Bosna i Hercegovina

Initial National Communication of Bosnia and Herzegovina under the United Nations Framework Convention on Climate Change

INITIAL NATIONAL COMMUNICATION (INC) OF BOSNIA AND HERZEGOVINA UNDER THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE (UNFCCC)

Banja Luka, October 2009

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INTRODUCTION

It has been indisputably proven today that increasing climate variability is the direct consequence of human actions. One of the most visible consequences of these actions is the greenhouse gas effect, which has been proven to be increasingly apparent during the last century. It is believed that industrialization and rapid population growth, and the resulting increase in human activities, have had a significant impact on that effect.

It is completely true that gas emissions with greenhouse gas effect are largely the result of fossil fuel combustion, deforestation, and the conversion of forest land for agricultural use. Of human activities that contribute to the greenhouse gas effect, the most important are the production and consumption of energy and transport. In addition, they have a direct impact on global temperature balance. This was also precisely shown in 2001 Third Assessment Report (TAR) prepared by Intergovernmental Panel on Climate Change (IPCC). That document presents the following findings:

- New systematic observations over the last 50 years confirm the negative effect of human activities,
- During the 20th century, global average temperature on the earth's surface has increased by 0.6 degrees Celsius,
- In the 21st century, human impact on the atmosphere change will continue, based on all the IPCC scenarios, an global average temperature and sea levels will increase – in the period 1990 to 2100, the increase in global average temperature is projected to be between 1.4 and 5,8 degrees Celsius, whereas increase in sea level will be between 9 and 88 cm.[1]

All of these projections, particularly those which have subsequently been confirmed by current data, point to direct impacts from climate change on human health and ecosystems, agriculture, water resources and generally on economic and social aspects of humankind. According to existing results of scientific research in Southeastern Europe, negative consequences of climate changes are to be expected due to a further increase in air temperature, a decrease of precipitation in vegetation zones and more frequent extreme weather events, such as droughts, hailstorms, floods, heat waves, frosts, snowstorms and avalanches. The detrimental consequences of climate change may be particularly evident in food production, energy, forestry, water management, tourism and other branches of industry. All of these factors, albeit to a lesser extent, led the international community to decide in 1992 to establish the UN Framework Convention on Climate Change (UNFCCC). UN Convention on Climate Change (UNFCCC) entered into force in 1994 and in accordance with the adopted procedures of work and acting, 14 annual conferences (COP) have been held until now. The Convention has been ratified by 186 countries and by the European Union (EU) as an economic community.

The basic objective of the Convention is to provide for the stabilization of levels of greenhouse gases (CO_2, N_2O, CH_4, HFCs, PFCs, and SF_6) in the atmosphere at the level to prevent dangerous anthropogenic impacts on the climate system (consisting of the atmosphere, hydrosphere, land, ice cover, biosphere and interactive relationships between these subsystems). Further, the activities stated in the Convention are designed to decrease the speed of the atmospheric warming and thus provide conditions for natural ecosystems to adapt to climate change, to prevent adverse weather conditions for food production and water supply, and to ensure future economic development.

Bosnia and Herzegovina became a member of the Convention on December 6, 2000. In accordance with inter-entity agreement, the function of the UNFCCC Focal Point for BiH was placed at the entity-level Ministry of Physical Planning, Civil Engineering and Ecology of Republic of Srpska (RS). For successful implementation of Bosnia and Herzegovina's obligations under the Convention, a BiH Climate Change Committee was formed with 32 representatives. Subsequently, in accordance with the conclusion of the BiH Council of Ministers 66th session (held on May 16, 2002), a BiH Sub-Committee for Climate Change was established, consisting of 10 members, and the majority of the Sub-Committee members were also appointed to the BiH Climate Change Committee.

One of the key activities of the Focal Point has been to oversee the preparation of the Initial National Communication (INC). As a non-Annex I member country, in accordance with Article 4 of the Convention, BiH will carry out its obligations to that extent that it receives technical and financial assistance. Because of the fact that BiH did not have formalized relations with the GEF until 2004, the preparation of the INC began after that point. The GEF then approved funding through UNDP to finance preparation of the document "Self-Assessment for Preparation of a Project Proposal for Preparation of the Initial National Communication of BiH to the UNFCCC." This document was successfully completed using national experts, thus creating conditions for the GEF to provide further financial assistance for BiH to prepare the INC. Due to technical issues, the attempts by the government to tender the preparation of the INC were not successful, so in agreement with the relevant entity and state stakeholders of Bosnia and Herzegovina and the UNDP in BiH, it was decided that optimal solution would be for UNDP BiH to undertake

[1] IPCC, 2001: Third Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, United Kingdom

the administrative role in organizing the preparation of the INC. It was agreed that the document should be prepared and submitted by the end of 2009. This agreement was made official at a meeting held on December 27, 2007 in Sarajevo.

In terms of obligations to the UNFCCC, the obligations of the parties to the Convention are as follows:

1. Developed countries - Annex I in the Convention: they are obliged to regulate GHG emissions on the territory of their country,
2. Developed countries - Annex II in the Convention: they are obliged to cover the costs of adaptation to climate change for the economies of developing countries,
3. Developing countries: They are obliged to report on their national GHG emissions, as well as to report on the vulnerability of their natural resources and economy to climate changes.

Member countries that do not belong to Annex I to the Convention, a group that includes Bosnia and Herzegovina, are not obligated to decrease their national greenhouse gas emissions.

Namely, according to the Convention, Bosnia and Herzegovina has only general obligations that are related to:

- Calculating annual GHG emissions using a defined methodology and reporting to the Conference of Parties to the Convention;
- Introducing and implementing measures to adopt to the consequences of climate change by regulating anthropogenic emissions and adaptation measures to climate change;
- Cooperating in the development and transfer of technology, methods and processes that lead to limits, reductions and stabilization of GHG emissions;
- Cooperation in the preparation of protection measures for areas exposed to drought and floods, as well as protection measures for water resources;
- Inclusion of an assessment of climate change impacts in appropriate strategies and economic development policies with the aim of minimizing negative consequences of the climate changes to the economy, health of the population and the environment;
- Systematic observation and research, data exchange and information sharing on climate and climate change with the aim of improving scientific findings on the causes and consequences of climate change.

According to this Convention, activities on issues related to the climate change are the responsibility of the governments of member states, meaning that this applies to BiH, too. Non-Annex I countries should research the impact of climate change on their territory and their vulnerability to climate change as well as identify adaptation measures to climate change and request appropriate assistance from developed countries by using appropriate mechanisms. These countries, of course, must be capable of establishing a comprehensive system for dealing with climate changes, for which, once again, they will need to obtain support from developed countries. Types of measures at their disposal are actions in all economic sectors affected by climate change, and actions that decrease global GHG emissions. Funding is, of course, necessary for the implementation of both these types of measures. Namely, the capacity to address climate change must be a national capacity with sufficient financing for both mitigation and adaptation activities.

