fossil fuel energy in traffic in Trebinje of the base 2001 year, that is shown in the following table in MWh. As in this town there is no organized public passenger transport, there is no energy consumption in this sector.

Table 6.7: Total fossil fuel energy consumption in traffic in Trebinje municipality for 2001 year in MWh

	Diesel	Fuel
Trebinje municipality vehicles	48	31
Public transport vehicles	0	0
Private and commercial vehicles	29175	24811
TOTAL	29223	24842

Totally 8484 of vehicles were registered in Trebinje according to the data for 2010 year. 7838 of those vehicles were owned by natural persons and 639 vehicles by legal entities. Trebinje municipality had 7 registered vehicles (three on diesel, four on fuel). Total passed kilometres were calculated by the identical procedure as for the base 2001 year and they are given in the following table:

Table 6.8: Passed kilometers of Trebinje municipality vehicles in 2010 year

Vehicles by possession	Passed kilometeres
Vehicles owned by natural persons	47,028,000
Vehicles owned by legal entities	19,170,000
Vehicles owned by Trebinje municipality	245,000
TOTAL	**66,443,000**

By comparison with the 2001 data it can be seen increase in passed kilomteres for 23%, because of the fleet increase. In accordance with passed kilometres increases fuel and energy consumption. Total consumption of fossil fuel energy in traffic, in Trebinje in 2010 year, is given in the following table in MWh.

Table 6.9: Total consumption of fossil fuel energy in traffic, in Trebinje for 2010 year

	Diesel	Fuel
Trebinje municipality vehicles	72	124
Public transport vehicles	0	0
Private and commercial vehicles	35910	30465
TOTAL	**35982**	**30589**

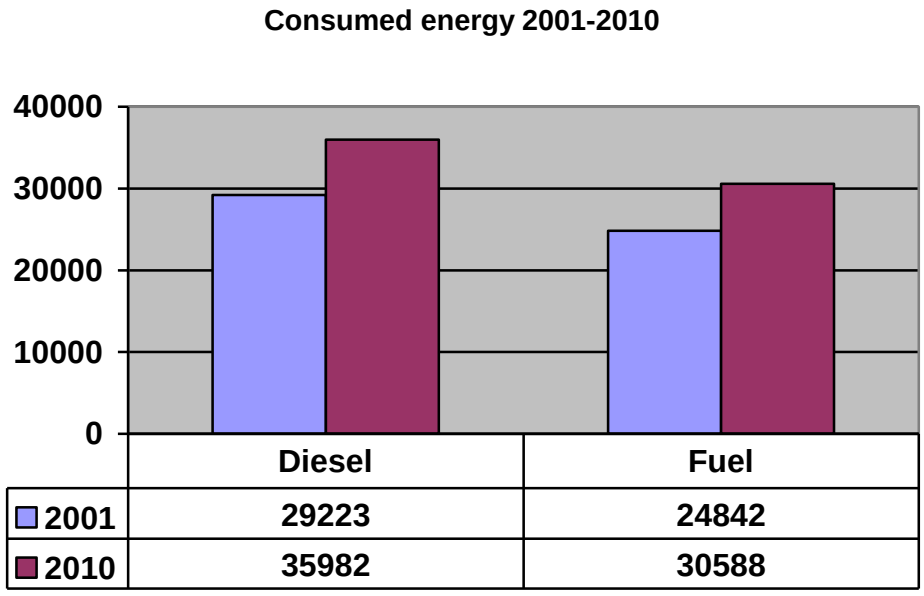


Figure 6.5 Fossil fuel energy consumed in traffic in the area of Trebinje municipality comparison 2001 year – 2010 year

6.2. Shortcoming of Trebinje municipality traffic system in terms of energy efficiency

Previous fleet, fuel and energy consumption analysis showed that energy consumption in the traffic sector has been growing in the period of 2001-2010 year. The main shortcomings of the traffic system are:

- state of traffic network is not at an aprropriate level (roadway surfacing and its condition),
- low level of traffic regulation modern methods application, lack of compliance of traffic light signals,
- fleet characteristics (vehicles age, low percentage of vehicles that meet EURO 3 standard conditions, negligible number of vehicles using alternative energy-generating products),
- lack of incentive measures for activities to achieve energy saving.

6.3. Proposals for improvement of energy efficency in transport

- planned and continous investment in reconstruction and rehabilitation of traffic network, that would raise service level and reduce energy losses (repair of traffic network parts with worn asphalt surfacing, reconstruction of roads that has no asphalt surfacing..),
- introduction of modern methods and means for regulation of traffic flow and application of information technologies in management (traffic light signal coordination, dynamic signal plans-depending on flow intensity, chanelling of transit traffic flows...),
- when purchasing vehicles for needs of the Administration service and companies and institutions that are by their organizational and management structure subordinated to Trebinje municipality it should be taken into consideration its characteristics in terms of energy efficiency, especially use the possibility of purchasing vehicles on alternative motor fuel and hybrid vehicles (vehicles that beside conventional ICE motor have additional generator unit on alternative fuel, for example electric power, gas, etc.) The possibility of enviromental product congruity evaluation is provided by the Law on public procurement of B&H, which must be respected by all legal entities in public sector at procurement (Article 34, Paragraph 1, point a)),
- by local legislative predict facilities for users of vehicles on alternative fuel (construction of energy stations to refill accu batteries, free parking for such vehicles,…).

WASTE COLLECTION AND DISPOSAL

7. SYSTEM FOR WASTE COLLECTION AND DISPOSAL

7.1. Characteristics of waste substances and the existing waste collection and disposal system

Waste substances by the place of origin are divided into communal and industrial waste. By this classification, in the area of Trebinje municipality dominates communal waste, for which exists organized system of collection and disposal. Collecting and disposing of communal waste is done by "Komunalno" company, ltd Trebinje. Waste being collected and disposed this way is not dangerous one. There is no organized dangerous waste collection and disposal in the area of Trebinje municipality, although there is such waste (medical waste, old accu batteries, batteries, cleaners and degreasers, fat, oil, emulsions, etc.).

The amount of waste produced in the area of Trebinje municipality in 2001 year can be calculated if number of population (35 000 inhabitants-assessment) is multiplied with coefficient of specific waste consumption per capita per day (Gsp=1kg/capita/day) and number of days in a year, that gives value of 12775 tons of waste. If we take that 80% of population are implied by organized waste outfreight and disposal, we come to the amount of 10220 tons of waste disposed in 2001 year. Morphological composition of collected and disposed waste, that corresponds towns with about 30000 inhabitants is given in the following table:

Table 7.1: Morphological composition of collected and disposed waste-town up to 30000 inhabitants

Ordinal no.	COMPONENT	SHARE IN TOTAL QUANTITY (%)	QUANTITY (T)
1	Organic waste	48.00	4906
2	Paper	18.50	1890
3	Metals	5.00	511
4	Plastic	4.20	429
5	Glass	5.80	593
6	Wood, textile, rubber	4.60	470
7	Public areas waste	10.00	1022
8	Others	3.90	399
	TOTAL	100.00	10220

Waste is disposed at the dump site "Obodina", that is about 4 km away from town centre. The dump site is not sanitary, not fenced, and by that access is free, as to unauthorized entities so to illegal collectors of secondary raw materials, domestic and wild animals and rodents.

Waste transport to the dump site is done by special vehicles (rottopresses and vehicles for transport of containers with auto-unloading). The disposed waste is pushed, planned and flatenned by a special machine (bulldozer), and then partially covered by available material (earth, stone, barren soil, building waste-debris,etc.). Because waste is not covered completely, we very often have cases of firebreak which are not completely controlled. In the process of waste collection is not done its selection, so there is no waste recycling that can be recycled.

In 2008 year, in the place of existing unsanitary dump site, it was built a sanitary dump site which included the rehabilitation of the existing state. The new sanitary dump site is fenced and it has access control, and disposed waste is covered with a layer of sand-pebble material, eliminating possibility of firebreak.

In the following Figure is given graphical illustration of waste disposed and covered material by years:

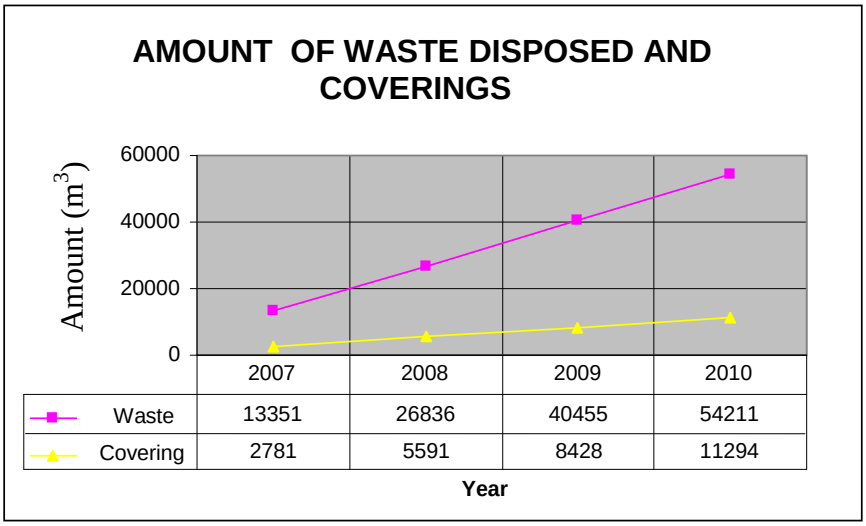


Figure 7.1:. The amount of waste disposed and coverings at the sanitary dump site "Obodina"

By calculation of CO_2 emission arising from waste combustion at the dump site "Obodina", it was taken the base 2001 year with following parametres:

Estimated population: 30 627 - Municipality

26 003 - Urban area

It was used the methodology defined by The Intergovermental Panel on Climate Change (IPCC) from 2006 year, and the area for which IPCC coefficients were taken is "Southern Europe". The values of CO_2, CH_4 and N_2O emission were calculated as a result of waste combustion at the municipal dump site. Total CO_2 emission as a result of open waste combustion at the dump site "Obodina" is 3021 tons of CO_2 in 2001 year. The following table shows the structure of CO_2 emission.

Table 7.2: Structure of CO_2 emission at the dump site "Obodina"-2001 year

Ordinal no.	Emission source	Quantity (t)
1.	CO_2 emission directly of waste combustion	1713
2.	CO_2 emission equivalent of CH_4 (21 x 49 t CH_4)	1029
3.	CO_2 emission equivalent of N_2O (310 x 0,9 t N_2O)	279
	TOTAL	**3021**

7.2. Shortcomings of Trebinje municipality existing waste collection and disposal system in terms of energy efficiency

- Lack of waste sorting system (all waste is treated identically, disposed and covered),
- Lack of waste recycling that can be recycled partially or completely,
- Fleet used for waste transport from an user to a dump site is outdated and inadequate.

7.3. Proposals for energy efficiency improvement in the area of waste collection and disposal

- Introduction of waste sorting system, especially the one that can be recycled (glass, metal packaging, PET packaging, paper and cardboard, etc.),
- Introduction of waste recycling system,
- Optimization of the fleet for waste transport,
- Use of hybrid vehicles and vehicles on alternitive fuel for waste transport.

WASTE WATER DISPOSAL

8. SYSTEM FOR WASTE WATER DISPOSAL

8.1. Characteristics of waste water sewage system and purifying plant

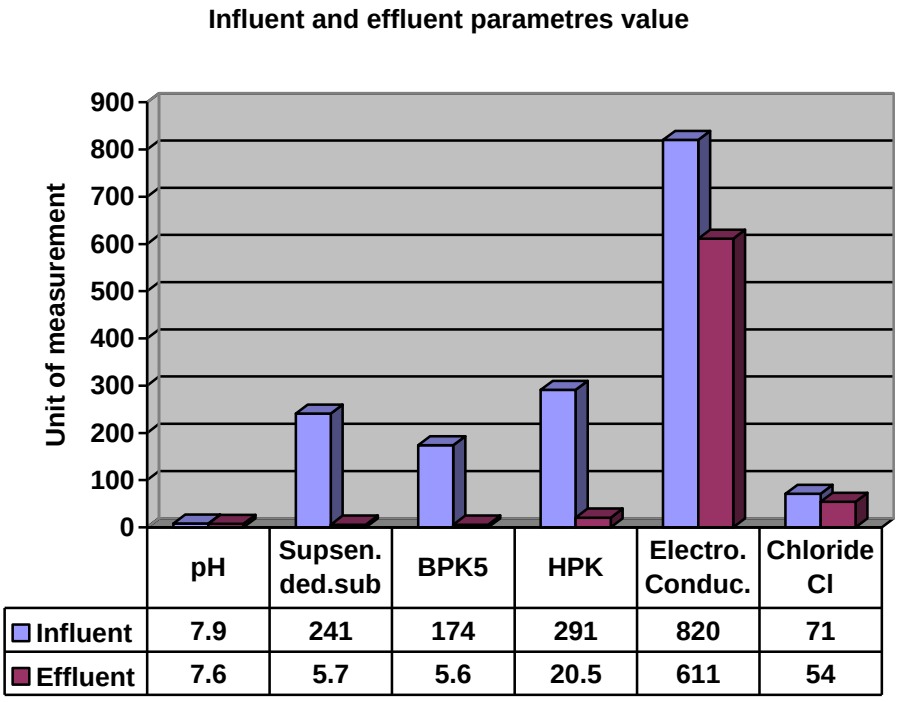
Waste water can be divided into precipitation waste water resulting from atmospheric phenomena and fecal waste water which are consequence of human existence and work.

Precipitation waste water by its origin do not contain harmful ingredients, they are polluted by moving, i.e. flowing over dirty surfaces of roofs, streets, pavements and green areas. Fecal waste water by its origin contain harmful ingredients. Fecal waste water flow into natural waterflows and thus pollute them.

In the area of town Trebinje beside precipitation and fecal waste water, in less measure are represented waste water from industrial plants.Trebinje town has seperate systems of precipitation and fecal sewage. The systems were built at the beginning of 80's of the last century, and from then on continously have worked.The system of precipitation sewage consists of network, lenght cca 17000 m, street drains, line grates and revision incline. Such collected precipitation water is discharged into the river Trebišnjica, with no previous purification, by 9 outlet facilities. Beside this system of precipitation water drain which covers narrow urban area, in marginal urban areas and suburban settlements, there are natural, partially and fully built open drainage channels for evacuating precipitation water from the surronding hills in which also flow in precipitation water from the settlements. As for waste water from industrial plants, they are not specially treated, so they tend to engage in the existing systems of precipitation water and fecal sewage. So far there were no recorded harder eniviromental incidents caused by this water.

The system of fecal sewage consists of network, length about 33000 m, inspection chambers, 2 siphons (across the river Trebišnjica) and waste water purifiers under the settlement Mostaći. There is no stations for prepumping on the existing network, because the entire system is based on gravitational moving of fluid. Waste water purifier was designed in two phases. The first phase, that was built and put into operation in 1982 year has capacity of 30000 EC (equivalent citizen), and the second phase, that is planned, capacity of 50000 EC. Technological process of purification is a mechanical-biological with active sludge and anaerobic sludge stabilization. The projected result of purification is 92%, and value obtained by measurment on site are something better from projected ones, so the river Trebišnjica is, as a final recipient of purified waters, water flow of II class and downstream of the purifier.

On the following Figure was shown graphic illustration of certain parametres pH value relation, suspended substances, BPK5, HPK, electrical conductivity and chloride (Cl) influent and effluent.



	pH	Supsen. ded.sub	BPK5	HPK	Electro. Conduc.	Chloride Cl
Influent	7.9	241	174	291	820	71
Effluent	7.6	5.7	5.6	20.5	611	54

Figure 8.1: Influent and effluent parametres values

Current estimation is that water purifying plant purifies about 60% of total consumed water in the urban area of Trebinje. Households not connected to fecal sewage system, discharge their fecal water into septic holes, which are pumped by special vehicles and tranported to the purifier.

By the calculation of CH_4 emission developed on the purifier of fecal waste water under the settlement Mostaći, it was taken the base 2001 year with the following parametres:

The amount of treated waste water in the plant:

1.525.466 m^3 annually

127.122 m^3 monthly

Biochemical oxygen consumption (BPK-BOD): 174 mg O_2/ l average anual value for 2002 year 0,174 kg/m^3.

By calculation was used the methodology defined by The Intergovernmental Panel on Climate Change (IPCC) from 2006 year, and according to it was obtained value of 127,41 tons of CH_4 at the annual level, which converted gives equvivalent value of 2675,54 tons of CO_2.

8.2. Shortcomings of Trebinje municipality existing waste water collection, discharge and treatment system of in terms of energy efficiency

- By the existing sewage network is not covered entire urban area and most
- suburbs. That requires more operations of drainage from septic holes and water transport by a special vehicle which requires significant energy consumption.
- The existing purifying plant has run continously for almost 30 years, and because of certain parts and components wearing (especially worm pump) energy losses are increased.
- Special vehicles-tankers for waste water pumping and transport are outdated and technologically obsolated.

8.3. Proposals for improvement of energy efficiency system for waste water collection and discharge

- Upgrade of the existing network and connection to the greatest possible number of households to reduce the need for pumping and transport by special vehicles.
- Overhaul of the existing water purifying plant and construction of purifier 2nd phase according to the increase of needs for capacity.
- If a need for construction of prepumping plant arises, maximum use energy alternative sources for pumps running.
- At purchasing new special vehicles for waste water pumping and transport it should be taken into consideration their characteristics in terms of energy efficiency, especially to support purchase of hybrid vehicles.

PUBLIC LIGHTING

9. PUBLIC LIGHTING

9.1. Introduction

9.1.1. What is public lighting?

Nowdays human need for mobility generated the necessity of a quality public lighting, as at day through natural, so at night through artificial sources of light. Quality public lighting at night enables us secure traffic functioning, and free performance of the most different activities gathering, do sport, socializing, entertainment,etc.

Public lighting, as one of the most visible energy systems, represents an ideal ground for energy efficiency projects development. Because of its visibility and techical solutions which we have available, it stays a question how much can be saved?

The basic problem, also, represents lack or absence of information about the existing public lighting state. How actually to know what to do when you are not sure what have you got, when have you bought that, how much does it cost, how much does it spend, where is it? This problem is extremely important when you want entirely to consider the public lighting system efficiency. There are not many cities or municipalities that have unique base of installed equipment in the public lighting system, and even less of them regularly update the same base with changes related to maintenance and construction.

Figure 9.1: Trebinje at night

Basic recommendations for efficient public lighting and dynamic saving are:

- use of efficent light sources (advanced technologies),
- use of efficient lamps (light pollution),
- monitoring of expenses and public lighting consumption (lamp cadastre, consumption data base),
- designing of public lighting in accordance with standards,
- efficient public lighting management,
- regular maintenance.

9.1.2. Public lighting basic specifications

No matter public lighting purpose, it must meet four basic mutually connected requirements:

1. **Function**

Basic function of street lighting is to ensure the minimal required values of tranport routes lighting, even illumination and headlights glare reduction. Modern public lighting reduces impression of headlights glare for more than hundred times and ensures 70% bigger equality of illumination.

2. **Aesthetic**

In public lighting for illumination of different facilities, cultural monuments, etc. were traditionally used natrium light bulbs that have poor colour rendering index. Such light bulbs beam yellow colour of light that deactivate ambient and cause people to get asleep. If we want to revive a certain space, a modern solution represents high quality white light sources with the effect similar to natural sunlight, such as metal-halogen or compact flourscent light bulbs, and LED light diodes.

3. **Economy**

In regard to increasing electric power expenses, public lighting takes bigger share of the cities and municipalites expenses. The public lighting expenses mean expenses of construction, management, maintenance, arrangement of public facilities, and expenses of electric power for illumination of public areas and public roads that pass through settlement and unclassified roads.

4. **Ecology**

We do not want to jeopardize resources of the generations to come.

9.1.3. Overview of light source

9.1.3.1. Mercury light bulb

Turn on time of a mercury light bulb is up to 5 minutes. If they are turned off, they at first must be cooled down to turn them on again (because the time of repeated turning on is about 10 minutes, what is failure of this type). Life span is about 8000 hours.

Colour of mercury light bulbs is one colour (monochromatic) and because of that characteristic use of these light bulbs is limited to those places where no colour recognition is needed, but also where is necessary to achieve high illumination on the big work surface.

Use of mercury light bulbs is high and it goes from 45-60 lm/W, and therefore a standard VTFE mercury light bulb is especially suitable for illumination of big outdoor and indoor spaces, for example motorways, streets, squares, parks, construction sites, hangars, etc.

9.1.3.2. Natrium light bulb

We differ natrium light bulbs of a high and low pressure. Natrium low pressure light bulb emits light of especially yellow colour whereupon no colour recognition is possible. However, there are the other considerable advantages of these light bulbs: low flash, high utilisation of light, good penetration of yellow light through fog, dust and vapour. Their light utilisation is up to 130 lm/W (almost twice higher than light utilisation of a high pressure mercury sources). Life span of these sources is about 12000 hours.

These light sources need pre-coupling device for ignition and drive-transformer. Natrium light bulbs of a high pressure work on the principle of electrical discharge through natrium vapour of high pressure at higher drive temperatures. These light bulbs have a long life span, give pleasant gold white colour, of 2100 K temperature. They are produced in three variants: tubular (transparent), in the shape of ellipsoid with flourscent layer and in the shape of ellipsoid transparent. When this light bulb is connected to voltage it comes to initial discharging between electrodes, because of high voltage impulse. High voltage impulses disappear as soon as current is set up between electrodes (turn on time is 5-10 minutes). The ballast serves to stabilize current during Na light bulb work.

Typical areas of high pressure natrium sources application are illumination of transport routes, tunnels, sports facilities, parkings and other big areas.

9.1.3.3. Metal-halogen light bulb

They use similar principle as mercury light bulbs. It is achieved much better quality of light (colour rendering 1A) and higher utilisation (up to 120 lm/W). By combining different metals it is possible to get different colour temperatures – from 3.000 K to 6.500 K.[14]

They are produced in power from 35 W-3500W, with an extremely broad range of application (from internal to public lighting, photo lighting, effect lighting to auto lighting). Life span of these sources is about 6000 hours. For drive, these light bulbs need special high voltage start element (ignitor) which provides necessary voltage impuls from 3-6 kV. Turning on procedure lasts up to 5 minutes, and again turn on on hot 5-10 min. We will still mention flourscent tubes, whose light utilisation is around 100 lm/W (for flourscent tube of 26 mm diametre). The life time of flourscent tubes is close to 7500 hours. During exploitation, light flux of flourscent tubes is reduced from two main reasons: the first relates to changes occuring on flourscent layer, the other to tube ends occulation, resulting from particles sedimentation of thermal emission material.

a) Mercury light bulb

b) Natrium light bulb

c)Metal-halogen light bulb

Figure 9.2: Light bulb types

9.2. The existing state of public lighting in Trebinje municipality

The existing solutions for the public lighting system management in most cases carry features of systematic and technical solutions that were used in this technique twenty or more years ago. Such solutions and the very public lighting status and its systematic lack of definition resulted in:

- development and expansion of the system without concept,
- partially solving of problems from case to case,
- heterogeneity of light-technical, control and switching gear,
- neglect of analysing and monitoring of public lighting efficiency,
- rationalization of electric power consumption reduced to exclusions,
- neglect of repairs and failure resulting in waste of energy,
- lack of interest of the system owner for public lighting quality improvement,
- random installing of pillars without care whether they disturb residents and whether efficiently illuminate public areas and outer parts of buildings.

[14] The temperature of daylight is the most ideal for public lighting

As a consequence, there is a great number of burnt and broken lamps in Trebinje municipality now and curved and collapsed pillars.

In Trebinje municipality public lighting can be divided into three groups by the way of construction and type of installation:

- town centre,
- residential areas with a dominant individual residential units,
- rural areas.

9.2.1. Town centre

Public lighting was installed along town streets on the public lighting pillars. Power supply is from belonging distribution stations 10/0.4 kV in property of the distribution. Measurements and automatics located in SS 10/0.4 kV are the distribution property.

9.2.2. Residential areas with individual construction

Public lighting of rural areas was done miscellaneously. Cables with public lighting pillars placed along streets and at pillars of low voltage network are distribution property. Power is supplied from distribution SS 10/0.4 kV, which are also in distribution property, as well as measurment and automatics, located in SS 10/0.4 kV.

9.2.3. Rural areas

Public lighting is located exclusively at pillars of power grid which are distribution property. Power is supplied from distribution SS 10/0.4 kV, which are also in distribution property, as well as measurment and automatics, located in SS 10/0.4 kV.

Table 9.1: Overview of light source structure in Trebinje municipality

Type of light source	Power (W)	Total number
Hg	125	2543
Hg	250	71
Hg	400	203
Na	70	187
Na	150	77
Na	250	24
Metal-halide (MH)	150	23
Metal-halide (MH)	250	9
Metal-halide (MH)	400	109

9.3. Energy efficiency measures in public lighting sector

9.3.1.1. Replacement of light bulbs

By insight in the existing state of installations and equipment, it can be concluded the next:

- light sources are obsolate beacause of low light utilisation, so electric power consumption at power supply of these installations is too big,
- the equipment is outdated, inefficient, and proper maintenance is impossible due to lack of spare parts,
- illumination and brightness of the observed areas are extremely bad (by intensity and equality) and do not meet minimal requirements of offical regulations and recommendations.

By newly designed installation is predicted installation of high pressure natrium lamps.

It should be emphasized that they, apart from higher light flux, have declared life span of 16000 hours, with a small precentage of expected failures.

Table 9.2: Light source characteristics

Light source	Light utilisation (lm/W)	Specific consumption(W/klm)	Life span (h)
High pressure mercury	45-60	18-20	8000
High pressure natrium	130	9-10.5	16000

The existing lamps (Hg 125W) are old, most often without a protector. Illuminators went dark, have layers of dust, so ability to reflect is minimal. Most lamps are mounted directly on pillars of overhead electroenergetic network, and smaller percentage is mounted on utizable consoles.

The existing light sources (Hg 125W) are replaced with natrium source of 70W.

Table 9.3: Overview of existing and proposed light sources

EXISTING INSTALLATION			
Light source	Power (W)	Number of light sources	Annual consumption (kWh)
Mercury (Hg)	**125**	**2543**	**1283579,25**
NEW PROPOSED INSTALLATION			
Light source	Power (W)	Number of light sources	Annual consumption (kWh)
Natrium (Na)	**70**	**2543**	**718804,38**

In order to in a right way calculate expenses for compensation of electric power consumption it was adopted:

- 1 kWh – 0,1508 KM,
- 4038 –annual number of public lighting working hours

Overview of electric power consumption in the existing and newly designed installation:

Table 9.4: Overview of electric power consumption and newly designed lighting for 6 years.

Light source	kWh 1st year	kWh 2nd year	kWh 3rd year	kWh 4th year	kWh 5th year	kWh 6th year
Hg(125W)	1283579,25	2567158,5	3850737,75	5134317	6417896,25	7701475,5
Na(70W)	718804,38	1437608,76	2156413,14	2875217,52	3594021,9	4312826,2
Difference	**564774,87**	**1129549,74**	**1694324,61**	**2259099,48**	**2823874,35**	**3388649,3**

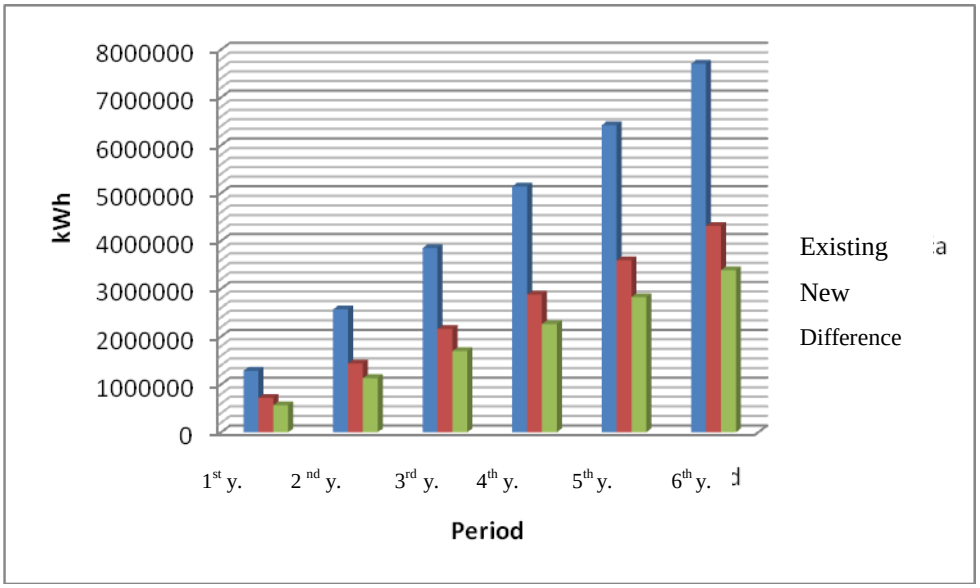


Figure 9.3: Overview of electric power consumption for reference period of 6 years

Analysis of metal-halogen (400W) light bulbs replacement with natrium (250 W) ones, in the area of substation Aleksina Međa.

Namely, from subtation Aleksina Međa is supplied 64 metal-halogen light bulbs, so power for mentioned share will be:

P=64 x 400 W=25.6 kW

considering the number of working hours per year, total consumption will be:

W=25.6 kW x 4038 h=103 372.8 kWh.

If the replacement would be done with mentioned Na 250 W light bulbs we will have:

P=64 x 250 W=16 kW

W=16 kW x 4038 h=64.608 kWh.

Annual saving:

W_{saving}= 103 372.8 kWh – 64 608 kWh= 38 764.8 kWh

considering the price is 1 kWh= 0.1508 KM we will have:

C=38 764.8 kWh x 0.1508 KM= 5845.73 KM.

Conclusion:

From the previous calculation it can be seen that electric power saving is 5845.73 KM annually. When we also consider life span of a lamp which is twice higher than that of a metal-halogen lamp, considerable saving is also realized at maintenance. When we add to that better light utilisation of a light bulb (130 lm/W) in relation to metal-halogen ones (120 lm/W) it can be concluded that above mentioned light bulbs replacement is economically justified.

9.3.2. LED technology

Light Emitting Diode (LED) is a semiconductor that emits directed light by an effect better known as “electroluminescence“. Colour of radiated light therefore depends on doped p-n junction chemical composition and it can be ultraviolet, visible and infrared.

9.3.2.1. Development of LED diode

Since the first practical application (1962 year) development of LED has been rapidly developing parallel expanding area of its application. The development can roughly be divided into three parts. First were developed monochromatic LED diodes (red, yellow, green), and then in 1993 year Japanese scientist Shuji Nakamora managed to develop LED diode of a blue colour. In 1997 year based on a blue LED diode technology was developed white LED diode what meant a turning point in the extent of its application. From that time until now development has been directed on increase of light level, so that nowdays exist LED diodes with light flux exceeding 120 lumens/W. Considering their characteristics and development speed, LED diodes represent the light source of future.

9.3.2.2. General characteristics

LED diodes are designed for rated voltage of 2-3,6 V with current of 20-30 mA, what means they need less than 0,1 W for operation. Unlike conventional light bulbs, they transform electric power directly into the light of certain wavelenght with negligible heating. Regarding endurance, along with certain working conditions, life endurance exceeds 100 000 hours. They do not contain mercury, glass, harmful gases, toxic materials so they can be recycled. Due to great mechanical characteristics they are insensitive to vibrations, strokes and other stresses.

Figure 9.4: a) LED diode b) LED lamp

9.3.3. Illumination units replacement

Non-enviromental illumination units that disperse light above the horizon and cause light pollution are being replaced by modern enviromental armature (so called cut-off armature). Such a structure, i.e. straight cut glass directs light on roads and pavements where it is actually necessary, leaving the night sky and eco-system completely preserved.

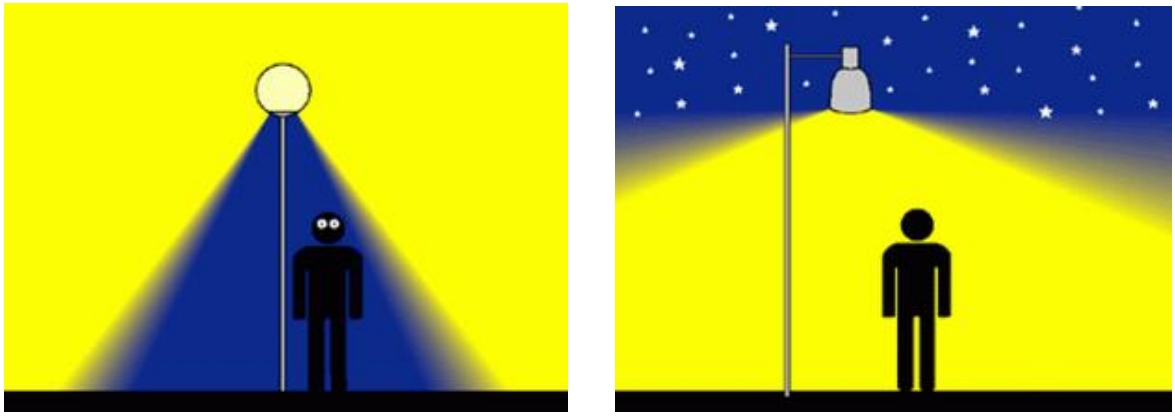
Figure 9.5: Non-enviromental light unit dispersing light

Figure 9.6: Light unit with enviromental (cut-off) armature

9.3.4. Conception of light pollution

Light pollution is a change of natural light level in night conditions caused by light input produced by human activity. Conception of light pollution could also be described by the next definition: "Light pollution is every unnecessary, useless light emission into the space outside the zone which should be enlightened."

But, can we give up lighting in night conditions? Certainly not, because a part of our activities happen at night. But we can reduce lighting to the necessary measure so as not to lighten the sky, trees, town walls, lawns by the roads and other things we actually do not want to.



a) bad b) good

Figure 9.7: Examples of bad and good public lighting

If we look at the above two pictures, we can easily conclude what are causes of light pollution on the one hand, and on the other hand how to prevent or to reduce light pollution.

Light pollution causes inadequate actually improperly installed lighting of public areas and facilities that the greatest part lighten toward the horizon and the sky (Picture 9.7-a).

Prevention (reduction) of light pollution is achieved by installation of light units that lighten areas and facilities top-down, and their illuminative area is parallel to the ground. Those are enviromental lamps (Picture 9.8-b).

9.3.5. Installation of light level control

The level of illumination depends on a number of factors such as traffic density, traffic configuration complexity, number of intersections, etc. Traffic density is variable of all these factors. When traffic density on a road is reduced, drivers do not need the same level of lighting as before. Similar can be applied to decorative installations in the very town centre where sometimes installations are turned off for the purpose of energy saving after a certain period of time. In the case of road lighting, regulation of lighting by the method of turning off every second lamp is very dangerous in terms of traffic safety, namely it leads to non-uniformity and the appearance of black holes in the road.

Therefore, the regulation in terms of light level reduction (and thereby energy consumption) is the best solution "Step dimming" principle of reduction reduces light level for 50% and energy consumption for 35% (compared to the standard option of overnight 100% of light level).

The reduction is done through a combination of reduction ballast and time programmed relay called "Chronosense."

The working method is the following:

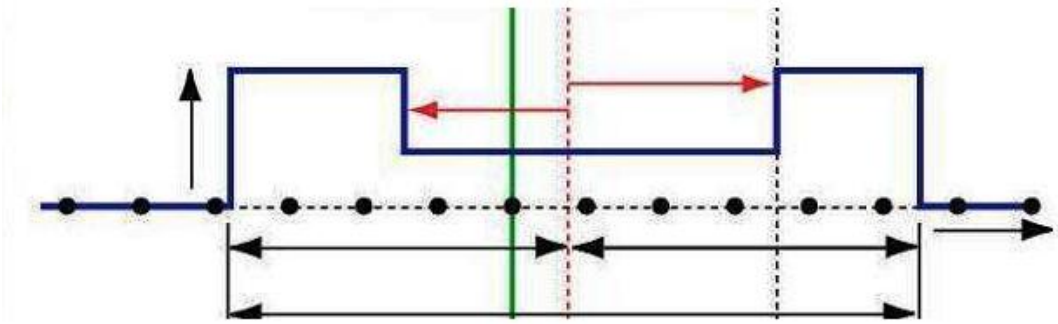


Figure 9.8: Working method of "Chronosense" relay

In the Figure we can see five characteristic points: ligting turn on time, lighting turn off time, half of the night (MID POINT) and two periods between half of the night.