The following communication was prepared starting in early 2008 in direct coordination with UNDP BiH and according to the guidance provided in "Instructions for the Preparation of National Communications of the Member Countries not involved in Annex I to the Convention" (17/CP.8), the corresponding Operational Program of the GEF, and relevant documents from Bosnia and Herzegovina. Out of 200 candidates, 45 domestic experts from 14 relevant areas were selected to work directly on the preparation of the document. In accordance with procedure, this Project Team had the full support of the GEF Political Focal Point of BiH and the UNFCCC Focal Point of BiH. Also, the Project Board, which was established separately to oversee preparation activities on behalf of BiH as beneficiary of this project, has, within their defined duties, actively followed and supported the INC preparation process.

Because of the known particularities and complexities of the structure of Bosnia and Herzegovina, professional work in accordance with Instruction 17/CP.8 and other documents met with certain difficulties. The lack of necessary data on the whole, the unreliability of those data, the lack of sufficient background statistical data, the small number of professional institutions, the low level of public awareness of climate change, and insufficiently informed and trained NGOs, as well as the complex administrative structure and lack of financing, have all presented certain obstacles to the preparation process. However, in spite of these difficulties, the resulting communication is a comprehensive and highly professional document.

Taking into account the aforementioned factors, the INC represents a truly significant document for Bosnia and Herzegovina that will not only respond to the needs of the country within the UNFCCC but will also serve as a significant strategic document for sustainable development. While the INC is an important starting point, Bosnia and Herzegovina is already looking ahead and planning for the preparation of a Second National Communication and active participation in global and regional partnerships that will improve the current state of research and analysis regarding climate change in the country.

EXECUTIVE SUMMARY

Introduction

Bosnia and Herzegovina (BiH) became a party to the United Nations Framework Convention on Climate Change (UNFCCC) on December 6, 2000. The following Communication was prepared starting in early 2008 in direct coordination with UNDP BiH and according to the guidance provided in "Instructions for the Preparation of National Communications of the Member Countries not involved in Annex I to the Convention" (17/CP.8), the corresponding Operational Program of the GEF, and relevant documents from BiH. The INC represents a truly significant document for BiH, incorporating the work of more than 45 experts from the whole of BiH and various academic disciplines, and it is not only a contribution to the obligations as a party to the UNFCCC, but an important strategic document for sustainable development of Bosnia and Herzegovina.

National Circumstances

Structure and Institutional Framework

BiH is a sovereign state with a decentralized political and administrative structure. Consensus building and decision making involves the State Government, the two Entities (the Federation of Bosnia and Herzegovina and Republic of Srpska) and Brčko District. The Federation of BiH is in turn sub-divided into 10 Cantons. In environmental sector in BiH Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina (MOFTER) has responsibilities for coordination of activities and in international relations, but environmental issues in BiH are responsibilities of entity governments. The corresponding authorities are the Ministry of Environment and Tourism of Federation of BiH, the Ministry of Physical Planning, Civil Engineering and Ecology of Republic of Srpska. Upon the agreement of the entity Ministries and Brcko District Department for Communal Works, the seat of the Contact Institution to UNFCCC is Ministry for Physical Planning, Civil Engineering and Ecology of Republic of Srpska. The process of European integration will require a series of policy and legislative changes associated with adopting the European Union's treaties and its body of laws.

Characteristics

Geography: Bosnia and Herzegovina has a total surface area of 51,209.2 km^2, composed of 51 197 km^2 of land and 12,2 km^2 of sea. BiH has common frontiers with the Republic of Croatia (931 km), the Republic of Serbia (375 km) and the Republic of Montenegro (249 km). The land is mainly hilly to mountainous, with an average altitude of 500 meters. Of the total land area, 5% is lowlands, 24% hills, 42% mountains, and 29% karst region.

Population: The last census of population on the BiH territory was done in 1991 and all the data on the population in this Initial National Report are prepared on the basis of statistical evaluations of relevant studies. At the end of 2007, according to estimates from the statistical institutions, the population of BiH was 3,315,000. Urban population is estimated at 80% of the total population as a result of mass war-time migration from rural to urban areas. There has been an observable rise in the proportion of people aged over 64 (from 6.4% to almost 14,8% of the total population) and a significant drop in the active working population in the 20-40 age group.

Climate: The climate of BiH varies from a temperate continental climate in the northern Pannonia lowlands along the Sava River and in the foothill zone, to an alpine climate in the mountain regions, and a Mediterranean climate in the coastal and lowland areas of the Herzegovina region in the south and southeast.

Economy: Despite major international aid efforts, the pace of post-war economic recovery has been much slower than expected. Nominal GDP is estimated at KM 20,950 million in 2007, representing a real growth of 6%. Since the war ended, BiH has attracted only around KM 2.1[2] billion in foreign investment. Estimates made by Agency for Statistics of BH the year 2008 shows that GDP velue was 24,716 bilion of KM, while an average GDP per person was 6435 KM (Agencz for Statistics, 2009). Estimations made by CIA shows that the real growth rate of GDP for 2008 was 5.5 %, while the world average was 6%. Composition of GDP by sectors was 10.2% agrucultuure, 23,9% industry, and 66% services (CIA, 2009).

Sectoral Information

Industry: The share of industry may have risen to close to 40% of GDP in 2007, but the industrial sector in BiH is currently characterized by low productivity and poor competitiveness. There are serious infrastructure problems, and financial markets are also underdeveloped and inefficient. Exports cover only around 30% of imports. The present difficult situation of BiH industry is certainly caused by devastation from the war and the loss of pre-war markets, but the legacy of the socialist command economy and previous orientation on heavy industries are also important causes.

Energy: The basic sources of primary energy in BiH are coal and hydropower, which accounted for 62% of primary energy consumption. Energy efficiency in BiH is low relative to high-income countries, as is

[2] 1 EUR=1.95583 KM

the use of renewable energy sources, with the exception of hydropower. BiH depends on energy imports to meet consumption needs. Power consumption in 2009 is 2385 kWh/capita which is also lower than the world average and it amounted to 2752 kWh/capita, and the average for OECD countries amounted to 8477 kWh/capita (IEA, 2009). This is clear indication that some BiH inhabitants live below the general poverty line. TPES (Total primary energy Supply) in 2009 is 1.49 toe/capita, while World TPES is 1.82 toe/capita and OECD TPES is 4.64 toe/capita (IEA, 2009). One of the indicators of the efficiency of energy use in a country is the energy intensity, which represents the ratio of energy consumed per unit of GDP. In 2006, an average of TPES 0,79 toe per GDP (USD exchange in 2000) while world average was 0.31 toe per GDP and EU27 countries average 0.19 toe per capita (IEA, 2009).

Transport: The geographical position of BiH is important within the European transportation system; the shortest routes linking Central Europe with the Adriatic run through BiH. The total length of the road network in BiH is around 22,734 km. The rail network of BiH consists of 1,031 km of railways, but the current state of rail infrastructure is such that normal traffic is impossible without major investments. BiH has four airports and while it has no seaport, it uses the Adriatic ports in Croatia, primarily the port of Ploče. Water transport is significant for the geo-communications position of BiH, and the Sava River is the main navigable river.

Agriculture: Out of the total land area in Bosnia and Herzegovina, about 2.6 million ha is suitable for agriculture, of which only 0.65% is irrigated. This small percentage of irrigated land is the result of an undeveloped irrigation infrastructure. Fertile lowlands comprise 16% of agricultural land in BiH, 62% are less fertile hilly and mountainous areas, and the Mediterranean area accounts for 22%.

Forestry: Forests and forest land occupy a surface area of about 27,100 km^2, or about 53 percent of the territory of BiH - among the highest forest coverage in Europe. BiH forests mainly regenerate naturally and, as a result, show marked diversity. Due to activities such as illegal logging and mining, forest fires, etc., forested areas have been shrinking rapidly; furthermore, a significant part of the forest cover has been declared as mined (approximately 10%). However, three forest management public enterprises hold Forest Stewardship Council (FSC) certification, and currently around 50% of state-managed forests in BiH are FSC certified.

Waste Management: Two to three million of tons of solid waste of all kinds are generated annually in BiH, and this waste is mainly deposited at about 1,100 "illegal garbage dumps." The exclusive jurisdiction that municipalities have over utilities represents a huge obstacle for improving conditions. Only 60% of larger urban municipalities provide waste disposal services, while the situation is much worse in smaller municipalities. A solid waste management strategy in BiH is now in the implementation stage.

Water Management: BiH possesses considerable water resources; The Law on Waters of Republika Srpska of 2006 and the Law on Waters of the Federation of BiH of 2008 have been adjusted to the European Directive on Waters (2000/60/EC), thus providing integral approach to water management, which implies all the surface and underground waters and which is related to protection of water, usage of water, protection from harmful effect of waters, planning of water flows and other water bodies and public goods. Water management is provided at the level of water basins and water management agencies have been established at an entity level.

Damages caused during the war at water facilities for usage and protection of water, as well as insufficient maintenance, still requires special attention to be paid to these issues by the competent institutions.

Health: Public expenditure for health care accounts for 7.6% of GDP, and all health care expenditures including informal payments and private payments total 12.3% percent of GDP. However the state of health of the population of BiH has deteriorated due to consequences of the war as well as to socio-economic circumstances, unemployment, migration, the large number of displaced persons, lack of health insurance, and unhealthy lifestyles. Road accidents, physical disabilities, and mental ailments are also a major problem for public health care. Available data indicate that more than 47,000 people were disabled by the war, and landmine risks are still an important public health issue. The health laws of the country proclaim the principle of universal health insurance coverage for the population.

Education: The right to education is built into the Constitution of Bosnia and Herzegovina. In 2003, there were approximately 606,000 students in Bosnia and Herzegovina. Around 367,000 attended 1,836 primary schools, and around 172,000 students attended 295 secondary schools. There are seven public universities with 95 schools and 67,000 full time students. Education in BiH is covered by legislation at various levels in the FBiH and RS.

Calculation of Greenhouse Gas Emissions

Methodology: The 1990 BiH inventory of greenhouse gases has been compiled in line with UNFCCC Reporting Guidelines. The methodology used was the European CORINAIR methodology. Specific emission factors for Bosnia and Herzegovina were calculated for the 12 types of coal found in BiH. Barriers to the calculation of emissions included data that were incompatible with IPCC methodology, lack of equipment for data collection, and missing data (particularly for industrial processes and LUCF and waste). The quality of activity data was the main problem. Among other methods, inventory calculations were checked by comparing results with regional data and by preparing two calculations for the energy sector: approach by sector and a simpler reference approach (the difference between the two was 1%).

The most significant source of CO_2 emissions is certainly the energy sector, which contributes 74% of total CO_2 emissions. Other emissions sources include agriculture (12%), industrial processes (11%), and waste (3%). In the energy sector, solid fuels-coal make the largest

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Total
	CO2 equivalent (Gg)						
Total (Net Emissions)	26,461.07	4,454.52	3,127.90	0,00	0,00	0,00	34,043.49
1. Energy	23,121.74	1,627.71	139.50				24,888.95
A. Fuel Combustion (Sectorial Aproach)	23,121.74	30.66	139.50				23,291.90
1. Energy Industries	16,434.64	4,20	71.30				16,510.14
2. Manufacturing Industries and Construction	530.16	1.47	3.10				534.73
3. Transport	2,308.06	12.39	37.20				2,357.65
4. Other Sectors	3,848.88	12.60	27.90				3,889.38
5. Other	0.00	0.00	0.00				0.00
B. Fugitive Emissions from Fuels	0.00	1,597.05	0,00				1,597.05
1. Solid Fuel	0.00	1,597.05	0,00				1,597.05
2. Oil nad Natural Gas	0.00	0.00	0.00				0.00
2. Industrial Processes	3,339.33	0.84	213.90	0.00	0.00	0.00	3,554.07
A. Mineral Products	736.75	0.00	0.00				735.75
B. Chemical Industry	0.00	0.00	213.90	0.00	0.00	0.00	213.90
C. Metal Production	2,602.58	0.84	0.00		0.00	0.00	2,603.42
D. Other Production	0.00						0.00
E. Production of Halocarbons and SF_6				0.00	0.00	0.00	0.00
F. Consumption of Halocarbons and SF_6				0.00	0.00	0.00	0.00
G. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Solvent and Other Product Use	0.00		0.00				0.00
4. Agriculture		1,833.51	2,774.50				4,608.01
A. Enteric Fermentation		1,548.33					1,548.33
B. Measure Management		258.18	396.80				681.98
C. Rice Cultivation		0.00					0.00
D. Agricultural Soils		0.00	2,337.70				2,377.70
E. Prescribed Burning of Savannas		0.00	0.00				0.00
F. Field Burning of Agricultural Residues		0.00	0.00				0.00
G. Other		0.00	0.00				0.00
5. Land Use Change and Forestry	-7,423.53	0.00	0.00				-7,423.53
6. Waste	0.00	992.46	0.00				992.46
A. Solid Waste Disposal on Land	0.00	992.46					992.46
B. Wastewater Handling		0.00	0.00				0.00
C. Waste Incineration	0.00	0.00	0.00				0.00
D. Other	0.00	0.00	0.00				0.00
7. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Memo Items							0.00
International Bunkers	0.00	0.00	0.00				0.00
Aviation	0.00	0.00	0.00				0.00
Marine	0.00	0.00	0.00				0.00
Multilateral Operations	0.00	0.00	0.00				0.00
CO2 Emission from Biomass	0.00						0.00

[1] For CO_2 emissions from Land Use Change and Forestry the net emissions are to be reported. Please note that the purposes of reporting the sighn for uptake are always (-) and for emissions (+).