A "Chronosense" measures the time of lighting switching on and switching off during the first three days of system work and on the basis of these information automatically determines MID POINT. Periods before and after the MID POINT are set on the device itself and thus there is flexibility in duration, start and end of reduction period. Control measuring of public lighting switching on and off is done every three days.

The system does not depend on the summer and the winter night duration or changing the time of switching on and off, because every three days it again repositions time of system switching on and off in its internal memory.

RENEWABLE ENERGY SOURCES

10. RENEWABLE ENERGY SOURCES

As renewable energy sources are considered sources that are found in nature and can be renewed. At that the most often are used hydropower, solar, wind, biomass, biofuels as well as geothermal energy.

Considering the available natural resources in the area of Trebinje municipality, the subject of consideration will be:

- Watercourse energy-hydroenergy,
- Wind energy,
- Solar energy-for electric power generation and hot water preparation,
- Biomass energy -for heating facilities .

10.1. Use of renewable energy sources for electric power generation

10.1.1. Hydro power plants

In the area of Trebinje municipality are located two hydro power plants, HPP Trebinje 1 with 3 x 60 MW power and HPP Trebinje 2 with 1 x 8MW power. Beside these power plants, the tunnel inlet structure that leads water to the turbines of HPP Dubrovnik, The Republic of Croatia, is located in the area of Trebinje municipality, as an integral part of the facility HPP Trebinje 2. Generation of electric power from the exisiting hydro power plants is in detail described in the separate chapter. The river Trebišnjica hydropower potential is completely used, considered solely from the area of Trebinje municipality. In the case of construction of electro energetic facilities on the upper area of HPP Trebinje 1 (HPP Dabar with corresponding storage and other plants) will appear additional potential in the form of annual generation of 265 GWh.

From the existing capacities we have at Gorica dam unused outlet for biological minimum by which water is discharged in the summer period to ensure minimal flow through the river-bed, necessary for the river life. The short-term plan is the installation of one generation unit on this outlet. The generation unit would be 2.7 MVA of designed powers and an average annual generation of cca 15.000 MVh of "clean"electric power.

Figure 10.1: Outlet for biological minimum on the HPP Trebinje 2 for the river Trebišnjica

If it is considerd hydropower potential of the other river courses in the area of Trebinje municipality, based on the data obtained by preliminary analysis, there is the possibility of small HPP Brova construction on the same name river, power 500 kW. The construction of this plant depends on the research and techno-economic analysis that should follow after the completion of the research.

10.1.2. Wind power plants

Previous resarches of wind resource in the area of Trebinje municipality, preliminary indicates to a possibility of wind power plant construction at the edge of mountain Leotar, at an altitude of 650-750 m, maximum power to 20 MW, annual generation to 40 GWh. Preliminary analysis was done by "Sander@partners", making a satellite wind atlas for wider area of Bosnia and Herzegovina in the period ending in 2007 year. The main indicators of this analysis for Trebinje municipality were given in the following Figures.

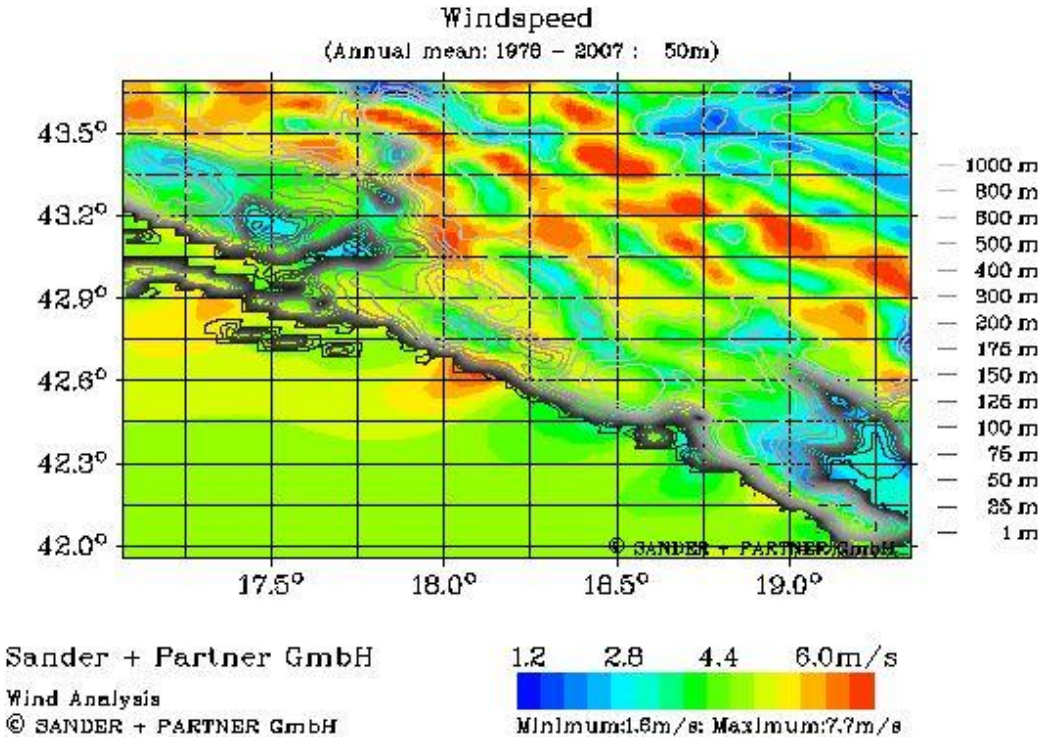


Figure 10.2: Wind source in the area of Trebinje municipality

The area of Trebinje municipality belongs to the areas of moderate values of average annual wind speed, which is around 4 m/s at a height of 50 m. At that, in the northern parts of the municipality average annual speed reaches a value of up to 6 m/s.

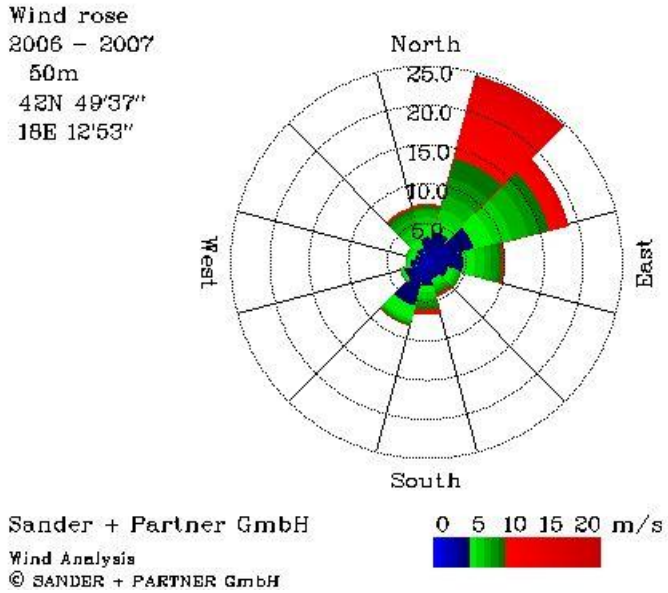


Figure 10.3: Overview of wind strenght in the area of Trebinje municipality

Windrose analysis for the period 2006-2007 year shows a dominant wind share from the course north-northeast, with maximum speed slightly exceeding 20 m/s.

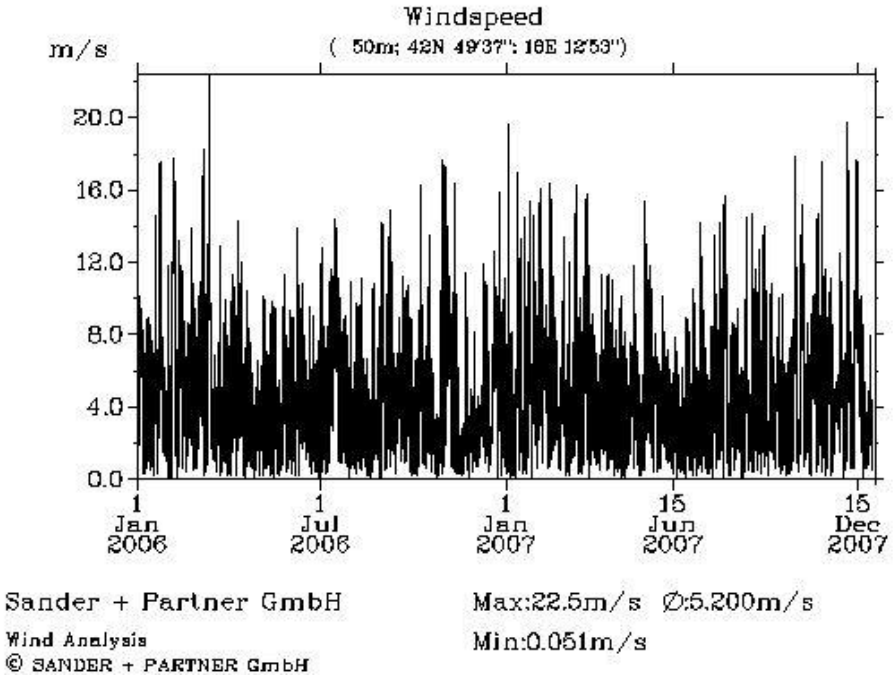


Figure 10.4: Overview of wind strenght in the area of Trebinje municipality 2006-2007 year

In the following period, wind resource will be additionaly explored by mounting pillars for wind measuring (direction and intensity), and depending on the obtained results will be known whether there is economic feasibility for electric power generation at this location.

If techno-economic analysis shows feasibility of construction, the plan predicts a wind power plant construction, at this location, of 10 MW power, the annual generation of 20.000 MWh.

10.1.3. Solar power plants

The area of Trebinje municipality belongs to the climatic zone with expressed mediteranean influence, characterized by mild winters without snowfall and very hot summers. The average annual number of sunny days is about 260, which makes this area very suitable for installation of photovolatic cells for electric power generation. Considering the current cost price of electric power from solar power plants, which multi exceeds the cost price of power plants that use other sources, the construction of these facilities is possible and economically justified exclusively if there is appropriate system of incentives/subsides. During 2010 year in the Goverment of the Republic of Srpska in procedure was the Regulation on generation and consumption of energy from renewable resources and cogeneration. By that Regulation in the period up to 2020 year, would be prescribed indicative targets of certain types of power plants participation using renewable sources and that will be subject of generation stimulation. The indicative target corresponding to stimulation of solar energy is 4,2 MW of installed capacities, estimated annual average generation of 5.000 MWh.

The map of solar irradiation for the area of Bosnia and Herzegovina, with the possible electric power generation of horizontally placed solar panels, and panels set up under the optimum angle, is shown in the next Figures. Maps were downloaded from the web site of the EU Joint research centre, in the part related to the research project of solar energy and development of solar irradiation map for a wider Europe area.

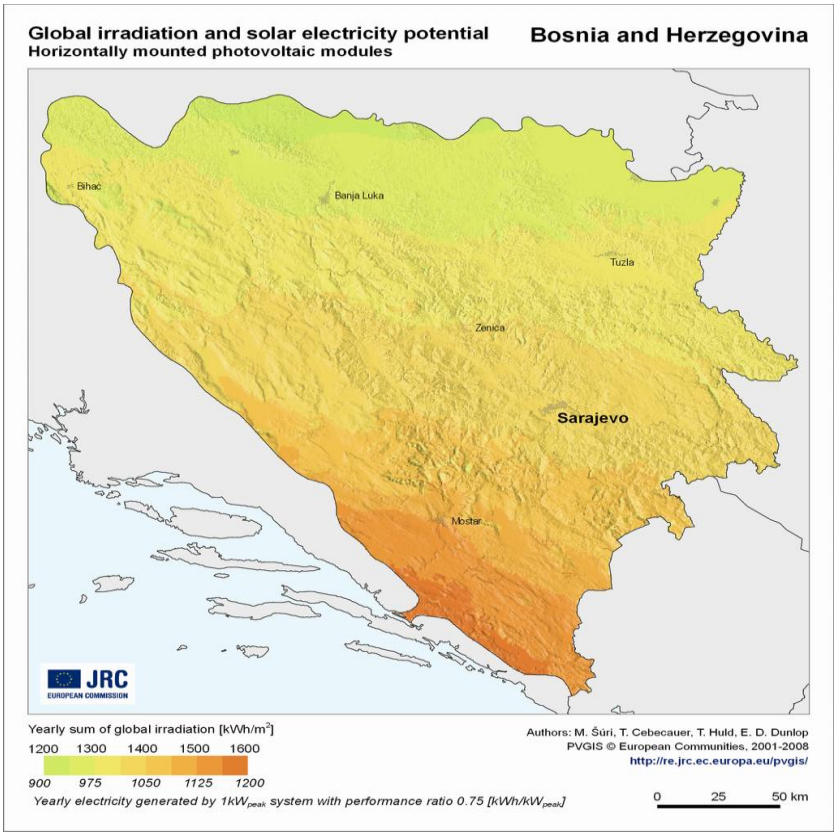


Figure 10.5: Map of solar irradiation for the area of Bosnia and Herzegovina

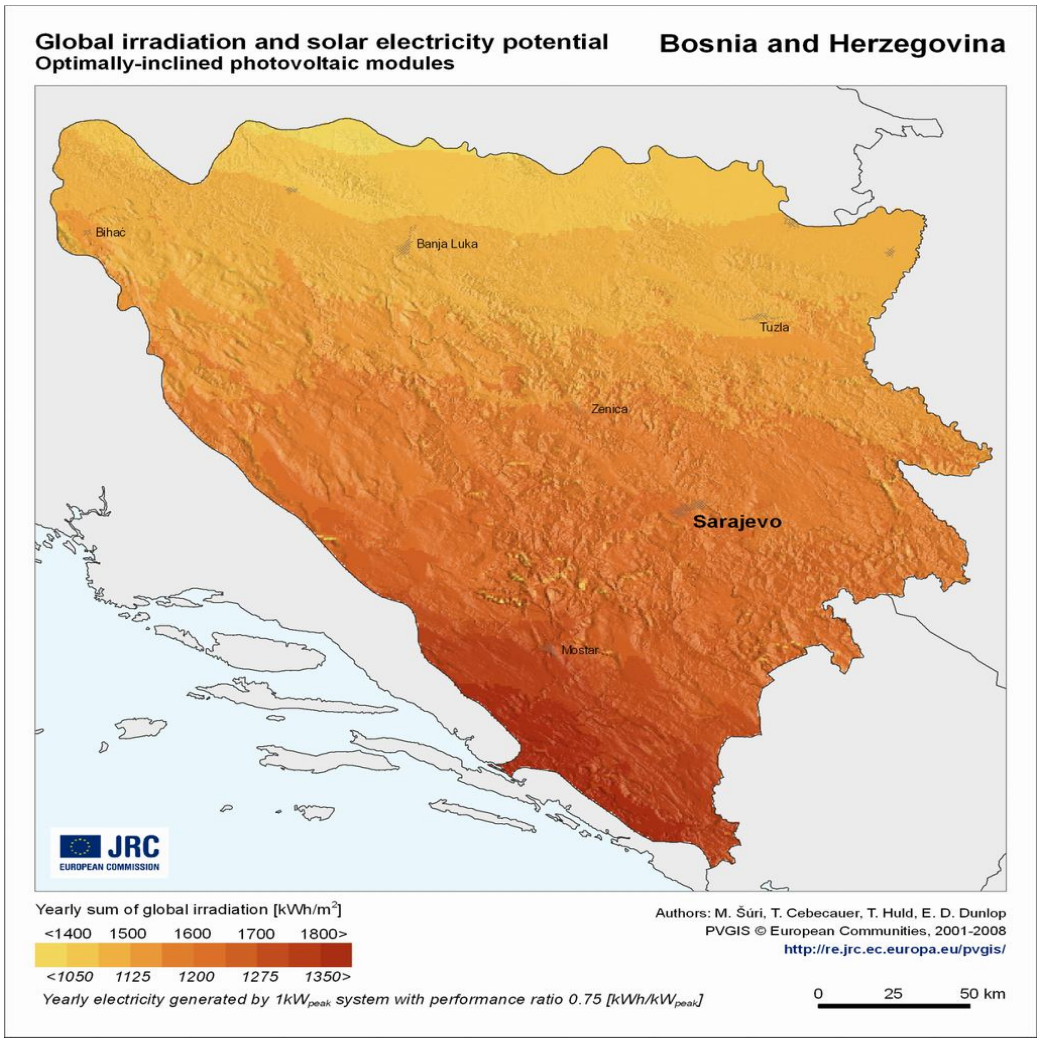


Figure 10.6: Map of solar irradiation for the area of Bosnia and Herzegovina

The map of solar irradiation shows that area of Trebinje municipality is the region with the highest potential for electric power generation using photovoltaic panels. Possible annual generation of a solar panel power 1 kW is 1200 kWh in the case of horizontal installation, and more than 1350 kWh in the case of panel installation with optimization of an incident angle of radiation

By the Action plan for the SEAP programme realization, it is predicted installation of photovoltaic panel for electric power generation of total electric power 1.000kW by 2020 year,an average annual generation of 1.300 MWh.

10.2. Use of solar energy for hot water preparation

Due to above mentioned climatic characteristics, the conditions for installation of solar collectors for preparation of hot water in residential and business facilities are extremely suitable.

In most cases, **solar collectors** are used for sanitary water heating. The reason for that is the high consumption of sanitary hot water during a year and relatively low required temperature, 45-60^{o} C.

There are more types of solar collectors:

- flat plate solar collectors can achieve fluid temperature up to 100° C, they have simple design, less expensive, and are very often in use,
- solar collectors with vacuum tubes composed of series of glass tubes from which air is drawn and whose axis passeses dark metal receiver through which flows working fluid.