GREENHOUSE GAS SOURCE AND SINK CATEGORIES Land Use-Change and Forestry	CO_2 Emissions	CO_2 Removals	Net CO_2 Emissions/ Removals	CH_4	N_2O	Total Emissions
A. Changes in Forest and Other Woody Biomass Stocks	0.00	0.00	0.00			0.00
B. Forest and Grassland Conversion	0.00		0.00	0.00	0.00	0.00
C. Abandonment of Managed Lands	0.00	0.00	0.00			0.00
D. CO_2 Emissions and Removals from Soil	0.00	0.00	0.00			0.00
E. Other	0.00	0.00	0.00	0.00	0.00	0.00
Total CO_2 Equivalent Emissions from Land-Use Change and Forestry	0.00	0.00	-7,423.53	0.00	0.00	0.00

Total CO_2 Equivalent Emissions without Land-Use Change and Forestry *	34,043.49
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry *	26,619.96

* The information in these rows is requested to facilitate comparision of data, since Parties differ in the way they report emissions and removals from Land-Use Change and Forestry.

Table 1. Summary Report for CO2e Emissions in BiH for the base year of 1990.

proportion (77%), followed by liquid fuels (17%) and gas (6%). The largest source of CO_2 in industrial processes is iron and steel production, with more than 67%. The main sources of methane are agriculture (cattle breeding), fugitive emissions from coalmines, and waste disposal. The largest amount of N_2O emissions results from agricultural soils through soil cultivation and crop farming.

According to the collected data, forests in BiH represent a significant CO_2 sink: 7,423.53 Gg CO_2 for the base year of 1990.

Vulnerability and Adaptation to Climate Change

Climate Conditions, Climate Variability, and Projections of Climate Change

In all model runs examined, average annual temperature increased, and average net precipitation decreased for the future periods in the projections.

Using the EH5OM global model, the temperature in BiH is projected to increase from 0.7 to 1.6°C per 1°C of global increase during the period 2031-2060.[3] It is clear that the average rise in temperature (the daily mean averaged over 30 years) is between 1 and 2°C along the coast, and between 2 and 3°C inland. The largest temperature increases would occur in summer, and in inland areas: Tmean by 4°C and T_{max} by 5°C on average. Furthermore, T_{max} is expected to rise more than T_{min}. The increase in the number of summer days, defined as the number of days when T_{max} exceeds 25°C, is from 2 to 6 weeks, or about one additional month of summer days on average. Finally, the increase in the number of hot days in the Balkans, defined as the number of days with $T_{max} > 30$°C, ranges from 2 weeks along the coast to 5-6 weeks inland.

For precipitation, using the EH5OM global model, the summer climate will be noticeably drier in Southern Europe. This will be especially noticeable in summer (June-August), when already small amounts of rainfall could be halved. All parts of the Mediterranean (including the Balkans) are expected to see a decrease in summertime precipitation and a small decrease or no change in the other seasons during the period 2031-2060. On average, the Mediterranean region is expected to feature more dry days. The increase in dry days is likely to be lower along the coast but higher in the inland Balkans.

Increasing variability in the weather has been noted in all seasons, with rapid changes of short periods (five to ten days) of extremely cold or warm weather - heat and cold waves - and periods with extremely high levels of rainfall, as well as droughts. It is expected that the duration of dry periods, the incidence of torrential flooding and the intensity of land erosion will increase over the next century. In addition, an increase is expected in the occurrence of hail, storms, lightning, and maximum wind velocity, which can represent threats to all forms of human activity.

BiH did not have the capacity to select adequate methods and approaches for socio-economic scenarios and climate change scenarios that would reflect national circumstances in a robust way during the preparation of the INC due to severe data shortages in and projections. Therefore, the INC has made preliminary conclusions based on a combination of two types of existing projections: 1) regional-level output from a global model (Section 3.2.1.); and 2) findings from other research. The task of expanding scenarios to reflect national conditions in future projections is an urgent one and a high priority for the Second National Communication.

Vulnerability and Adaptation Assessment

BiH is highly vulnerable to climate change. Exposure to threats from climate change will be considerable. BiH also has a high sensitivity to these threats because of the economic role of "climate-sensitive" sectors, such as agriculture and forestry (and the role of hydropower in the energy sector to a lesser extent), with significant secondary impacts. Finally, BiH has very limited adaptive capacity to address climate risks (constraints are discussed in Chapter 6). Vulnerability and adaptation in key sectors are summarized in Table 2.

[3] With respect to the reference period of 1961-1990.

Key Sector	Vulnerability	Primary adaptation measures	Secondary adaptation measures
Land	- Move of climate zones towards the North and in accordance with the altitude - Inability of some ecosystems and species to adapt to rapid climate changes - Soil degradation due to decrease in water supply	- Implementation of nature protection measures throughout the country - Increase in the amount of territory designated as protected areas by law. - Consideration of potential changes in habitat due to climate change when establishing the boundaries of national parks and protected areas.	Improvements in the legislative system and in enforcement in the area of nature protection Improvement of the protected areas management system
Coastal area	- Erosion risk and soil deficiency due to sea level rise - Increase in water temperature	Inclusion in the coastal zones management programmes of the Republic of Croatia	Reduction in anthropogenic impacts on the coastal and sea areas.
Water management	- Changes in seasonal river flows - Decrease in the quantity of water flow in rivers - Difficulties in water supply for households and industry	Construction dams and accumulation reservoirs for hydropower generation, agriculture, drinking water, tourism, fish-farming, etc.	- Training on the efficient use of water and reduction of losses in distribution - Strengthening the system of water quantity monitoring and forecasting; - Development of a Hydrological Information System
Agriculture and cattle breeding	- Change in the precipitation regime - Change in seasonal air temperatures - Decrease in arable land area - Lack of snow cover for protection of winter crops	- Changes in crop mix - Modification of crop rotation - Inclusion of agriculture in water management programmes - Construction of reservoirs and canals for agricultural needs - Use of drip irrigation techniques	- Training for farmers and decision-makers on new technologies for land cultivation - Training on protection of livestock against overheating - Assisting farmers to cover costs of bad weather insurance policies
Forestry	- Loss of biodiversity due to climate change - Danger of increased vector activity and occurrence of plant diseases	- Conduct a detailed mapping of forests - Afforestation of bare areas - Change of species in the process of forest development - Establishment of plantation forests for the needs of industry and energy - Increased protection of forests against pests and plant diseases	- Higher level of care for forest protection - Improve the forest fire protection system

Mining and energy	- A long-term decrease in coal demand - Changes in the pattern of seasonal demand for electric power - Inadequate water supplies in the accumulation reservoirs of hydroelectric power plants due to changes in precipitation	- Planning of energy development (energy industry) within the regional cooperation (SEE) initiative - Introduction of integrated water resource management - Development of renewable energy sources to promote employment opportunities (especially in villages) and decrease the level of dependence on energy imports	- Include the effects of anticipated climate changes during development of annual and seasonal energy balances - Stimulation of increases in energy efficiency on the demand side (buildings, industry, transport) - Public campaigns and training on energy efficiency.
Tourism	- Decrease in the potential for winter tourism	- Promote the development of year-round tourism	- Providing information to entrepreneurs from the tourism industry about anticipated climate changes (change in the snow regime) - Production of artificial snow
Economy and trade	- Changes in supply and demand - Risk of losing raw materials for production - Decrease in the export capacity of goods and services - Increase in the import of equipment and goods	- Development of infrastructure for the entire process of transfer and commercialization of new technologies (within the UNFCCC and other forms of international cooperation) - Encouragement of scientific and research work, development of technological parks and introduction of funds for support to development and acceptance of technologies related to adaptation to climate changes	- Advising entrepreneurs on the impacts of climate changes on product supply and demand (equipment and goods) - Involve banking system actively - analysis of the impacts of climate changes on loans related to projects
Infrastructure	- System of settlements and buildings is inadequate for anticipated changes in behavior that result from climate change. - Increased risk of traffic accidents during summer - Increased risk of self-ignition of landfills - Increased risk of landslides, flooding - Increased risk of water shortages	- Creation of a vulnerability study and strategic assessment of the environment that address climate change within current infrastructure planning procedures - Analysis optimal residential density - Planning that includes space for plants (for the water accumulation) and aqueducts - Inclusion of risk of landfill self-ignition during assessments of repair projects for existing landfills	- Improve technical regulations for thermal quality of buildings and HVAC systems - Use elements of solar architecture for heating and protection against overheating of buildings - Improve microclimate conditions by increasing the size of green areas in settlements - Implementation of measures for improvement of traffic safety

Health and social status	- Chronic and acute health impacts - Higher occurrence of air-borne allergens - Changes in working conditions - Risk of losing jobs - Intensified migration to urban areas	- Timely warnings about anticipated heat waves - Strategy to protect at-risk populations from extreme heat events.	- Training - Establishment of statistical monitoring of climate change-related pathology - Strengthening of the public health infrastructure as a whole
Education	- Lack of knowledge and skills to cope with climate change and its related impacts	- Introduction of curriculum related to climate change (and environmental education more generally) at all educational levels - Introduction of relevant programmes of study for secondary schools and universities	- Training for decision-makers - Training for the media
Socio-Economic Development	- Pressures from endangered industrial branches - Pressures from endangered social groups - Pressures of the international community based on international agreements	- Practical implementation of aggregated indicators (climate-development) - Development of a system of monitoring, forecasting, and disseminating information on climate change - Improvement of the hydro-meteorological services - Formal and informal training on coping with climate change - Introduction of development plans for state and local communities that respect existing and anticipated climate change	- Establishment of an inter-sectoral body for adaptation to climate change at the state and entity levels - Active cooperation within the UNFCCC (use of support to developing countries on the application of measures for adaptation and mitigation) - Use of Ecofund to finance activities on adaptation to mitigation - Adoption of a Short-Term Action Plan on Climate Changes at the state and entity levels

Table 2. Vulnerability and adaptation to climate change in BiH for key sectors.

Estimating the Potential for Mitigating Climate Change in BiH

Two scenarios were used to assess the potential effects of reducing greenhouse gas emissions: a baseline, or "business as usual" scenario, and a second scenario that assumed organized measures to reduce greenhouse gas emissions in line with actual in-country potential and realistic stimulus measures from abroad.

Energy Sector: Measures to reduce GHG emissions in this sector included reducing methane emissions caused by underground mining by using a mixture of ventilation air and methane; increasing the energy efficiency of the existing facilities (both production and transmission facilities); developing renewable energy sources; using biomass or lower-carbon fuels; and reducing N_2O emissions. BiH should continue the process of translating EU directives on the use of renewable energy sources and introducing energy efficiency measures into BiH legislation. The country should also designate a fund that would be used to finance renewable energy source and energy efficiency projects;

District Heating Systems: These systems must increase their energy efficiency and improve operations, thus increasing competitiveness. Potential measures include general strategic measures, improvement of the infrastructure, introduction of meters and controls, and the development of co-generation.

Buildings: The possibilities of reducing energy consumption and of CO_2 emissions in the buildings sector are enormous. Key measures may be classified into three groups: 1) Adopting new standards and codes in the field of energy efficiency; 2) Optimizing the shells of existing buildings based on cost-effective measures; and 3) Using energy-efficient technologies in buildings and introducing metering and controls.

Renewable Energy Sources: Key measures to support mitigation by increasing the share of renewable energy include the following: create a legislative framework for renewable energy; develop a functional system of incentives, taking into account the capability of the current Environmental funds; develop a strategy for renewable energy in close cooperation with competent institutions for water management, agriculture and forestry; address grid connection issues; substitute renewables for liquid fuels, especially in public buildings; assess biomass-fueled remote heating systems in places with a developed timber and wood industry.

Industrial Processes: Assessments made on the basis of official statistical data of the FBiH and RS Statistical Institutes show that consumption of energy per unit of product is the highest in the textile industry (3,924MWh/t), whereas it is the lowest in the food and drinks industry (0,268 MWh/tIn the food processing industry, the possibility of replacing liquid and gas fuels is important, including fuel switching to biogas. Furthermore, in the frozen food cold chain, there are eight measures that could save energy and reduce emissions. In beer production, improvements in energy and water efficiency would bring substantial benefits. In the cement industry, one of the solutions for reducing greenhouse gas emissions is to partially replace fossil fuels with alternative fuels that are obtained primarily from waste. In the cement industry, one of the measures for reducing CO_2 emission is the reduction in the clinker-to-cement ratio, because CO_2 emissions are mostly ascribed to clinker production. One important cross-cutting measure for mitigating climate change and for considerably reducing emissions is the systematic management of industrial waste. A related measure would be the use of waste disposal for energy, whether it be thermal energy from solid waste incineration or the use of landfill gas methane for energy purposes.