Solar collectors with vacuum tubes are for about 30% more expensive than flat plate collectors. The system with solar collectors is good dimensioned if an annual share of used solar energy in total energy necessary for heating of hot sanitary water, is in smaller solar systems 50-60% , and in middle 30-50%. At a request for greater share of solar energy,the system would be oversized (especially in the summer period) and ratio between investment expenses and energy gains would be disproportional.

The first step in sizing solar system is determining a boiler size on the basis of needs for hot sanitary water. Later, on the basis of boiler size, is determined number of collectors and solar station characteristics. In the summer period solar collectors prepare hot sanitary water without help of a boiler or heater. If it happens a cloudy weather for a few days, sanitary water must be heated using heater or boiler. In order to store as much energy as possible during a day (while there is solar radiation), a water heater of greater volume is necessary. For family houses, a water heater volume approximately corresponds to a double daily consumption of sanitary water. As an orientation measure for the collector size serves a data that per a household member is necessary to mount 1 to 1,5 m^2 of collector area for hot water preparation. Most heat is obtained when the collectors are installed on a roof toward the south, under angle of 40°-45°. Also, bigger area on the west, or on the east side can ensure the same effect.

If we assume that the average four members household monthly consumes about 200 kWh of electric power for hot water preparation, it is obtained the annual consumption for these purposes of 2400 kWh. According to the current valid prices, total annual expense is about 350 KM. If it is known that a price of a collector system for heating hot sanitary water that would meet needs of four members household is about 3000 €, it is clear that payback of these systems can be achieved only after the expiry period of 15- 20 years. It is important to mention that in favour of solar collectors application goes a fact that the price of electric power in the Republic of Srpska is at the moment relatively low, and in the future inevitably follows its increase, and thus shortening payback period of investment.

The aim of Trebinje municipality is to instal solar panels onto the facilities in its possession by 2020 year, whereby would be achieved saving of electric power intended for hot water preparation. The aim is, also, to provide by 2020 year, by incentive measures, installation of solar collectors on 250 individual residential facilities, achieving annual saving in electric power consumption for preparation of hot sanitary water of 300 MWh annually.

In order to encourage application of solar collectors, by the Action plan for SEAP programme implementation, within municipal budget, was suggested to establish a special fund from which subsidies would be granted assigned for paying part of 30 % of investment expenses for solar collectors installation.

10.3. Use of biomass for facilities heating

Biomass is a renewable energy source, whereby it can be divided into wood, non-wood and animal waste, within which can be distinguished:

- wood biomass (forest residues,waste wood),
- timber grown biomass (fast-growing trees),
- non-wood biomass (fast-growing algae and grass),
- agriculture residues and waste,
- animal waste and residues,
- urban and industrial waste.

Important fact is that wood biomass can be considered as a renewable energy source only if biomass annual growth, realized through planned afforestation, is bigger than its consumption.

If it is observed biomass consumption in the area of Trebinje municipality, important application has wood biomass used for facilities heating. At that it cannot be spoken about planned breeding of fast-growing trees, but the exploitation of natural plantations of forest cultures, mainly oak and beech. Considering that the municipality has no developed wood-processing industry, there is no possibility of using wood waste that could be reworked in the form of briquttes or pellets.

There is no built remote heating system in the area of the muncipality, so individual facilities are heated seperately. Wood mass, beside electric power represents main energy-generating product for heating of residential facilities. Other, unrenewable energy sources, such as coal, fuel oil or gas do not importantly participate in primary energy consumed for facilities heating.

Systematic analysis of energy-generating product consumption for residental facilities heating was done on an occasion of making the Development Study of Energy Sector in B&H, upon conducting an overall questionnaire on energy-generating products consumption for different purposes in households.

Total number of households in the year the questionnaire was carried out was 11.000, whereof 7.400 is in the inner town area. The average residental unit size was 107 m^2 in the inner town area, what is for about 26 m^2 more than the average in the Republic of Srpska.

At that the percentage of heated residential area was 42%. When we talk about the rest of residential facilities in the area of the municipality, average size was 89,3 m^2 with a percentage of heated space of 24,6%.

By the analysis of carried out questionnaire and obtained results by individual zones, it is obtained final energy consumption of wood mass for facilities heating of 202 TJ in 2005 year. With an assumed low heat power of 14500 kJ/kg for wood mass with moisture content of 20%, it is obtained that annual consumption of wood was about 27.900 m^3.

The study predicted increased consumption of wood for facilities heating of 46,5% by 2020 year, what for the area of the municipality Trebinje gives consumption of 40.900 m^3.

According to the data submitted from PC "Forestry of the Republic of Srpska", the planned afforestation in the area of Trebinje municipality in the period from 2006 to

2010 was done dominantly with cypress, black pine and accacia cultures, which are not used in generation of heating power. By the planned activities was carried out afforestation of bare land and filling of the existing plantings of these crops.

10.4. Use of geothermal energy in the area of Trebinje municipality

The World Commission on Enviroment and Development- WCED also known as the Brundtland commission, in 1987 year published the report under title “Our common future.“ In this report, it was for the first time presented concept of “sustainable development“. Only in 1992 year, after the conference in Rio de Janeiro finishing, sustainable development indicators were grounded (SDI). In the area of energy use one of the indicators includes representation of renewable energy sources in the global energy transformation.

Guided by these guidelines were collected and analyzed data on the use of renewable energy sources in the area of Trebinje municipality. The collected data show a very low level of participation of renewable energy potentials in the energy scenario. While the global trend shows the use of solar energy as the most common in the area of renewable energy sources, in the area covered by analysis this energy is almost not used in technical scale. The alternative, that is just now experiencing a greater expansion around the world, is the use of geothermal energy. In this paper are analyzed possibilities of geothermal energy use in the area of Trebinje muncipality.

10.4.1. Geothermal energy

Geothermal energy represents the natural heat of the Earth, and it includes accumulated heat of rocks and water in the Earth skin. Depending on the temperature it could be divided into high temperature and low temperature, and it can also be divided according to energy carrier on petrogeothermal (rock heat), hydrogeothermal (water heat) and magmageothermal energy (magma heat). In contrast to solar energy this energy is available throughout a day and year round and it does not depend on weather conditions. As such it is very suitable for heating and cooling, both private homes and public institutions. There are different ways of using this energy (generation of electric power and heat energy) and they primarily depend on its manifestation.

There are no thermal springs or some other way of high-temperature geothermal energy in Herzegovina territory. It is strictly manifested through heat of soil and surface and ground water and its temperature does not exceed 20° C. Because it is about low temperature geothermal energy it can be used exclusively by means of heat pumps with the aim of heating, cooling, and sanitary water heating.

10.4.2. Heat pumps

Heat pumps are devices that perform heat transfer from one place to another. Such systems are of an active type and use electric power to perform the work. They, beside heating, are used for cooling, and they have existed since the first fridge was made. They are more used for heating of residential and commercial facilities only recently, the most often as a split system air conditioners.

The geothermal system uses soil, surface and ground water or both as its heating source in the winter, and as heat sink for cooling in the summer. From this reason, this type of heat pump is still called geothermal heat pump. Heat is taken from the ground by using liquid, such as water or antifreeze. The first such system was made in Geneva and it used heat capacity of the Geneva lake for heating the municipal building in Geneva.

It also can be made just for heating, heating with passive cooling or heating with active cooling. The passive system for cooling pumps cold water through system, without using heat pump.

10.4.3. Types of geothermal systems

There are three basic types of geothermal heating and cooling systems. They are:

- open loop system
- closed horizontal loop system
- closed vertical system

In the area of Trebinje municipality the most convenient for use is an open loop system. An open system takes water from a river, lake or discharge well. Water is then pumped out to the heat pump where exhange of energy is done. After that water is reversed into a river, lake or reverse well. This system is shown in the Figure 10.7. In the case of using water from a well, as discharge as reverse well must have enough capacity so a geothermal system could constantly work. This process is still called an open recharge.

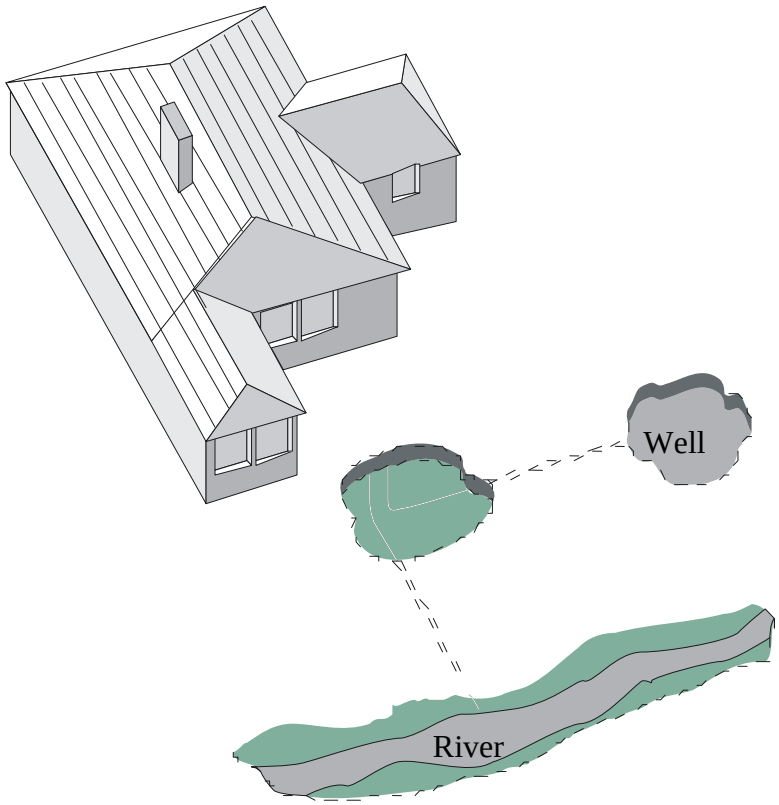


Figure 10.7: Open loop geothermal system

Water used in geothermal system is slightly cooled or heated and is not treated chemically so it cannot considerably affect the enviroment.

In such systems, it is necessary to bear in mind that water is taken freely from ground, river or lake. It must be provided enough amount of water in order a heat pump to work undisturbedly.

10.4.4. Assumption for possibility of geothermal system use

For heating and cooling of big facilities in the territory of Trebinje municipality a trend is the use of chillers (air-to-water heat pump). These systems use the outside air as temperature source. Efficiency level of these systems varies depending on outside air temperature. In contrast to chiller systems, geothermal systems use water as a temperature source. The basic assumption of using this heating system is enough amount of water and relatively uniform temperature throughout a year.

The river Trebišnjica, artifical storage Gorica, and existence of ground water give a clear idea of sufficent amounts of water for constant operation of geothermal system. There are many ways for undisturbed pumping of this water, as follows:

- facilities located immediately along a river or a lake can directly use water from a river and return it into the same source after the use,
- realization of the special piping from a river or a lake to the facility,
- boring of artesian wells near facilities, where one would serve as a discharge well, and other as the reverse well where used water would be pumped back.

Temperature of Trebišnjica water is shown in the Table 10.1, Figure 10.2. Measuring devices are located 4-5 kilometres downstream from possible water intake, and the values refer to 2008 year.

Table 10.1: Average monthly water temperatures in the river Trebišnjica in 2008 year[15]

Month	Januray	February	March	April	May	June	July	August	September	October	November	December
°C	8	8	10	11	12	13	15	16	15	13	12	8

[15] Data taken from the data base of Subsidary company "Hydro power plant on the Trebišnjica", ltd Trebinje

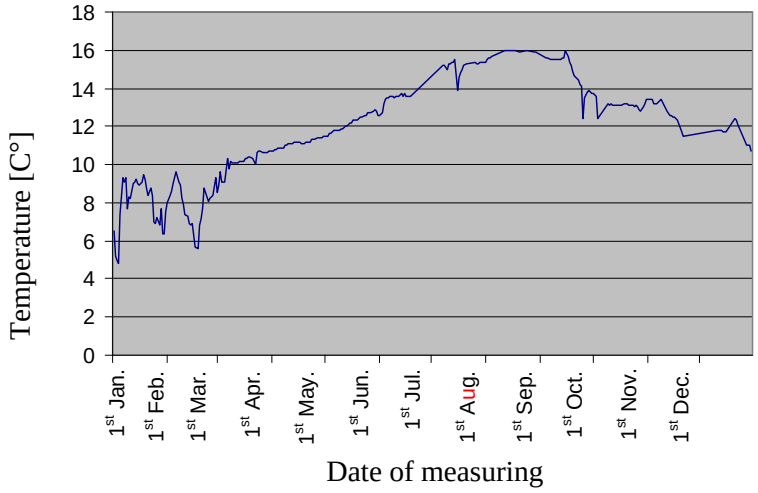


Figure 10.8: Change of water temperature in the river Trebišnjica for 2008 year

Systematic measurings of the river Trebišnjica water temperature have started in the middle of 2007 year. Previous discountinous measurings have shown that, with minor variations, in some years, the water temperature in the river Trebišnjica ranged from 10° C to 14° C. The other way of water use is water from an artesian well. The data of ground water temperature and water temperatures at the spring show an average temperature of about 11°C.

Table 10.2: Water temperatures measured at certain springs in the area of Trebinje municipality [16]

Date	Location	Analysis number	Time	Water temp.	Air temp.
	Gorica - storage			°C	°C
20.04.02	Artifical storage - 100 meters more from the dam	01102	11:52	14,8	23,1
	Lušac- spring				
28.04.02	Under settlement Gučina - Trebinje	01502	14:00	10,8	22,3
05.07.02	Under settlement Gučina - Trebinje	03102	17:47	12	28,6
17.09.03	Under settlement Gučina - Trebinje	05603	13:45	11,5	23,1
	Mali Vruljak - spring				
20.04.02	3 metres from Vruljak, 100 metres to Studenac spring	01202	13:00	11,7	24,1
01.07.02	3 metres from Vruljak, 100 metres to Studenac spring	03002	18:52	11,5	25
	Oko- estavel				
01.03.02	Settlement Zasad - near School centre	00102	15:30	17,4	11,9
28.04.02	Settlement Zasad - near School centre	01402	12:00	11,3	23,5
05.07.02	Settlement Zasad - near School centre	03202	19:00	0	0
14.09.03	Settlement Zasad - near School centre	05903	14:25	12,2	20,3
	Oko- estavel - Petrovo polje				
07.04.02	Under village Čičevo-near Moslim cemetery	00602	10:40	11,5	17,5
24.11.02	Under village Čičevo-near Moslim cemetery	04302	13:30	13,1	14,8
14.09.03	Under village Čičevo-near Moslim cemetery	05703	11:40	12,5	20,9
	Pecine- estavel				
07.04.02	Dražin do - on the river bank	00802	13:00	10,4	14,5
24.11.02	Dražin do - on the river bank	04002	10:10	11,7	15,6
16.09.03	Dražin do - on the river bank	06003	14:21	14,2	16,9
	Studenac - spring				
20.04.02	On the river Trebišnjica bank, under Crkvina	00902	9:45	11,8	16,1
01.07.02	On the river Trebišnjica bank, under Crkvina	02802	17:36	11,7	25
09.11.02	On the river Trebišnjica bank, under Crkvina	03902	15:00	11,5	10,6
23.07.03	On the river Trebišnjica bank, under Crkvina	04803	17:30	12	33,5
17.09.03	On the river Trebišnjica bank, under Crkvina	05403	14:20	11,5	16,2
	Šumet - estavel				
07.04.02	Under village Bugovina- Mokro polje	00502	10:00	11,4	11,7
20.07.02	Under village Bugovina- Mokro polje	03502	15:05	11,6	24
14.09.03	Under village Bugovina- Mokro polje	05803	10:30	12,3	19,8
	Trebišnjica-river				
20.04.02	Sample taken 100 metres under spring Studenac	01002	11:00	11,2	16,1
	Tučevac-estavel				
07.04.02	Dražin do - under crossroad	00702	12:00	10,5	12,7
24.11.02	Dražin do - under crossroad	04102	11:00	11,7	15,6
16.09.03	Dražin do - under crossroad	06103	18:30	11,6	12,5
	Vruljak-spring				
20.04.02	100 metres upstream from the spring Studenac on the other side of the river	01302	14:00	11,3	24,1
01.07.02	100 metres upstream from the spring Studenac on the other side of the river	02902	18:41	11,4	25,5
13.09.03	100 metres upstream from the spring Studenac on the other side of the river	05503	16:03	11,8	20,1
11.01.09	100 metres upstream from the spring Studenac on the other side of the river	06708	10:00	11,1	10

[16] Data taken from the "Zelena brda" Spelological society Trebinje

As the temperatures of surface and ground waters in the area of Trebinje municipality slightly vary efficiency level of a potential geothermal system can be considered constant.

10.4.5. Comparative analysis of different heating system costs

In order to more realistic consider position of the geothermal heating system in relation to conventional heating systems, it was made rough calculation of operating costs. The calculation was done for the pavilion in the Trebinje barracks, total area 1845 m^2. The building was built of stone, in the period of Austro-Hungarian rule. By the calculation of a building heat losses it was calculated 300 kW necessary for heating of such facility. For this calculation were taken the most unfavourable weather conditions for Trebinje, in the last 100 years.

Four different heating systems were considered.

- Conventional coal-fired heating system with two coal types of different heating powers and different cost prices.
- Geothermal system with an option of two different tariff models for the calculation of consumed electric power. It was dimensioned geothermal system of nominal consumption 80 kW based on the river Trebišnjica water temperatures and desired temperatures inside the facility. The efficiency coefficient of this system is 3,75.
- And the system of direct heating with electric power, also with an option of two different tariff models for the calculation of consumed electric power.