Transport: Stricter measures need to be introduced for passenger motor vehicles when conducting regular vehicle inspections and preventive maintenance inspections. That way, 5% of motor vehicles a year would have to be barred from traffic, which would result in a considerable renewal of the passenger vehicle pool in the next 20 years, as well as a 30% reduction in GHG emissions. By encouraging a large number of passengers to use public transportation services, and their number would increase by about 40,000 passengers a year, it would be possible to save about 2,100,000 tons of fuel by 2030.

Furthermore, if the railway infrastructure and supra-structure are renewed, passenger transport in both entities will increase by about 12% a year; i.e., by 2030 it will grow from the present 53 million to 180 million passenger kilometers. Increased use of water transport could considerably enhance the development of heavy industry and relieve road transport: in water transport, 1 kW can push 4 tonnes of cargo, while in road transportation 1 kW can push 100 kg, and in railway transportation 1 kW can move 400 kg.

Agriculture: Mitigation in this sector should include the following measures: the use of biomass in biogas production, i.e. for energy purposes; measures to reduce methane emissions by introducing new livestock breeding and feeding practices; and measures to reduce nitrogen oxides emissions through programmes aimed at improving the application of mineral and organic fertilizers and introducing organic production. Furthermore, the introduction of organic production principles would reduce energy consumption and lead to greater accumulation of organic matter in soil.

Forestry: Updated forest inventories are acutely needed to provide information for decision-making in the sector. The application of certain silviculture methods could increase carbon sequestration in tree biomass and enlarge forest area by reforestation of bare lands, therefore increasing the overall annual biomass increment. Activities that could be integrated into everyday forest management planning include permanent control of forest health conditions and monitoring, increase of thinning activities and planting pioneer wood species on the degraded forest lands. Increasing fire protection measures, restoring the productive forest cover, increasing protection measures and generally expanding the forest and mountain areas under protection.

Waste management: It is necessary to improve the system of waste management (avoiding of waste generation, recycling and re-usage), with an emphasis on collection and usage of methane from regional landfills.

Other Relevant Activities

Technology Transfer

Technology transfer has occurred in only in a limited number of cases: those where big companies have majority owners that are large multinationals. These instances were supported by measures designed to decrease environmental impact. BiH does not have a well-developed infrastructure for needs identification, collection of information on available technologies, or special incentive systems. Limitations due to lack of incentives should be taken into account when creating technology transfer models. Technology needs identified in the preparation of the FBiH Environmental Protection Strategy are listed in Table 5.1.2.1 and cover four key sectors: Energy, Transport, Economy, and Civil Engineering. Although BiH has still not established a Designated National Authority for mechanisms under the Kyoto Protocol, several CDM projects are under development, and an additional three have been announced. Projects are designed to reduce N_2O (coke industry), CH_4 (mines), SF_6 (a thermo-electric power plant), and CO_2 (small hydro plants).

Systematic Monitoring

BiH needs to improve meteorological monitoring. Plans include the modernization or establishment of a total of seven Class 1 weather stations in RS and further modernization of the 13 professional weather stations in FBiH. It is also necessary to establish a professional weather station in Brčko District. There is also a need to introduce Automatic Weather Stations connect them with hydrological stations, particularly with the purpose of automatic monitoring and software control of the situation at river basins, as well as for planning water consumption for the needs of electricity supply, water supply, agriculture, other activities, and the population.

Education, Training, and Awareness Raising

The education system in BiH has not paid special attention to the environment, much less to climate change. One of the biggest gaps is the lack of a national strategy for environmental education in BiH. The Education for Sustainable Development initiative (Michele Biasutti, 2007) is of great importance. In addition, the concept of environmental protection and management as an administrative task is comparatively recent in BiH. There is, therefore, a need for strengthening the capacities of existing personnel in the environmental sector at all administrative levels. All of the activities related to education mentioned above, whether they relate to formal or informal education, need to be implemented in the constant presence of the media, as it is the fastest means of influencing public opinion. A bigger number of documentaries on climate changes is necessary as well as public debates and discussions on state TV stations with politicians and representatives of public companies.

Capacity Development

Priorities for capacity building in the countries of Southeastern Europe are related to the following: capacity building for participation in systematic observation networks; development/strengthening/improvement of national activities for strengthening public awareness and education as well as access to information; a vulnerability assessment of nature, populated areas and the living world; adaptation of primary activities to climate change (agriculture, forestry, cattle breeding); redirection of technological development in the area of energy, industry, construction; finding/coping with technological demands and capacity building for assessment of technological needs and ways of obtaining and adopting, preparation, assessment and acceptance of projects; and inclusion into international programs for decreasing GHG emissions.

Constraints and Gaps and Related Technological and Capacity Needs

Constraints and Gaps

Institutional Constraints: One of the findings of a functional review (Functional Review, 2005) was that the jurisdiction of the state is very limited, which affects country-wide coordination. With three levels of autonomy and up to four levels of administrative layers, public administration is in general very complex also in the environmental field. The study also found that the environmental administration was still undersized and unskilled for the challenges and obligations it would have to face. Understaffing in environmental agencies remains a serious obstacle to fulfilment of the obligations of BiH considering the implementation of requirements under UNFCCC.

Policy Constraints: There is no comprehensive environmental policy at the state level and no institution entirely dedicated to the environmental protection issues, either from the policy and legislative point of view, or from the technical and implementation point of view. The only state-level ministry that has responsibility for environmental issues – Ministry of Foreign Trade and Economic Relations of BIH (MOFTER) – only deals with selected aspects of environmental issues, primarily those related to international relations and coordination. There is still no law on environment at the state level that would establish the legal framework for environmental policy at the state level and at the same time establish a legal basis for a national environmental policy. Environmental policy in BiH also suffers from an insufficient use of economic and fiscal resources. At present, some existing economic instruments do not work as they should, including charges and fees for water management. Other instruments do not work at all: for example, no charges are being collected from enterprises for the emission of air pollutants.

Information Constraints: Statistics are incomplete and are compiled at the entity level (for example, the number of citizens was established for the last time in 1991). These are great problems that require constant improvement and updates, as well as the engagement of the entity and state governments. Documents as the NEAP and others that have been verified through official BiH procedures have at that time provided a good platform for coordination of activities in environmental sector, and on basis of that entity environmental strategies have been developed.

International support in addressing constraints has included 1) Funding from the Global Environmental Facility (GEF) to support the preparation of this INC; and 2) Funding from the GEF to support the preparation of the National Capacity Self-Assessment, which is expected to begin in near future.