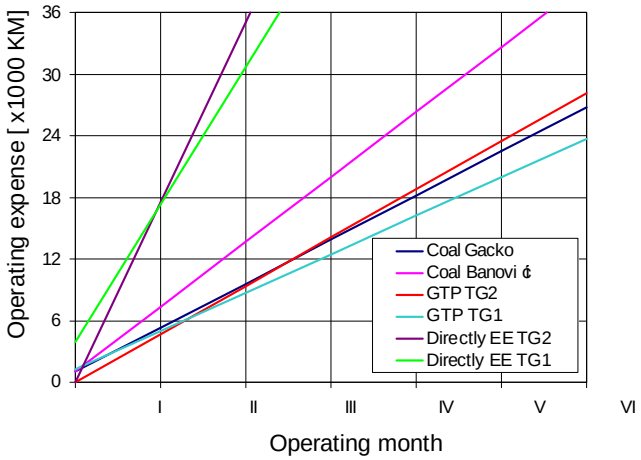


Figure 10.9. Change of operating costs for different heating systems for 320 hours of work monthly (16 hours daily 20 working days)

If we take into account that geothermal system, beside it heats in the winter, can also cool in the summer, then it is clear that an option of such heating way is in advance over the proposed coal and electric power heating solutions.

10.4.6. Investment height

There are pumps of different powers and prices in a commercial use. Geothermal heat pump of a nominal power 50 kW and COP 4 costs cca 28000 EUROS, although prices

drastically vary from manufacturer to manufacturer and of an installation type. Prices of a low power system are about 1000 KM per kWh of output power. An investment in such system is 4 to 5 times higher than investment in any of the conventional heating systems, but due to a high level of efficiency investment is returned through energy saving in relatively quick time.

Unlike the technically developed countries, there are no funds to subsidize such heating and cooling systems in the Republic of Srpska. The countries have a direct interest to promote and encourage consumers to use such heating and cooling system. Comparison for the construction of a small hydro power plant Brova, a nominal power of 500 kW investment ranges depending on conditions from 1.000.000 to 1.500.000 EUROS. The same power can be reserved by investment in above mentioned 14 geothermal systems, which requires total investment of around 448000 EUROS, or below 50% of means necessary for hydro power plant. This comparison is given under the assumption that electric power for hydro power plant is only used for heating.

10.4.7. Conclusion

Geothermal heat pump is a system that has high level of energy efficiency, what reduces expenses for heating and cooling in residental and commercial facilities up to 50%. In relation to conventional heating systems operating life of a heat pump is longer. Geothermal heat pump does not pollute the enviroment (no harmful substances emission, noise is reduced to minimum). It can be used in warm and also in cold periods of a year. In the summer for cooling, and in the winter for heating.It is easily combined with some other alternative heating systems. Maintenance expenses are minimal. Life expectancy of this system is from 25-30 years. Although the initial investment price is too high, refund of those means through energy saving is relatively quick in relation to the lifetime of a system.

10.5. Literature

1. Mitrović J.: Termodinamika, Skripta FPM Trebinje, 2000.
2. Vučić V., Ivanović D.: Fizika I, Naučna knjiga, Beograd, 1990.
3. Heating and Cooling With a Heat Pump, Natural Resources Canada's Office of Energy Efficiency, EnerGuide, 2004.
4. Manual H, Heat Pump Systems: Principles and Applications, Air Conditioning Contractors of America, 1513 16th St. NW, Washington, D.C.
5. www.energyoutlet.com/res/heatpump/
6. www. c l i m a t e c h a n g e . g c . c a
7. www.honoluluswac.com
8. www.makai.com/p-swac.htm
9. www.seaconinternational.com

11. ESTIMATION OF ELECTRIC POWER CONSUMPTION

11.1. Distribution network structure and the number of electric power customers

Electric power supply of the area of Trebinje municipality is done over substations SS 400/220/110/35/10 kV Trebinje and SS 110/35/10 kV Trebinje 1. Installed power of transformer 110/35 kV in the stated substations is:

- SS Trebinje 2, 2 x 20 MVA
- SS Trebinje 1, 1 x 20 MVA

Electric power is by feeding lines of 35 kV from SS Trebinje and SS Trebinje 1 distributed to distribution SS 35/10 kV, which are used for primary transformation of electric power with a voltage level of 35 kV to 10 kV:

- SS 35/10 kV Trebinje 1, power 4 + 8 MVA,
- SS 35/10 kV Trebinje 2, power 2 x 8 MVA,
- SS 35/10 kV Volujac, power 4 MVA,
- SS 35/10 kV Veličani, power 2,5 MVA,
- SS 35/10 kV Grančarevo, power 1,6 + 1 MVA.

Figure 11.1 Map of electric power supply in Trebinje municipality

For the transformation of electric power from voltage level 10 kV to 0,4 kV voltage level, as of 31st December 2010 year, it is used 260 of transformer stations of 10/0,4 kV.

Total lenght of distribution network in the area of Trebinje municipality, as of 31st December 2010 year is:

- Voltage level 35 kV-61,6 km,
- Voltage level 10 kV - 384 km,
- Voltage level 0,4 kV - 416 km.

Total number of electric power customers in the area of Trebinje municipality, as of 31st December 2010 year is 13.330. Customers are divided into five categories of consumption, defined by the Tariff system for sale of electric power to tariff customers in the Republic of Srpska.

Table 11.1: Overview of electric power customers structure for 2010 year

Ordinal number	Consumption category	Number of customers 31st December 2010. y.
1.	Other consumption on 35 kV	0
2.	Other consumption on 10 kV	8
3.	Other consumption on 0,4 kV	1.108
4.	Households	12.200
5.	Public lighting (154 measuring points)	1
6.	**Total**	**13.317**

Overview of the total number of customers on 31st December in the last five years is given in the following table.

Table 11.2: Overview of total number of customers on 31st December from 2006-2010 year

Ordinal number	Year	Other consumption	Households
1.	2006	1.124	11.038
2.	2007	1.160	11.223
3.	2008	1.251	11.586
4.	2009	1.265	11.928
5.	2010	1.270	12.200

Based on the data shown in the previous table it can be concluded that in the last five years period the number of customers increased for 1.308, with an average annual growth rate of 2,07%.

11.2. Electric power consumption in the previous period

Total annual electric power consumption for the previous ten-year period is shown in the following table.

Table 11.3: Annual electric power consumption, 2001-2010 year

In GWh	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Consumption	92,74	92,05	91,21	90,74	89,80	90,75	98,89	105,77	103,09	104,74

Consumption stated in the table above includes the net consumption of end customers and distribution losses. The past period is characterized by relatively high

level of distribution losses, caused by significant share of commercial losses (electric power theft).

Table 11.4: Net consumption of end customers and distribution losses, 2001-2010 year

Losses	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
GWh	20,86	19,29	14,65	13,83	12,63	12,78	14,66	18,25	14,78	14,50
%	22,49	20,96	16,06	15,24	14,07	14,08	14,82	17,25	14,34	13,84

Net consumption of electric power, shown by consumer categories, for the previous past ten- year period is given in the following table.

Table 11.5: Net consumption of electric power, shown per consumption categories

GWh	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Other consumption 10 kV	12,10	12,14	12,25	12,03	11,67	14,23	15,93	14,92	12,05	12,85
Other consumption 0,4 kV	11,02	11,07	12,01	13,89	16,02	14,02	16,56	18,13	18,58	18,94
Households	47,69	48,56	50,97	49,37	47,72	47,65	49,45	51,79	54,83	55,21
Public lighting	1,08	0,99	1,33	1,61	1,75	2,07	2,29	2,67	2,85	3,24
Total	71,89	72,76	76,56	76,90	77,16	77,97	84,23	87,51	88,31	90,24

Electric power consumption increase in the previous period, in an absolute and relative relation, with the shown average annual growth rate, by consumer categories, is shown in the following table.

Table 11.6: Electric power consumption increase 2001-2010 year

	Consumption increase 2010 - 2001			Consumption increase 2010 - 2005 year		
	in GWh	%	Average %	in GWh	%	Average %
Other consumption 10 kV	0,75	6,23%	**0,61%**	1,18	10,15%	**1,95%**
Other consumption 0,4 kV	7,92	71,92%	**5,57%**	2,91	18,19%	**3,40%**
Households	7,52	15,76%	**1,47%**	7,48	15,68%	**2,96%**
Public lighting	2,16	199,50%	**11,59%**	1,50	85,55%	**13,16%**
Total	18,35	25,53%	2,30%	13,07	16,95%	3,18%

By the analysis of the data shown in the previous two tables it can be seen a significant consumption increase in the previous ten-year period, with an average growth rate of 2,3%. At that in the last five years it came to an increase of growth trend, with realized average rate of 3,18%. The cause of this phenomenon can be

explained by consumption of Household category, that in 2005 year was achieved at the level of 2001 year. The reason for stagnation of Household category consumption in the period from 2001-2005 year should be sought in a gradual establishment of electric power economic prices and in an increase of discipline in its payment, that inevitably led to a rationalization of consumption.

In order to determine the share of electric power used for residental facilities heating, it was done analysis of customers consumption of the Household category and the Other consumption at a low voltage, for the winter period (1st January to 31st March and 1st October to 31st December) and the summer period (1st April to 30th September) 2010 year.

Table 11.7: Customers' consumption from the Household category 2010 year

Category	Period	Consumption in kWh
Households	Winter period	31.906.685
	Summer period	23.299.502
Other consumption of 0,4kV	Winter period	10.364.980
	Summer period	8.573.985

It is assumed that electric power consumption during the winter period, without energy for heating needs, at Household category is for 25% higher than the consumption in the winter period. In this way, it is get approximate amount of 2.782.308 kWh of electric power, that customers from Houshold category consume for needs of space heating.

11.3. Prediction of electric power consumption

For prediction of electric power consumption in the period from 2011 year to 2020 year it will be used study results presented in two study documents, that processed electric power consumption in the area of the Republic of Srpska in this period:

- Energy Development Strategy of the Republic of Srpska, processor "Energy Institute Hrvoje Požar" Zagreb, 2010.
- Development study of the distribution system of the Republic of Srpska, processor "TP Elektrotehna Niš" and "Electrical Engineering Institute Nikola Tesla" Belgrade, 2011.

By the Energy development strategy, prediction of consumption was analyzed in three reference scenarios:

- S1-High GDP -scenario with a rapid growth of gross domestic product,
- S2-High GDP with measures- scenario with a rapid growth of gross domestic product, and application of energy efficiency measures to reduce electric power consumption,
- S3-Low GDP- a scenario with relatively slow growth of gross domestic product

Consumption was observed at the macro level by this strategic document, with direct conditionality of consumption growth from the gross domestic product growth rate and application of energy efficiency measures. Average growth rates of electric power consumption, by consumption categories, for different scenarios are given in the following table.

Table 11.8: Growth rates of electric power consumption

Consumption category	Scenario		
	C1	C2	C3
Other consumption 35 kV, 10 kV	7.28%	6.77%	5.81%
Other consumption 0,4 kV	5.16%	4.89%	3.93%
Households	1.75%	1.33%	1.23%
Total	**3.73%**	**3.33%**	**2.81%**

By the distribution system of the Republic of Srpska development study, electric power consumption was obsereved at the micro level, and on the basis of consumption change of smaller geographic areas of 2 x 2 km surface, in the period from 1998-2008 year, was made prediction of consumption by 2020 year. The consumption of major customers (customers of a medium voltage and customers of a low voltage where peak-load power is done by measuring) was predicted based on a questionnare of these customers need for electric power by 2020 year. For the consumption of Household category, in the period by 2020 year, it was assumed the slowdown of consumers number growth at approximately 0,8% annually. The expected electric power consumption growth rates given in the Development study, by consumption categories, for the area of distribution company "Elektro Hercegovina", joint stock company Trebinje, for period 2008 year to 2020 year, are given in the following table.

Table 11.9: The expected growth rates of electric power consumption for the distribution area "Elektro Hercegovina", joint stock company

	Consumption		Consumption increase 2020 - 2008 year		
	2008	2020	in GWh	%	Average %
Other consumption 35 kV, 10 kV, 0,4kV I TG	24,584,142	37,299,052	12,714,910	51.72%	**3.53%**
Other consumption 0,4 kV	28,611,590	43,229,206	14,617,616	51.09%	**3.50%**
Households	99,223,250	131,604,500	32,381,250	32.63%	**2.38%**
Public lighting	4,563,914	10,861,727	6,297,813	137.99%	**7.49%**
Total	**156,982,896**	**222,994,485**	**66,011,589**	**42.05%**	**2.97%**

In order to develop the prediction of electric power consumption for the needs of this document, it was made the comparison of results obtained by the Energy development strategy and the Study of distribution system, with the consumption growth rates realized in the previous period.

The average consumption growth rate for the Other consumption category at medium voltage has significantly lower value than the growth rate stated in the Energy development startegy. Experience from the previous period and consumption growth

achieved in the period from 2005 to 2010 year of 1,95% shows that growth rates predicted by the Strategy are too optimistic, and that better quality results can be obtained using the growth rate defined by the Strategy.

When we talk about customers consumption growth rate from the category Other consumption at low voltage, both documents predict similar values, what approximately corresponds to the rate accomplished in the period from 2005-2010 year of 3,4%.

If we observe the consumption of Household category, the growth rate predicted by the Study is significantly higher than the growth rate of all three scenarios processed in the Strategy. On the other hand, average achieved growth rate was 2,96% in the period from 2005 to 2010 year, i.e. 1,47% in the period from 2001 to 2010 year. It is assumed that growth trend of this category will be continued by 2020 year with an average rate of about 2%, whereat unmeasured energy part that is currently considered as distribution losses, would be eliminated and implied by measured and invoiced electric power.

Having in mind the above comparison, for development of electric power consumption prediction will be applied growth rates predicted by the Development study of the distribution system.

By application of growth rates in electric power consumption by consumption categories in the area of Trebinje municipality achieved in 2010 year, it is obtained the predicted consumption in 2020 year as follows.

Table 11.10: Predicted consumption in 2020 year for Trebinje municipality

	Consumption		Consumption increase 2020 - 2010		
Category	**2010**	**2020**	**in GWh**	**%**	**Average %**
Other consumption 10 kV, 0,4kV	31,789,739	**44,838,356**	13,048,617	41,05%	**3.50%**
Households	55,206,187	**69,855,750**	14,649,563	26,54%	**2.38%**
Public lighting	3,244,067	**6,681,762**	3,437,695	105,97%	**7.49%**
Total	**90,239,993**	**121,375,868**	**31,135,875**	**34,50%**	**3.01%**

On the basis of previous analysis, it is expected net electric power consumption to grow for 34,5 % by 2020 year, with an average annual growth rate of 3,01%. In relation to consumption growth rates achieved in the period from 2005 to 2010 year, it is expected the trend growth to be kept at nearly the same, relatively high level, of about 3% annually.

When it is about distribution losses, it is expected that most of the commercial losses (theft) to be eliminated in the next period, so that the total losses will approximately correspond to the technical losses. The standard level of tecnical losses correspond to the level of about 7-8% of gross overtaken electric power, that will for predicted net consumption of 121,38 GWh amount be 10,55 GWh. In this way, total electric power consumption, as the sum of net consumption and distribution losses, is predicted in the amount of 131,93 GWh in 2020 year, what is growth for 27,19 GWh, i.e. 25,96%.

12. ELECTRIC POWER GENERATION IN THE AREA OF TREBINJE MUNICIPALITY

12.1. The existing capacities and their characteristics

Electric power generation in the area of Trebinje municipality has been realized by use of hydropotential and therefore it does not cause CO_2 emission during the generation.

Increase of electric power generation from these resources contributes to reduction of generation from other resources (thermal power plant, gas plant, etc.) and in that way indirectly affects CO_2 emission into the air.

There is installed part of capacity of the Hydro power plant on the river Trebišnjica (HPP) system in the area of Trebinje municipality that was realized in the first construction phase. The capacities of HPP system realized downstream from Trebinje municipality do not have affect electric power generation in the area of Trebinje municipality, while the planned capacities upstream of Trebinje municipality has influence, by making this way of electric power generation in the municipality will be increased due to increase of water discharge due to regulated re-direction of water into Bilećko lake.

In the territory of the muncipality there are two Hydro power plants, HPP Trebinje 1 and HPP Trebinje 2. HPP Trebinje 1 is a non-diversion hydro power plant that uses water from Storage reservoir Bileća, total volume of 1277.6 x 106 m^3. Bileća storage enables the annual regulation of the river Trebišnjica flow. Grančarevo dam is located on 18th km downstream from the river spring, and 17 km upstream from Trebinje.

Two generator units were put into operation in 1968 year and the third unit in 1975 year, when was performed increase of water level of Bileća storage for 2 m, wherewith energy value of storage increased for 60 million of kWh.