Priority Needs

Table 6.9.1. in Chapter 6 lists priority policy and activity needs for BiH for the following sectors: state development policy; biodiversity and environmental protection; protected areas and the most vulnerable ecosystems; energy policy; environmental policy; forest management policy; technology development; energy; hydrology and water resources; industry; transport; waste management; agriculture; the service sector; public health; and socio-economic development.

Rather than identifying specific project proposals, the Communication identifies the following general criteria for the selection of projects that should be a high priority for BiH: 1) projects relevant for increasing energy efficiency; 2) projects focusing on the use of renewable energy sources; and 3) projects in agriculture. In addition, two cross-cutting project proposals are described in Chapter 3: "Rural Development at the Crossroads" and "Demand-Side Energy Efficiency."

International Cooperation

Regionalism presents a strategic way to address adaptation to global changes, considering that there is an increasing number of countries lacking capacities and resources to deal independently with challenges imposed by the changes. The creation of regional networks and structures increases the outlook for economic stability and establishes a more open and more stimulating business environment. Three key initiatives related to climate change are: 1) The energy community of the SEE Region; 2) The Regional Cooperation Council and 3) The Belgrade Climate Change Initiative.

Also, UN development agencies in BiH have in the new United Nations Development Assistance Framework (UNDAF) for period 2010-2014, embraced environment as one of the key focal areas and significant resources are foreseen to be allocated for supporting BiH in achievement of strategic environmental goals.

Recommendations and Next Steps

With the submission of its Initial National Communication, Bosnia and Herzegovina has undertaken an important step towards understanding and addressing climate change issues. The INC represents a landmark document that is the product of cooperation across scientific disciplines and geographic regions. However, it is only a first step in addressing the challenges represented by climate change and its effects. Three recommendations have emerged from the findings of the report to support continued work in this area: 1) Develop a national climate change mitigation strategy and action plan; 2) Take steps to implement commitments under the South East European Climate Change Framework Action Plan for Adaptation (CCFAP, 2008); and 3) Begin preparations for the Second National Communication as soon as possible.

1. NATIONAL CIRCUMSTANCES

1.1. Structure and Institutional Framework

The Constitution of Bosnia and Herzegovina (BiH), which was an integral part of the Dayton Agreement in 1995, created a state comprised of two entities: the Federation of Bosnia and Herzegovina (FBiH) and Republic of Srpska (RS). Under this constitutional construction, Bosnia and Herzegovina is a sovereign state with a decentralized political and administrative structure.

Consensus building and decision making involves the State Government, the two Entities (the Federation of Bosnia and Herzegovina and Republic of Srpska) and Brčko District. The Federation of BiH is in turn sub-divided into 10 Cantons. In environmental sector in BiH Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina (MOFTER) has responsibilities for coordination of activities and in international relations, but environmental issues in BiH are responsibilities of entity governments. The corresponding authorities are the Ministry of Environment and Tourism of Federation of BiH (FBiH), the Ministry of Physical Planning, Civil Engineering and Ecology of Republic of Srpska (RS) (the seat of the UNFCCC Focal Point), and the Department for Communal Works in Brčko District (BD). European integration will require a series of policy and legislative changes associated with adopting the European Union's treaties and its body of laws.

Since the Dayton Agreement, environmental issues in BiH have been the responsibility of entity governments. The corresponding authorities are the Ministry of Environment and Tourism in FBiH, the Ministry of Physical Planning, Civil Engineering and Ecology in RS, and the Department for Communal Works in BD. The work of both entity ministries and the BD department is governed by the following set of environmental laws:

- Law on Environment Protection,
- Law on Air Protection,
- Law on Nature Protection,
- Law on Waste,
- Law on Waters, and
- Law on Environment Funds.

This set of laws was prepared with the financial and technical assistance of the European Commission PHARE Programme with the intention of developing laws that would be in accordance with the relevant European Union Directives and that would be harmonized for both entities and BD. The laws were adopted in RS in 2002 (Official Gazette of RS no. 50, 51 and 53/02), in FBiH in 2003 and 2006 (Official Gazette of FBiH. 33/03 and 70/06), and in BD in 2004 (Official Gazette of BD no. 24/04). In December 2005, the Ministry of Physical Planning, Civil Engineering and Ecology of RS prepared amendments to the Law on Environmental Protection that was published in Official Gazette of RS no. 109/05.

With the adoption of a body of environmental law, BiH has unified all legal aspects of environmental protection. Previously, regulations related to the environment were spread out across different acts, laws, rules, decrees and decisions. Environmental laws mandate the adoption a number of sub-laws and define the responsibilities of different bodies.

The Government of BH is a party to a number of international environmental agreements and conventions, and it is fully committed to meeting the requirements stipulated in these agreements. The most important international agreements ratified include the following:

United Nations Framework Convention on Climate Change (UNFCCC)

Bosnia and Herzegovina ratified the UNFCCC in 2000. Following the ratification of the UNFCCC, BiH has made a serious effort to establish an appropriate political, institutional and legal framework to meet the commitments of the convention. Based on mutual agreement of both of the relevant entity, the BH Focal Point for the UNFCCC is the Ministry of Physical Planning, Civil Engineering and Ecology of RS. At the beginning of 2004, the most important institutions in Bosnia and Herzegovina related to climate protection and the participation of BiH as a Non-Annex I Party in the UN Framework Convention on Climate Change negotiation process were:

- National Focal Point BiH to the UNFCCC (the Ministry of Physical Planning, Civil Engineering and Ecology of RS);
- The BiH Committee for Climate Change and Sub-Committee for Climate Changes;
- The GEF Political and Operational Focal Point; and
- The Administrative Committee for Sustainable Development.

The Kyoto Protocol was also ratified April 22, 2008.

United Nations Convention on Biological Diversity

Bosnia and Herzegovina ratified the United Nations Convention on Biological Diversity in 2002.

United Nations Convention to Combat Desertification

Bosnia and Herzegovina ratified the United Nations Convention to Combat Desertification in 2002.

Vienna Convention for the Protection of the Ozone Layer

Bosnia and Herzegovina became a Party of the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer through succession of the former Yugoslavia.

Convention on Long-range Trans-boundary Air Pollution

Bosnia and Herzegovina became a Party to the Convention on Long-range Trans-boundary Air Pollution and to the Protocol to the Convention Financing of the Co-operative Program for Monitoring and Evaluation on the Long-range Transmission of Air Pollutants in Europe (EMEP Protocol) through succession from the former Yugoslavia.

Aarhus Convention

Bosnia and Herzegovina ratified the Aarhus Convention in September 2008.

Other Conventions

On 1 March 2009, Bosnia and Herzegovina become the 48th Contracting Party to the Convention on the Conservation of European Wildlife and Natural Habitats (Bern, 1979).

During 2009, Bosnia and Herzegovina become the Contracting Party of CITES Convention (the Convention on International Trade in Endangered Species of Wild Fauna and Flora).