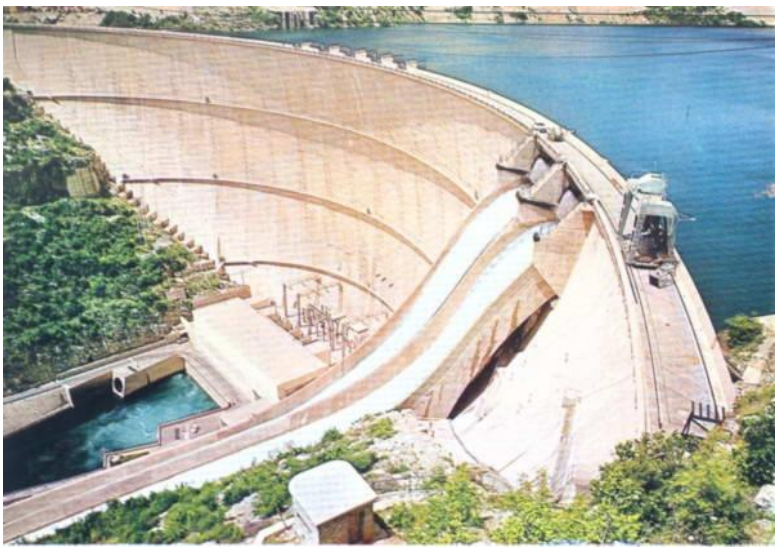


Figure 12.1: Hydro power plant, HPP Trebinje 1

Table 12.1: Basic technical characteristics of HPP Trebinje 1

BASIC DATA	number of generator units::		3
	generator unit type:		Francis
	installed capacity (MW):		2 x 54 + 1 x 63
	installed flow (m^3/s)		3 x 70
	technical minimum (MW):		1 and 2 - 26; 3 - 28
	annual average generation (GWh):		370 - 420
	ten years average generation (GWh)		410
	$1m^3$ of water energy (kWh):	0.12 - 0.25	(351 m.n.m. - 400 m.n.m.)
	water amount for 1 kWh (m^3/s):	8.33 - 4.00	(351 m.n.m. - 400 m.n.m.)
INFLOWS, STORAGES, HEADS	annual average inflow (m^3/s):		71
	storage volume (mil. m^3)	total:	1277.6
		active:	1 and 2 - 1074.6; 3 - 1060.6
		inactive space:	1 i 2 - 203; 3 - 217
	storage energy value (GWh):		1010.7
	head racewater level (m.n.m.)	max:	400.00
		normal:	384
		min:	1 and 2 - 351; 3 - 352
	tail race water level (m.n.m.):		295
	gross heads (m)	max:	103.5
		normal:	86.5
		min:	1 and 2 - 54.5; 3 - 55.5

Hydro power plant Trebinje 2 is located just below Gorica dam, the interstation of water distribution in the system, i.e. at this plant is predicted optimization of consumption of available water. The storage of Gorica uses the river Trebišnjica water from upstream hydro power plant -HPP Trebinje 1 and its storage Bileća. Tail racewater of HPP Trebinje 1 is at the same time headrace water of this hydro power plant, i.e. its compensation reservoir Gorica created by Trebinje 2 dam construction, at the dam profile place 13.5 km downstream of HPP Trebinje 1. The compensation reservoir Gorica, total volume of 15.74×10^6 m^3, enables daily water direction of HPP Trebinje 1 and the tributary Sušica. The concrete gravity dam Gorica with a height of 33.5 m and length of 185 m. To this plant organizationally belongs the channel, i.e. regulated concrete river bed of 67.8 km lenght, covered with concrete on 61 km of length. By this channel part of water is drained toward small HPP Čapljina and the tunnel toward HPP Dubrovnik. At Gorica dam there are two bottom outlets on the left side of dam and two spillway fields (poljes) in the dam middle by which is enabled evacuation of flood discharge. On the left side immediately next to Gorica dam were built two inlet structures for inlet tunnels. Of the two predicted inlet tunnels one was built toward HPP Dubrovnik. The power plant is connected to the voltage network of 35 kV and it has a

local character because the average annual generation is less than needs of the town Trebinje. It was put into operation in 1981 year.

Figure 12.2: Hydro power plant, HPP Trebinje 2

Table 12.2: Basic technical characteristics of HPP Trebinje 2

BASIC DATA	number of generator units:		1
	generator unit type:		Kaplan
	installed capacity (MW):		8
	Installed flow (m^3/s)		45
	technical minimum (MW):		1.5
	annual average generation (GWh):		14.5
	$1m^3$ of water energy (kWh):		0.042
	water amount for 1 kWh (m^3/s):		23.8
INFLOWS, STORAGES, HEADS	annual average inflow (m^3/s):		82.9
	storage volume (mil. m^3)	total:	15.74
		active:	9.36
		inactive space:	6.38
	storage energy value (GWh):		6.037
	head race water level (m.n.m.)	max:	295
		normal:	292.5
		min:	288
	tail race water level (m.n.m.):		273
	gross heads (m)	max:	22
		normal:	19.5
		min:	15

In 2001 year in this part of the system was totally generated 500.100 MWh of electric power whereof the HPP Trebinje 1 generated 489.800 MWh, and at the facility HPP Trebinje 2 was generated 10.300 MWh. In 2010 year total generation in the municipality was 817.555 MWh whereof at the HPP Trebinje 1 was generated 794.125 MWh and at the facility HPP Trebinje 223.430 MWh. Before considering this data it is important to mention that generation directly depends on weather conditions of that year. Beside greater amount of precipitation we will look at some aspects that directly influenced generation increase. In this period was finished inlet tunnel Fatničko polje - Bileća storage, by which water is re-directed from Fatničko polje to Bileća storage. Designed influence on downstream built power plant is 140 GWh.

13. POTENTIAL SOURCES FOR FINANCING ENERGY EFFICIENCY PROJECTS

13.1. Introduction

The realization, i.e. successful implementation of the Action plan implies provision of an adequate financing sources. The local authority can finance energy efficiency projects from public revenues or budget funds or from an external sources of financing. Previous practice and the existing model of budget creation neither recognize energy efficiency projects as a priority ones, nor enable application of planning mechanism that especially evaluate, segragate or eleborate this category. Beside the fact that the existing budgeting model does not affect stimulative in the energy efficiency area, the additional limitation represents the practice to allocate budget funds for the most part to current expenditures with no tendency to introduce new solutions that would reduce current expenses. On the other hand, there are various external sources of financing that can be local or foreign, public or private (commercial) credits or grants, enabling partial or full financing, etc.The contemporary enviroment, where global trends encourage the development of different opportunities and mechanism for financing the energy efficency projects and the enviroment protection, opens various opportunities for the local community.

The variety and availbility of financial sources represent a motivating factor for the implementation of EE and RES projects but at the same time requests modernization and strenghtening of the local authority capacity in order to make use of them.

13.2. Overview of the most favourable potential sources of financing

13.2.1. Budget

The budget of Trebinje municipality is an estimation of annual revenues, aid, and financing and the estimation of annual expenditures and other expenses. The budget is the main financial document and the most important instrument for realization of set local policies. Planning principles of the local budget are provided in the Document on Framework budget of the Republic of Srpska that contains macroeconmic projections and predictions of revenues and expenditures for the next year and the next two fiscal years, published by The Finance Ministry of the Republic of Srpska.

In accordance with provisons of Article 26 of the Law on the Republic of Srpska budget system upon budget planning the local authority is responsible to disclose the financing priorities i.e. the description of the planned policy for the planning period. In the previous practice Trebinje municipality was, in this segment of the planning process, as a reference document used Trebinje municipality Development strategy 2009-2017 year.[17]

[17] www.trebinje.rs.ba

The first necessary step for the provision of funds in the municipal budget implies that during initial activities on planning particularly should be defined and highlighted the priority of energy efficency projects implementation and use of renewable energy sources from Trebinje municipality Development strategy 2009-2017 year. It is necessary formally to form and include into the offical acts [18] a general guideline by which all activities financed from the budget, inter alia, are valued by energy efficiency criteria and use of alternative energy sources.

The budget of Trebinje municipality for 2011 year is planned in the amount of 18.135.490 KM whereat in the structure of planned budget funds, the most significant part is tax and non-tax budget revenues in the amount of 14.598.808 KM. The tax and non-tax budget revenues are planned almost at the level of performance of 2010 year (99,30%) and still reflect the effects of the global economy crisis that originally influenced the local community budget in 2009 year. Total planned means are allocated to current expenditures of 12.915.514 KM what makes 71,22% of total planned expenditures, expenses for non-financial means and debt repayment of 5.188.043 KM, what is 28,61% of the planned expenditures and budget reserve of 31.933 KM. The existing model does not motivate expenses rationalization because current expenses are planned on the basis of previous years achievements, with no consideration of possible saving.

Rationalization and reduction of current expenses through savings achieved by use of energy efficient technologies should be particularly stimulated.

Within non-tax revenues realized by Trebinje municipality, an important item represents means realized on the basis of recompense for using natural resources with the purpose of electric power generation. In 2009 year this basis achievement was at the level of 3,3 million KM, and by the plan for 2011 year is predicted 2,6 million KM on this basis. Means are achieved on the basis of the Law on Fees for the use of natural resources in order to generate electric power (The Offical Gazzette of the Republic of Srpska 83/03, 75/10) and dedicatedly used according to the Programme of funds use that adopts the Municipal assembly and delivers to the Ministry of Finance of the Republic of Srpska. According to valid legal framework funds can be used for:

- construction of new economic capacities or expansion of the existing by incentive lending,
- construction of primary infrastructural facilities in the function of development and employment,
- other purposes (except for employees salaries).

Except infrastructural facilites financed by these means, Trebinje municipality in 2004 year started with realization of the Stimulating employment programme realized through partnership banks and which involves the placement of loans for SME under extremely favourable conditions. Up to date in the placing is over 10 million of KM, what is for given economic surronding and absorbing capacities enough, so the last few years we record significant placement fall. For these reasons, it is necessary, in the most recent time, to create a new model that will enable the most purposeful dedicated use of means.

Bearing in mind the legislator intention to provide a return of benefit to the community that gives resources, it is necessary to suggest a new model of means

[18] Instruction to budget users for planning funds from the municipal budget.

expenses from compensations for use of resources to generate electric power that would predict financing of EE and RES development projects.[19]

The existing legal framework includes one year budget cycle, i.e. the budget is adopted for a period of a fiscal year which lasts 12 months and starts on 1st January and ends on 31st December. Perennial budgeting is not the practice of local authority in the Republic of Srpska. For implementation of the significant energy efficiency projects, renewable energy sources and enviromental protection, would be from an essential importance to plan budget funds for a longer time period, at least for three years.

Perennial budgeting would enable to overcome a problem of insufficent financial funds, within one fiscal year, and before all to ensure long-term commitment and to ensure development continuity and further improvement of energy efficency projects.

Local authorities can borrow in a way and to the extent prescribed by the Law on borrowing, debt and guarantees of the Republic of Srpska (The Offical Gazzette of the Republic of Srpska 30/07). The valid provisions allow the debt if in the period of making debt total amount due on repayment does not exceed 18% of achieved regular municipal revenues in the previous fiscal year. In 2011 year total amount due on repayment is about 1,1 million KM, and it remains for repayment about 4,1 KM to be repaid by 2020 year. Current debt of Trebinje municipality (7,40%) is at the level that leaves enough possibilities for new indebtness.

Beside the loan negotiating one of the local authorities' borrowing ways regulated by the Law is issuing of municipal bonds. Financing of capital projects by issuing municipal bonds meets the needs of energy efficiency projects financing because it is about borrowing directed at the projects of a public interest and it enables a greater volume of available funds, longer repayment period, and high degree of safety.

By analyzing securties classes, into which fit the projects suggested by the Action plan, we determine that budgetary funds are sufficient for financing smaller volume projects . At the same time, it is recommended the budgetary funds to be used strategically and in a way to ensure necessary preparation of a project (concept development and technical documents) or to provide the required percentage of participation for the use of external sources.

In the Republic of Srpska and B&H is not applied the principle of a green public procurement which basically means that enviromental and energy eligible goods and services have an advantage over those who are not. Forcing and stimulating the use of the goods and services that are enviromentally and energy acceptable is not part of the awareness of the public procurement administration.

In this regard, it is necessary to prescribe a policy of green procurement which means that when evaluating all procurements it is used principle of additional evaluation for goods and services that do not have negative impact on the enviroment.

[19]In planning and the project development of alternative energy sources use it is necessary to take into account obligations resulted from the Law on Concessions of the Republic of Srpska (The Offical Gazzette of the Republic of Srpska 25/02, 91/06, 92/09) and budget allocations needed for those purposes.

13.2.2. Public private partnership

Public private partnership (PPP) is a joint influence of public and private sector in which these entites coorporate resources in the production of public products or in offering public services.

Model PPP was created as a response to the growing needs of population on the one hand and expressed shortsomings of the public sector on the other hand. The model combines knowledge, skills and private sector capital with a real defining of a public interest, creation of a mechanism that ensures access under equal conditons and prevents abuse which are the primary determinants of the public sector. The public sector offers cooperation, seeks a partner and defines a scope and type of work or services to be transferred or given to the performance of a private sector. Private sector accepts the offered businees cooperation, if it sees an economic interest, i.e. if it sees an opportunity of making profit with a respect to any given conditions for work performing, or offering services.

The aim to be achieved is more effficient and more economic production of the public services and products. The public sector transfers jobs to a private sector when it estimates that there is no, or not enough capacity (human, organizational, financial, or technical) or when the costs of performing are high.

The model PPP is a contractual relationship characterized by long-term and risk distribution. The model of a joint action is applicable in many sectors, and in practice is the most often seen in the energy, health and education sector.

Methods, forms, conditions and speech elements of PPP in the Republic of Srpska are regulated by the Law on private partnership (The Offical Gazzette of the Republic of Srpska 06/09). The mentioned law prescribes that in a role of public partner can appear local community or local authority and that PPP can appear in a contractual or institutional form (which considers shared establishment of a new commercial entity). A private partner is selected through the public competition. If for financing of the project from the Action plan, Trebinje municipality decides for a model of PPP that would mean that is necessary to ensure protection of a public interest in this very enterprise, ensure free competition and equal treatment on the possibilty of large number of bidders-potential investitors. According to the exisiting legal decision, local authority is responsible to make a study of economic justfication and to ensure the Ministry of finance and the Ministry in charge consent on the contract proposal and the tender documents. A new legal decision is in the procedure by which a part of administrative barriers including consent of the Ministry of finance, is terminated or removed.

13.2.3. Investment-development bank of the Republic of Srpska

IDBRS was established by the Government of the Republic of Srpska (The law on IDBRS, The Offical Gazzette of the Republic of Srpska 56/06) in order to provide a financial support for development and investments and that way contribute to creation of a sustainable economy in the Republic of Srpska.

IDBRS, among other strategic goals of action, defines a support to investments and protection of the enviroment. The bank over partnership commercial banks offers to the local authorities a favourable long-term loans intended for capital investment. Volume of loan is from 50.000 KM to 3.000.000 KM to a period of, maximum, 10 years with a grace period of 6 months. The procedure of a credit debt is the same as when borrowing from commercial banks.

13.2.3.1. Fund for the development of the eastern part of the Republic of Srpska

Fund for the development of the eastern part of the Republic of Srpska is one of the funds within IDBRS, established by the Goverment of the Republic of Srpska with a goal of supporting development projects in the eastern part of the Republic of Srpska. Development projects that can be supported by the Fund means, among others, are the projects of enviromental protection in the broadest sense. Management of the Fund is regulated by the Law on the Fund of the Eastern part of the Republic of Srpska development (The Offical Gazzette of the Republic of Srpska 52/07) and initially available Fund budget was 200 million of KM. IDBRS manages the Fund means and they are used on the basis of the programme made by the Government of the Republic of Srpska. Until now the Fund disbursed about 7 million of KM loan to the local authorities.

13.2.4. The Republic of Srpska enviromental protection fund

By the Law on the Republic of Srpska enviromental protection fund (The Offical Gazzette of the Republic of Srpska 51/02) is defined the Fund activity for collection and distribution of the financial means for enviromental protection in the area of the Republic of Srpska. The Fund was established on the model of positive practices of developed countries that supported EE and RES projects, which could not be implemented by individual investors or were not reimbursable according to investors criteria (bankable), as well as through national funds which were given important financial capacities. Previous practice in the Republic of Srpska did not imply the large scale projects but with the new legislative proposals went into that direction. In 2011 year a new Draft Law on the Fund for Environmental Protection of the Republic of Srpska was made and submitted for the Assembly procedure, by which the Fund wil be designated as a basic financial instrument through which the Government of the Republic of Srpska finances priority projects in the area of energy efficiency, climate changes and enviromental protection.

Based on the valid legal decision, the Fund determines priorities of financing for each current year and announces a public invitation for submission of proposals to be financed by the Fund. In 2011 year the priority for financing still have projects in the

area of communal solid waste management. The inviation for proposals is announced in the Offical Gazzette of the Republic of Srpska, daily newspapers and on the web site of the Fund (www.ekofondrs.org). The Fund means can be available to the users as a loan, subsidy, financial help or donations.

Provision of their own participation (financial or material) by claimant's means is a case of scoring. Between funds benificaries and the Fund is made a contract that allows the Fund to monitor a proper use of funds. Scope of funds, that in this way was available until now, was limited and ranged at about 1.1 million of KM. With the Law amendments it is expected significant increase of funds available to the Fund, from the present about 2 million to 5 million of KM, what will enable work of the Fund in full capacity in the way that meets requirements, and it will also imply increased volume of available funds for project financing. New legal solution, in relation to the existing, considerably gives especial emhasis to the area of energy efficiency and increases degree of compliance with the EU provisions in this area.

13.2.5. European fund for B&H

The European fund for B&H was established in 1997 year as the EU support for the regeneration of B&H in a way that the Fund enabled the local banks to expand the range of long-term loans that are offered to enterpreuners. Since the establishment over the Fund was available totally 66 million of EUROS for establishment of SME and strenghtening of the banking sector.

Based on B&H Council of Ministers and The German government agreement in 2010 year, to EFBH will be directed additional 7,7 million of EUROS from loan-guarantee fund between B&H and German development bank KfW. Funds are intended for construction of infrastructure in municipalities and energy efficiency increase of SME and households in B&H. The time frame for operation is 2015 year.

13.2.6. ESCO model

ESCO (Energy Service Company) model is a financial concept over which an interested investitor entrusts development and implementation of EE project to a company specialized for providing services in the energy field. The model implies a complete set of services from creation, development, financing to project implementation aimed at improving energy efficiency and energy expenses reduction. The basic principle of functioning implies that the savings achieved by new and more efficient equipment installation and optimization of energy systems ensure investment repayment on a longer period. Beside innovative solutions for energy consumption reduction and energy efficency improvement ESCO companies offer financial schemes (theirown or provide markets) for implementation. A risk of achieving the planned savings is on ESCO company and during the investment period a client pays amount for energy expenses that was paid before implementation of a project to cover actually made energy expense and repayment of investment cost. In this way, a client is relieved of a risk of equipment and plant modernization because the company guarantees savings.

A special convenience of this model is in the fact that a client does not have to possess its own human and financial capacities to implement EE project, and that the

implementation is simplified in a way that a client cooperate just with one entity, i.e. a company that intergrates and implements all necessary activities.

ESCO model is still a novelty for the market in B&H and presents insufficently developed concept. The potential in this field is promising especially if are taken into account possibilities for impending implementation of international programme to support the establishment of ESCO companies in B&H.

13.2.7. European investment bank (EIB)

The European Investment Bank is a financial institution of the European union that finances projects compatible with the development policy and the EU aims. It was established by the Roman agreements in 1958 year and it is in possession of the EU member countries.

The Bank aim is to ensure economic progress and to reduce disparities in the regional development. The EIB group consists of the EIB and the European Investment fund-EIF. The primary task of the EIF is directed to support of small and middle corporations in order to ensure the implementation of the EU policy in the area of enterprenuership, technology, innovation, growth and regional development. The EIB finances various projects of the public and private entities in several priority areas among which is sustainable energy sector development. The projects eligible by the EIB standards might be infrastractural investments or project documentation. Services provided can be classified into four groups:

- providing loans and issuing guarantees,
- providing technical assistance (specialized instruments ELLENS, JASPERS AND JESSICA)
- financing of venture capital (instruments EIF, JEREMY, JASMINE)

The European Investment bank, due to the fact that provides means under the most favourable conditions, provides to benificiaries low cost loans, long repayment periods and the possibility of using the grace period, became an important participant in the area of EE and RES financing.

Types of the EIB loans are:

- *Direct loan*- The project is financed directly by the EIB therewith an investment value must exceed 25 million of EUROS. The infrastracture projects in the sector of transport,energy, ecology, industry are financed. There is no loan volume limit and it is common, for the projects from energy sector, a repayment period to be from 15 to 25 years.
- *Indirect loan*-the EIB finances projects over intermediary bank in the country of investor in the amount of 40.000 to 25 million of EUROS. It is usually financed the investment in the amount of 100% and benificiaries are local authorities or small and middle enterprises.
- *Group loans*- In a case when it is not possible to fulfil a condition of minimal investment amount of 25 million of EUROS, the EIB finances several individual projects connected in a group. In December 2009 year the EIB toghether with EBRD, WB and CoEDB launched Western Balkan Investment Framework (WBIF) that offers grants and loans for priority investments in the region. The aim is to attract and coordiante various financial sources for the region key projects.

13.2.7.1. Green loans

The EIB, over partner banks in B&H offers favourable commercial so called green loans i.e. loans intended to finance activities with a positive impact on the enviroment. Loans are intended, among other, for activities in the energy sector where the biggest volume of approved loan lines is available for SME while a smaller amount is intended for the lending of public sector.

From 2001 year to 2010 year the EIB allocated more than 1,2 billion of EUROS for the projects in B&H. Until now the most important part of means related to infrastructure projects in the area of transport, water supply and waste management. At the same time, the Bank over partner banks in B&H finances especially created loan lines that for an aim have acceleration of economic development.

13.2.7.2. European Local Energy Assistance (ELENA)

ELENA is a specialized technical assistance instrument that was launched by the European Commission and the EIB in 2009 year. This instrument is financed through the Energy Intelligent Europe programme-EIE. Technical assistance is provided to cities and regions for development of projects in energy sector, where is enabled assistance for projects preparation, implementation and financing. **The total value of available fund in 2010 year was 15 million of EUROS and it was announced that the fund will be doubled in 2011 year.** ELENA finances projects partially, i.e. it is necessary to provide their own participation or financing from the other sources.The key criteria in selecting project is their impact on total CO_2 emission reduction and access to the funds is enabled to the signatories of The Convenant of Mayors.

Website: www.eib.org/elena

13.2.7.3. Joint Assistance to Support Projects in European Regions (JASPERS)

JASPERS is an assistance instrument intended to member countries and it provides technical assistance for preparation of projects financed from the EU funds. The assistance is intended for national entities responsible for projects implementation. In the current state B&H does not have access to this instrument.

Website:http//www.jaspers-europa-info.org/

13.2.7.4. Joint European Support for Sustainable Investment in City Areas (JESSICA)

JESSICA is a project of the EC, EIB, Council of Europe Development bank and commercial banks intended for the EU member states which encourages member states of means allocation in the Urban development Fund from which commercial banks give loans to the end users. B&H in the present state does not have access to this instrument.

Website: http://www.jaspers-europa-info.org/

13.2.8. European bank for reconstruction and development (EBRD)

The European bank for reconstruction and development is a financial institution established by the EU in order to assist countries in transition to the open market economy and supports initiative of private enterpreuners. It is invested in 29 countries in Europe and Asia among which is B&H.

EBRD primarly gives loans, guarantees on loans, and finances projects from specilazied funds (Western Balkans Sustainable Energy direct financing facility WeBSEDFF and Green for growth fund – Southeast Europe) and provides support through development programmes.The Bank provides financing for other commercial banks, industries, private businesses and public companies or other entities from the public sector. EBRD finances infrastructure projects and project documents in the area of local community infrastructure, industry, agriculture, energy, transport and tourism. The Bank adjusts conditions under which finances projects to a certain region or sector, and volume of financing varies from 5 to 230 million of EUROS for the period from 1 to 15 years. An investor is obliged to finance a large part of the project and bank participation in total investment value is the most often about 35%. Important criteria, upon project evaluation, are the market prospect and contribute to the development of private sector. The characteristic of EBRD support is an individual approach to each project and client, i.e. there is no application form or a same scheme for all clients, but every project is separately negotiated, estimated, described and documented in accordance with the needs and specific situation. Also, one of the EBRD specific actions is that the Bank invests just in projects that cannot provide financing from the other sources under similar conditions. For each financed project, the EBRD forms their own expert team that have specialist knowledge in relevant areas and that will monitor the project from the start to finish.

A wide range of financial instruments and flexible approach to the creation of financial offer for a customer with excellent loan rating, institutions recommend EBRD for many important EE and RES projects.

EBRD provides direct financing (loans, guarantees), indirectly (over partner banks in the region) financing aimed at micro, small and medium enterprises and programmes aimed at business strenghtening. Business development programames-Turn Around Management (TAM) and Business Advisory Services (BAS) are advisory programmes that provide improvement of local businesses through international consultant services for management and structural changes (TAM), or through improvement of performace management (BAS).

EBRD is the biggest institutional investor in B&H and its main activity is focused on significant infrastructure projects that are crucial for development of the region. So far they supported 95 projects, total value 2,8 billion of EUROS. The focus of the Bank in the next period will be infrastucure, financial and economic sector that includes the investments in EE.

In 2010 year in B&H the Bank supported 13 million EUROS worth EE investments of a private sector and from total financed projects 11% of them is from the energy area.

Indirect financing includes facilitating of an acceess to more favourable loan lines by partner commercial banks. In B&H more commercial banks offer EBRD loan lines with a trend of available loans volume increase from year to year.

13.2.8.1. Western Balkans Sustainable Energy direct financing facility (WeBSEDFF)

WeBSEDFF is a specialized fund that was established by EBRD in 2008 year in order to finance projects of energy sustainable development in the countries of the Western Balkan. The fund gives loans and incentives to small and medium enterprises over local partner banks. Interest rates are of the market and strong instruments of loan ensuring are required. The range of funds per project goes from 100.000 to 2 million of EUROS. Incentives are issued after project implementation and the amount depends on achieved reduction of CO_2 emission. The incentive is in sense to reduce principal loan in the amount of up to maximum 20%. Loans are given for the period of 8 years for EE projects and 1 year for RES with a grace period. Basic criteria for project assessing are technical criteria (minimum 20% of energy saving for EE projects and minimum rate of financial return for RES projects) and financial criteria (financial stability and long term sustainability).

13.2.8.2. Green for growth fund – Southeast Europe

Green for growth fund– Southeast Europe based in Luxembourg was established in 2009 year on the model of public-private partnership by the EIB and the German development bank KfW. The Fund main goal is to promote development of financial market intended for lending EE and OIE projects. Investment goals are at least 20% reduction in energy consumption, minimal 20% reduction in CO_2 emission and promotion of RES. In the previous period the largest Fund investors are EBRD and the European investment fund. Funds provided for the Fund operation commencement were 95 million of EUROS and in the next five years the plan is the Fund to dispose with about 400 million of EUROS. The Fund gives loans, issues guarantees, debtor's securities, letter of credits and offers technical assistance. Bosnia and Herzegovina, in the status of potential candidate country for the EU, has the access to the Fund means. The EE and RES projects eligible to be financed must gurantee reduction in energy consumption, i.e. CO_2 emission reduction for 20%. Funds beneficiaries can be public and private entities and the financing is carried out directly or over partner banks. For public sector beneficiaries loans range from 500.000 to 10 million EUROS and interest rates are market formed. Since the main goal of the Fund is development of a financial market, it is ultimately expected the Fund to contribute to the development of a new banking products aimed at the EE and the RES projects and to support the establishment of local ESCO companies.

13.2.9. Energy programmes financed by the European Commission

The EU programmes in the energy sector offer significant opportunities and represent a great stimulation in the area of EE and RES and are available to the member states and other countries to sign the Memorandum of understanding and pay in participation in the programme, or so called entrance card.

Upon entry into force the Framework agreement on basic principles of B&H participation in the EU programmes in January 2007 year, Bosnia and Herzegovia was given a possibility of participation in the EU programmes. For each programme individually the procedure implies that the state Ministry in charge sends to the

competent Directorate General in Brisel Letter of intent for signing the Memo of understanding and all according to the Framework agreement.

The programmes implemented by the European Commission are implemented according to the model by which for implementation and financial management are in charge the EC or Directorates General of individual programmes. All member states of a particular programme may participate at public invitation under the same conditions, therewith countries that are not the EU members pay money contribution to the budget of that programme they want to participate in. A special convenience at payment of an enter card, paid on an annual level, for B&H represents the fact that the card can be financed from IPA funds for about 90% of its value while the remaining amount shall be paid in from the budget.

According to the report of the Directorate of economic integration B&H for 2010 year, B&H joined the Programmes FP7, CIP and Life+ of several possible programmes with environmental and energy protection component .

13.2.9.1. Sustainable Energy Europe Campaign

Sustainable Energy Europe Campaign is an intitative of the European Commission whose aim is a promotion of EE and RES European projects. The programme was created in 2005 year and it represents the most important promotion tool of the EU, when it is comes to energy efficency and the use of alternative energy sources. The main goal of this campaign is to spread the best practice examples and exchange of experiences. By the campaign is created a network of cooperation with a goal to support and encourage EE and RES projects. The programme does not offer financial support to the projects implementation but it represents important promotional tool and source of information.

Website: http://www.sustenergy.org/.

13.2.9.2. . 7th EU Framework Programme (FP7)

7th Framework programme for research and technical development (FP7) is the main financial instrument of the EU with a total value over 50 billion of EUROS for research and development area whose time framework of action is from 2007 year to 2013 year. Most part of the planned means will be spent in the form of grants to research projects and projects of echnological development allocated by a public invitation. The general goals of FP7 are grouped into 5 categories: Cooperation (includes energy and environment questions), People, Ideas, Capacaties and Nuclear research. Within the category of Cooperation of energy sector issues was totally allocated 2,35 billion of EUROS to be spent on the research in the energy area that creates new technologies to improve the existing energy system and ensures use of renewable energy sources. In the countries participating in the programme were set up the National contact points whose task is to facilitate users access to FP7 means (for B&H http://www.ncp.ba.). For funds that imply partial financing of the project (usually in the amount from 50% to 75% for a public sector) can apply local authorities and other public entities, SME, institutions and research organizations.

Concerto Program

Concerto Program is a special initiative within FP7 whose aim is to encourage local communities to implement EE and RES projects. The support is focused on the development of new and innovative technical solutions for energy sustainable development of local communities.

Website: http://concertoplus.eu/

13.2.9.3. Competitiveness and Innovation Framework Programme (CIP)

The framework programme for competitveness and innovation (CIP) comprises 3 subprogrammes of which the most important programme for EE area is:

Energy Intelligent Europe (EIE)

EIE goals are the increase of energy efficency and rational use of energy resources, promotion of renewable energy sources and promotion of EE and RES in transport. For the period from 2007 year to 2013 year the programme has available budget of 730 million EUROS. The activities within this programme are grouped into 4 areas:

1. SAVE (improvement of energy efficiency and promotion of rational use of energy especially in buildings and industry) has an annual budget of 7,7 million EUROS. Specific priorities of the area are:

- energy efficient buildings,
- energy efficient industrial plants.

2. ALTENER (promotion of use of new and renewable energy sources for generation of electric and heat power) has an annual budget of 19,6 million EUROS. Specific priorities of the area are:

- electric power from renewable energy sources,
- heating and cooling from renewable energy sources,
- renewable energy sources in households,
- biofuels.

3. STEER (promotion of more efficient energy use and use of new and renewable fuels in transport) has an annual budget of 50 million EUROS. Specific priorities of the area are:

- alternative fuels and “clean“ vehicles,
- energy efficient transport.

4. INTEGRATED ACTIVITIES (combination of the above) with priorities:

- establishment of local and regional energy agencies,
- european networking for local actions,
- initiative of energy services,
- education initiative in the area of intelligent energy,
- initiatives related to products standards,
- initiative of combining heat and electric power.

Website: http://ec.europa.eu/cip/

13.2.9.4. Life + Programme

Programme Life + (Life +) financially supports projects in the area of the enviroment and nature protection through three components (nature and biodiversity, enviromental policy and management, information and communications). The invitation announced for 2011 year is 267 million EUROS.

Website: http://ec.europa.eu/environment/life/

13.2.10. Instrument for Pre-Acession Assistance (IPA)

The Instrument for Pre-Accession Assistance is a programme with a special goal to help candidate countries or potential candidates in the process of harmonizing their legislation with the EU legislation, as well as to prepare them for the use of the EU structural funds that will be available to them when they acquire the status of Member states. The main difference between IPA programme and the EC programme from point 2.5 is the fact that the IPA was created individually for every country respecting pecularities and circumstances of that country and the programmes are available to all members or members that pay membership fee for the programme and were associated on the basis of the Memo of understanding under the same conditions. The IPA is an assistance instrument in the period from 2007 year to 2013 year based on the EC decision, and it replaces all previous programmes (CARDS, PHARE, ISPA and SAPARD) and whose total value is 11,468 billion of EUROS. For the coordination of the IPA programme in B&H is in charge the Directorate for the European Integration B&H Council of Ministers.

IPA programme consists of five components:

- transition assistance and institutions construction,
- overborder cooperation,
- regional development,
- human resources development,
- rural development.

B&H in the current status of the potential candidate has the right to use two components (under 1 and 2) of the total five IPA programme components. The other three components will be available to Bosnia and Herzegovina when it gets the status of candidate state.

Trebinje municipality with the objective of implementing identified energy efficency measures and use of renewable energy sources, as the municipality that belongs to geographically eligible area, can apply to invitations for overborder cooperation within bilateral programmes with Montenegro and Croatia.

13.2.11. Global Enivronmental Facility (GEF)

Global Environmental Facility i.e. the Global Environment Fund was established in 1991 year as an international financial mechanism to assisst developing countries to achieve goals in the implementation of international global agreements/ conventions whose goal is human health protection, global protection of the enviroment and the sustainable development.

GEF represents a partnership of 182 national governments in the world, international institutions, non-governmental organizations and the private sector in the area of the environment protection. In the GEF partnership operate the UN agency, relevant for the issues from the area of environment protection and development, the World bank, the European bank for reconstruction and development and others.

The Fund was originally established as a pilot project of the World bank in order to promote and support sustainable and enviromental development to grow into an independent institution that serves as a financing mechanism of CBD, UNFCCC, the POPs, the UNCCD conventions.

GEF means are available to the government agencies, the specialized UN agencies, non-govermental agencies, private sector, and for so-called small, grant projects of up to 50.000 American dollars (in partnership with the UNDP) can apply local communities.

Website: http://www.thegef.org/

13.2.12. Clean Development Mechanism (CDM)

CDM (clean development mechanism) enables developing countries financing of projects of sustainable development and gas emission reduction. Bosnia and Herzegovina accessed the Kyoto protocol by the model recommended to developing countries, i.e. without obligations to regulate gas emission. Such status enables B&H to use financial mechanism of CDM. The project financed must be in a standard form and approved by the national government. A mediator in the process is an operative body formed by the national government- DNA Designated National Authority and for every project is signed the Memo of Understanding. B&H Council Minister decided to form DNA (The Offical Gazzette of B&H 102/10) which creates preconditions for implementation of CDM projects.

Website: http://cdm.unfccc.int/about/

14. ACTION PLAN OF TREBINJE MUNICIPALITY SUSTAINABLE ENERGY ACTION PLAN

To achieve reduction of CO2 emission for at least 22% within the area of Trebinje municipality it is planned to carry out following activities:

Table 14.1: Action plan of Sustainable energy action plan of Trebinje municipality

Ord. No.	Activity name	Project duration	Estimation and costs [EURO]	Reduction estimation CO_2 [t]	Responsibility
1	**Buildings/plants, installations and industry**		**54.041.500**	**18.361**	
1.1	**Administrative and other facilities under the municipal jurisdiction**		**1.558.500**	**863**	
1.1.1	Improvement of municipal buildings energy efficiency by setting new thermoinsulation, windows, doors replacement,etc.	2012-2020	1.400.000	680	Trebinje municipality, public institutions
1.1.2	Replacement of the existing light bulbs with more energy efficient ones	2012-2016	150.000	180	Trebinje municipality, public institutions
1.1.3	Energy audit of the buildings owned by Trebinje municipality	2012-2013	2.500	n/a	Trebinje municipality
1.1.4	Establishment of a unified information system for monitoring of energy-generating products consumption in Trebinje municipality facilities	2012-2013	6.000	n/a	Trebinje municipality
1.2	**Facilities not under municipal jurisdiction**		**6.730.000**	**3.700**	
1.2.1	Improvement of energy efficiency in buildings by setting new thermoinsulation, windows, doors replacement,etc.	2012-2020	4.300.000	2.100	Facilities owners, private and public companies, organizations, etc.
1.2.2	Replacement of the existing light bulbs with more energy efficient ones	2012-2016	30.000	400	Facilities owners, private and public companies, organizations, etc
1.2.3	Installation of more energy efficient appliances for heating and cooling	2012-2019	2.400.000	1.200	Facilities owners, private and public companies, organizations,

					etc.
1.3	**Residental facilities**		**44.950.000**	**12.893**	
1.3.1	Improvement of residential facilities energy efficiency by setting new thermoinsulation, windows, doors replacement,etc.	2012-2020	24.000.000	7.374	Residential facilities owners, investors in new residential facilities.
1.3.2	Replacement of the existing light bulbs with more energy efficient ones	2012-2020	6.700.000	283	Residential facilities owners, investors in new residential facilities.
1.3.3	Installation of more energy efficient appliances for heating and cooling	2012-2020	11.250.000	4.682	Residential facilities owners, investors in new residential facilities.
1.3.4	Installation of solar systems for water heating	2012-2020	1.000.000	180	Residential facilities owners, investors in new residential facilities.
1.3.5	Installation of heat pumps for heating and cooling of households	2012-2020	2.000.000	374	Residential facilities owners, investors in new residential facilities.
1.4	**Public lighting**		**803.000**	**905**	
1.4.1	Replacement of the existing mercury(Hg) light bulbs with natrium (Na) ones	2012-2018	300.000	470	Trebinje municipality
1.4.2	Installation of new LED lighting modes	2012-2020	500.000	402	Trebinje municipality
1.4.3	Rehabiltation of public lighting segment Aleksina Međa-Dubrovnik	2012-2013	3.000	33	Trebinje municipality
1.4.4	Replacement of measuring places outside the substations	2012-2014	n/a	n/a	Trebinje municipality
2	**Transport**		**10.750.000**	**3.077**	
2.1	**Municipal vehicles**		**500.000**	**308**	
2.1.1	Purchase of hybrid vehicles and alternative fuel vehicles for the needs of Administrative service of Trebinje municipality and companies and institutions that are in control and dependent to the local authority.	2012-2020	500.000	308	Trebinje municipality, public institutions
2.2	**Private and commercial transport**		**10.250.00**	**2.769**	

2.2.1	Reconstruction and rehabilitation of transport network	2012-2020	10.000.000	1.846	Trebinje municipality

2.2.2	Pre-designing of signal plans at crossroads regulated by traffic light signalization and introduction of their work coordination and replacement of the existing classic lanterns (light bulb) with LED lanterns	2012-2020	100.000	615	Trebinje municipality
2.2.3	Introduction of facilities to the users of vehicles on electric motor fuel through construction of stations for accu batteries charging and providing free parking places	2012-2020	150.000	308	Trebinje municipality
3.	**Local generation of electric power**		**37.000.000**	**30.165**	
3.1	**Hydropower**		**20.000.000**	**12.465**	
3.1.1	Installation of an additional generator unit at the Hydro power plant “Trebinje 2“ for use of water discharging from the dam as a biological minimum for the river Trebišnjica	2012-2015	20.000.000	12.465	Company "Hydro power plant on the river Trebišnjica"
3.2	**Wind energy**		**14.000.000**	**16.620**	
3.2.1	Construction of wind farms at the edge of mountain Leotar, capacity 10 MW	2014-2020	14.000.000	16.620	Interested investors
3.3	**Photovoltaic cells**		**3.000.000**	**1.080**	
3.3.1	Construction of many small photovoltaic power plants with photovoltaic cells having total capacity 1 MW	2012-2020	3.000.000	1.080	Interested investors
3.3.2	To make available roofs and terraces in the municipal possession to private investors for installation of solar panels.	2012-2013	15.000	n/a	Trebinje municipality
4.	**Planning and land use**		**1.765.000**	**4.932**	
4.1	**Strategic urban planning**		**515.000**	**n/a**	
4.1.1	Integration of energy efficiency principle in the existing and new documents and acts within Trebinje municipality jurisdiction	2012-2020	100.000	n/a	Trebinje municipality, local political parties
4.1.2	Integration of an energy efficiency principle in spatial- planning documents	2012-2020	300.000	n/a	Trebinje municipality, local political

					parties
4.1.3	Establishment of a spatial information system for recording the greens, infrastructure and pollutants	2012-2016	100.000	n/a	Trebinje municipality, public communal companies
4.2	**Transport/ mobility planning**		**1.000.000**	**n/a**	
4.2.1	Construction of new cycling and footh paths and reconstruction of the existing	2012-2020	1.000.000	n/a	Trebinje municipality
4.3	**Others: Afforestation**		**250.000**	**4.932**	
4.3.1	Afforestation of areas devastated by fire and cutting	2012-2020	200.000	3.946	Centre for karst management
4.3.2	Greens in town park and other green town areas recovery	2012-2016	50.000	986	Trebinje municipality
5.	**Goods and services public procurement**		**4.000**	**n/a**	
5.1	The requirements of energy efficency standards		4.000	n/a	
5.1.1	Making procedures, recommendations, standards for the process of public procurement of goods, services and works performance, with the aim of energy efficiency principle implementation	2012-2013	4.000	n/a	Trebinje municipality
6	**Work with citizens and other interested parties**		**890.000**	n/a	
6.1	**Advisory services**		**30.000**	**n/a**	
6.1.1	Establishment of an info point with information about advantages of energy efficency application	2012-2014	30.000	n/a	Trebinje municipality
6.2	**Financial support and grants**		**500.000**	**n/a**	
6.2.1	Establishment of grant for co-financing of projects from energy efficiencv area	2012-2020	500.000	n/a	Trebinje municipality
6.3	**Raising public awareness**		**310.000**	**n/a**	
6.3.1	Organization of manifestation “Let's save energy for the future“	2012-2013	100.000	n/a	Trebinje municipality
6.3.2	Development and distribution of advertising material with the topic of energy efficiency increase	2012-2020	10.000	n/a	Trebinje municipality, enviromental organizations and associations

6.3.3	Organization of advertising actions aimed at energy efficiency increase	2012-2020	200.000	n/a	Trebinje municipality, enviromental organizations and associations
6.4	**Training and education**		**50.000**	**n/a**	
6.4.1	Organization of workshops with the topics of energy efficiency area	2012-2018	50.000	n/a	Trebinje municipality, enviromental organizations and associations
7	**Other: Waste management**		**1.255.000**	**2.041**	
7.1.1	Reconstruction of the existing and construction of a new sanitary dump site “Obodina“	2006-2018	1.255.000	2.041	Trebinje municipality, EU funds
	TOTAL		**105.705.500**	**56.535**	

15. ACTIVITIES ON RASING CITIZENS' AWARENESS

To reduce energy-generating products consumption in the area of Trebinje municipality it is necessary to influence citizens' public awareness about the importance of an investment in activities to increase energy efficiency. By the support of public for these projects we provide their general social acceptance and support, and an important citizens contribution. The current level of citizens' awareness on energy efficiency projects is very low. Houses are still built with low energy efficiency building material, use of energy saving light bulbs is still small, number of installed solar cells for heating water and electric power generation is minimal, almost unnoticable, etc.

In order to achieve the set goals of CO2 emission reduction for at least 20% by the end of 2020 year, it is necessary to raise level of citizens' awareness about the signficance of increase in energy efficiency of their local community and the importance of these activities for the development of their local community on sustainable development principles.

Because of all of this local population should be in the best possible way introduced about the importance of renewable energy sources use and local community energy efficiency increase, through the following activities:

- promotion of rational energy use through round tables where citizens will be able to find out more about the advantages of using alternative forms of energy,
- written media- publishing of articles where would be presented useful information concerning renewable energy sources,
- organization of presentations in the elementary and secondary schools for better education of the young about harmful CO2 emission, ways of CO2 emission reduction, use of renewable energy sources,
- creation and distribution of children's picture-books on the topic of energy efficiency and use of renewable energy sources,
- radio broadcasts- continous and clear information and education can help a gradual understanding of importance of using such types of energy,
- distribution of promotional material-flyers and pamphlets, at public places, managed by the administration-not only in the administrative offices, but also in libraries, theaters, sports facilities, etc., because they have many visitors every day and are ideal locations for placing such information flyers,
- organization of forums in order to stimulate and promote free exchange of opinion, awareness raising,
- to show possibility of biodiesel use, as a motor fuel in vehicles, instead of traditional fossil fuel, in order to reduce harmful gas emission,
- to provide education of cycling benifits, especially for short distances,
- organization of meetings to promote rational use of energy and CO2 emission reduction,
- actions in schools: literary competitions or drawings on energy efficiency of renewable energy sources topic with intersting prizes for the winners,
- promotion of energy saving light bulbs in households, and LED light bulbs for public lighting. They use a quarter of electric power of standard light bulbs and last up to 15 times longer,

- control of heat energy consumption in public buildings through development of a system for monitoring energy-generating products consumption,
- promotion of biomass usage as a form of energy-generating product,
- continous consumers informing about ways of energy savings and actual energy issues on the back of bills for communal services and electric power- with a consent of a competent company,
- installation of solar panels,
- promotion of construction of so-called “passive houses“- a house with a very low energy consumption (houses without traditional heating and active cooling system characterized by very good insulation, mechanical systems for insulation and very efficient possibilities for compensation, or heat recovery). The annual saving goes from 200 and 1000 EUROS for an average household. For example, several basic measures of insulation can easily save 200 EUROS of an annual energy bill (heating),
- put a link for EE and RES on Trebinje municipality website where all interested parties can get basic information from the mentioned area, as well as answers to asked questions.
- The excpected results are:
- educated young people,
- raised level of public awareness relating climate changes and renewable energy sources,
- provided useful information to interested population,
- increased interest of citizens for the use of renewable energy sources,
- engagement of civil society in the SEAP implementation,
- connected- govermental sector and civil society organizations,
- reduced consumption of fossil fuel,
- increased interest for production and use of biodiesel, use of alternative fuel, what should significantly lead to CO2 emission reduction,
- increased use of bicycles as a transport means, in much greater extent,
- increased use of energy saving light bulbs as in households so in public facilities,
- replacement of the old town public lighting light bulbs with new LED light bulbs,
- use of biomass,
- performed estimation of heat energy consumption,
- installation of insulation on most business and one part of residential buildings.

Based on the experience of energy concious cities of the EU, it was estimated that continous implementation of the above stated promotional, educational and informative measures by 2020 year would result in entire heat energy saving, what will in a great extent reduce CO2 emission reduction as well as the enviromental pollution, led to industry strengthening and economy comptetiveness and possibilities of creating new jobs.

These are just some of the things that we should do if we want to protect the enviroment and guarantee a stable energy reserves for our descendants.

16. IMPLEMENTATION, MONITORING AND REPORTING

Implementation of identified energy efficiency measures that will enable achieving a goal- CO2 emission reduction for more than 20% by 2020 year is the most difficult phase of the process of the Action plan development, implementation and monitioring that requires the most time and effort and considerable financial means. The phase of the Action plan development ends with the Plan of priority measures and activities development and it includes energy efficency identified measures, the proposed schedule of implementation, time framework and dynamics of implementation, and potentials of energy saving and associated CO2 emission reduction.

The first step of the Action plan implementation is establishment of the Work group to implement the Action plan and the appointment of its leader. The main task of the Work group is to coordinate the whole process of the Action plan implementation which includes conducting and coordination of the overall measure plan and activities implementation in accordance with the Energy council decisions, establishment of communication strategy, conduction of different competitions for the development of project documents, contractors, procurement of equipment for projects and measures according to the Action plan, project management and preparation of periodic reports on the results of the Action plan implementation. A good communication with appropriate experience and the expertise of the Work group members is of a great importance for a successful implementation of the Action plan.

The Energy Council is a supervisory and advisory body. It consists of local authority representatives, the main interested parties/stakeholders as well as prominent energy experts with years of experience in the field of energy planning, engineering and spatial planning and traffic and communal infrastructure.

The main tasks of the Energy Council are monitoring of all Process phases, communication with stakeholders and citizenship, review of the Action plan, monitioring the work of the Work group for the implementation of the Action plan, monitoring and control of the implementation of the Priority measures and activities plan, periodic reporting to Trebinje municipal assembly of achieved results and the review and acceptance of the Report on achieved results of the implementation of the Action plan for the European Commission.

A successful monitoring of achieved savings in different sectors and their subsectors as well as meeting targets of the CO2 emission reduction, as for each measure so for implementation of the Plan as a whole, is possible by making a new CO2 emission Registry for the municipality.

By accessing the Convenant of Mayors agreement cities/municipalities committed themselves to prepare and submit to the European Commission report on the Action plan implementation every two years that, with a detailed description of the implemented measures and activities as well as achieved results, should include Monitoring Emission Inventory of CO2 -MEI, where it is important the methodology of its development to be identical to the methodology according to which was made the Reference registry of CO2 emission for the reference year. Only the equal methodologies for the Registry making enable their comparison and an answer to the question-whether the set goals of CO2 emission reduction are satisfied.

The phase of the Action plan monitoring and control of implementation should take place at several levels:

- Monitoring of the dynamics of energy efficiency concrete measures implementation according to the Plan of priority measures and activities;
- Monitoring of the success of project implementation according to the Plan;
- Monitoring and control of the energy saving set goals for each particular measure within the Plan;
- Monitoring and control of achieved CO2 emission reduction for each measure according to the Plan.

Monitoring of dynamics and the successfulness of the plan of Priority measures and activities implementation will be carried by the Energy Council.

17. RESUME

Trebinje Municipal assembly has made the DECISION, at the session held on 30th December 2010, of adoption of the The Convenant of Mayors Intiative on CO2 emission reduction by 2020 year, and by whom the mayor of Trebinje municipality is authorized to access the procedure of signing The Covenant of Mayors. The Covenant of Mayors, actually represents a great initiative of the European Commission, initiated in January 2008 in order to connect the european cities into the permanent network to exchange experience in order to improve energy efficiency of urban units as well as to reduce CO2 emission for more than 20%, to how much binds the Proposal of the European energy policy from 2007 year.

Sustainable Energy Action Plan-SEAP of the Trebinje municipality represents a strategic and operational document that defines overall framework for objectives until 2020 year, i.e.the document that shows how the local authority will achieve CO2 emission reduction by 2020 year, as well as improvement of energy efficiency. The Action plan uses results of the previously prepared Baseline emission inventory (BEI) in order to identify the best areas for actions and opportunity for achieving the local authority CO2 emission reduction target. The document defines concrete measures of reduction together with time frameworks and given responsibilities.

According to Sustainable energy action plan of Trebinje municipality, the Trebinje municipality is by this plan determined to reduce CO2 emission for at least 22% in 2020 year related to the reference 2001. Therefore the SEAP of Trebinje municipality is an ambitious and comprehensive plan by which are defined activities in the key areas for achieving the set goal. The priority areas of CO2 emission reduction are the areas of buildings, public lighting, renewable energy sources. In the stated areas the main activities are:

- To increase energy efficiency of construction facilities owned by Trebinje municipality;
- To stimulate citizens and potential investors for residential and commercial facilities energy efficiency increase;
- To replace the exisiting public lighting light bulbs with more energy efficient light bulbs;
- To stimulate solar and geothermal energy application by citizens;
- To create positive conditions for investors in the area of application of solar, wind and hydropower;
- To rehabiltate the existing and to build new sanitary town's dump site.

By SEAP is planned range of activities for the public awareness raising from the area of energy efficiency (flyers distribution, workshops, radio broadcasts, and educational lectures). It is also planned setting up of the info point where citizens will have available all necessary information on advantages of energy efficiency principle application.

The greatest challenge in realization of the planned activities is to ensure enough financial means for its implementation .

At the moment, there are, at the entity and local level, intensive activities for making corresponding legislation to create conditions for realization of the stated activities at the local level.

Continous monitoring, control and reporting on achieved results is an extremely important part of the Process of preparation, implementation and monitoring of Sustainable energy action plan of Trebinje municipality. All cities signatories of the Covenant of Mayors has a responsibility, every two years, to prepare and submit to the European Commission the Report on Action plan implementation, that should, beside a detailed description of the applied measures and activities, as well as achieved results, contain so called CO2 emission Inventory control. Therefore, by the Sustainable energy action plan of Trebinje municipality, as a measure for monitoring of the planned activities, is predicted forming, at the municipal level, of the Energy council, to periodically analyze implementation of the activities predicted by SEAP. So, the council members will, based on the data collected in coorporation with municipal administration, every two years, make a report on the SEAP implementation. Comparison of the reference inventory of CO2 emission for 2001 year and the control inventory emission for some of the following years will uniquely show the real reduction of CO2 emission in Trebinje municipality, and answer the question whether the Action plan implementation was successful or not.

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Figures:

Abbrevations:

BAS – Business Advisory Services
BEI – Basement Emission Inventory
BPK – Biochemical oxygen consumption
B&H – Bosnia and Herzegovina
CDM – Clean Development Mechanism
COC – Chemical oxygen consumption
COP – Coefficient Of Performance(for heat pump)
DNA – Designated National Authority
EBRD – European Bank for Reconstruction and Development
EC – Equivalent citizen
EE – Energy efficiency
EEC – European Economic Community
EFBiH –European Fund for B&H
EIB – European Investment bank
EIE – European Intelligent Europe
EIF – European Investment Fund
ELENA – European Local Energy Assistence
EU – European Union
ESCO – Energy Service Company
FP7 – 7th EU Framework Programme
GEF – Global Enviromental Facility
GDP – Gross domestic product
Gsp – Amount of waste per person per day
HPP – Hydro power plant
HPP – Hydro power plant on the river Trebišnjica
LA – Local authority
LED – Light Emiting Diode
INC – Initial National Communication
IPA – Instrumenete for Pre-Accession Assistance
IPCC – Intergovernmental Panel on Climate Change
IRBRS – The Republic of Srpska Investment Development bank
JASPERS – Joint Assistance to Support Project in European Regions
JESSICA – Joint European Support for Sustainable Investement in City Areas
JRC - Join Research Centre
TAM – Turn Around Managment
MEI – Monitoring Emission Inventory
MSP – Small and middle enterpreuners
MH – Metal-halogen light bulbs
PE – Public enterprise
PEEPEA – Protocol on Enenrgy Efficiency and Related Enviromental Aspect
PPP – Public private partnership
RES – Renewable energy sources
RS – Republic of Srpska
UN – United Nations
UNDP – United Nations Development Programme
UNFCCC – United Nations Framework Convention on Climate Change
UHPP – Underground hydro power plant
SDI – Sustainable Development Indicators
SEAP – Sustainable Energy Action Plan
SHPP – Small hydro power plant
Sl. Gl.- Offical Gazzette
SS – Substation

WB – World Bank
WBIF – Western Balkan Investment Framework
WCED – World Commission on Enviromental and Development
WeBSEDFF – Western Balkans Sustainable Energy Direct Financing Facility programme
WMO – World Meteorological Organization