Regarding the Espoo Convention, the Socialist Federal Republic of Yugoslavia was an original member of the United Nations (the Charter having been signed on its behalf on 26 June 1945 and ratified 19 October 1945) until its dissolution, and Bosnia and Herzegovina subsequently became a member. The Republic of Bosnia and Herzegovina was admitted as a Member of the United Nations by General Assembly resolution A/RES/46/237 on 22 May 1992.

1.1.1. Environmental responsibilities of ministries and other bodies

More ministries are responsible for several aspects of environment-related activities. Their authority is defined by different laws. As defined by the Law on Ministries, the relevant authority for environmental issues at the state level is the Ministry of Foreign Trade and Economic Relations (MOFTER). More specifically, MOFTER is responsible for carrying out tasks related to defining policies and basic principles, coordinating activities, and harmonizing plans of the entity authorities and bodies at the international level for environmental protection, development and the use of natural resources.

The following sections provide an overview of the ministries and other bodies with environmental competencies at the entity level.

1.1.1.1. Republic of Srpska (RS)

The Ministry of Physical Planning, Civil Engineering and Ecology of RS is responsible for the overall protection of environmental quality and its improvement through research, planning, management and protection measures, including the protection of assets of general interest, natural resources, and natural and cultural heritage.

In accordance with the Law on meteorological and hydrological activities of RS (Official Gazette of the Republic of Srpska, 20/2000), the Republic Hydrometeorological Institute of RS is the government organization responsible for climate change monitoring, climate data exchange and database management, applied research, and climate forecasts in the framework of the various scientific and technical programs of the World Meteorological Organization (WMO).

1.1.1.2. Federation of Bosnia and Herzegovina (FBiH)

The Ministry of Environment and Tourism of FBiH is responsible for vocational and other tasks related to the air, water and soil protection, nature protection, waste management, develpoment of the environmental protection policy and strategy according to sustainable development, environemental monitoring and control of the air, water and soil, production of the periodical reports related to the environmental status.

The FBiH Institute for Meteorology is an independent agency responsible for administrative and professional duties related to meteorology, seismology, hydrology, and water resources, as well as for monitoring environmental quality, including air, water and soil quality. Furthermore, it is responsible for the collection, processing and publishing of data related to these activities. The Law on hydrometeorological affairs, which was inherited from the Republic of Bosnia and Herzegovina/SFRY (RBosnia and Herzegovina 10/76), also applies to the institute and forms the legal basis for its work. This law details the tasks of the institute in the field of hydrology and meteorology. The institute is an active partner in communication with the WMO (BiH is a member), and it follows various WMO guidelines in its work in the field of meteorology and hydrology.

1.1.2. Development Strategy of Bosnia and Herzegovina and the National Environmental Action Plan

Through the efforts undertaken by the BiH National Focal Point to UNFCCC and other responsible institutions, climate change issues havee been raised when identifying the various environmental problems and challenges facing BiH. Therefore, the Economic Development Strategy of Bosnia and Herzegovina (the World Bank-funded Poverty Reduction Strategy Plan, or PRSP), which included a discussion of the realization of national sustainable development and poverty reduction for the period 2003-2007 based on the Millennium Development Goals, emphasized the consequences of climate change and noted several priority activities with respect to climate protection.

The National Environmental Action Plan (NEAP) was also developed with the assistance of the World Bank, and it was adopted in 2003 by the entity goverments. The NEAP was based on national sustainable development priorities, Rio Agenda 21, and the objectives and priorities of The Sixth European Community Environment Action Program 2001-2010. It also considers climate change issues (NEAP, 2003). The NEAP contains a concrete list of the main existing problems and proposes measures to address them. In Chapter 3 on Environmental Management in Bosnia and Herzegovina, the NEAP recognizes the need to establish an Environmental Information System. The introduction of information systems and monitoring are considered priority areas, and two of the priority measures are:

- "The introduction of a comprehensive monitoring system in Bosnia and Herzegovina;"
- "The establishment of a central database, training of personnel and improvement of the existing communication with the European Environmental Agency (EEA/EIONET)."

The status of the development of emissions inventories in Bosnia and Herzegovina is primarily specified by the air protection laws for FBiH and RS that are currently in effect. The following should be emphasized in these laws:

- The Ministry of Environment and Tourism of FBiH and the Ministry for Physical Planning, Civil Engineering and Ecology of RS each release the Report on Air Pollution Emission Inventories for their respective entities in January of each year for the year two years prior;
- Cantons in FBiH release Air Pollution Emissions Inventories Emission in April of each year (including dissemination from natural resources) for the year two years prior.

The inter-entity environment body releases a joint Report on Emission Inventories each April for the year two years prior based on information submitted by entity ministries. This joint report is submitted to the Council of Ministers in BiH to be forwarded to the authorized agencies for international agreements of which Bosnia and Herzegovina is a member; however, this procedure is only regulated by FBiH law.

The reports on emission inventories have to be prepared in compliance with reporting requirements determined by the international agreements to which Bosnia and Herzegovina is a party. Emission inventories must be prepared for the following substances: SO2, N_2O, CO_2, CO, NH3, NOx, CH_4, NMVOCs, C6H6, and PM10. The emission inventory registry is maintained by fields of activity. Emission assessments are performed in accordance with internationally approved methods and guidance. Polluters, specialized institutions, and authorized bodies are responsible for submitting the data required for dissemination, assessment, and/or monitoring to the ministries.

1.1.3. Environmental Statistics

Although not directly involved, statistical institutes also play a key role in environmental monitoring. The relevant statistical institutes in Bosnia and Herzegovina are as follows:

State level

The Bosnia and Herzegovina Agency for Statistics is responsible for producing and publishing (after review) aggregated statistics for Bosnia and Herzegovina in accordance with internationally accepted methodology. These aggregated statistics are based on data submitted by the entity-level statistical institutes. The agency is also responsible for coordinating the work of the entity-level statistical institutes and for fostering closer cooperation.

Entity level

The RS Institute for Statistics and the FBiH Institute for Statistics are the authorized bodies responsible for performing work in the field of statistics. Their activities focus on the production of statistics: the collection, storage, processing, analysis, and distribution of data. In practice, the production of statistical data is conducted by other relevant ministries and organizations in their respective areas of responsibility, and the data are then submitted to the institutes. In particular, the RS Hydro-meteorological Institute and the FBiH Meteorological Institute, the entity Ministries of Internal Affairs, and the Ministries of Energy, Mining and Industry organize and conduct statistical research.

1.2. Geographical Characteristics

Bosnia and Herzegovina has a total surface area of 51,209.2 km^2, composed of 51,197 km^2 of land and 12.2 km^2 of sea (Source: Agency for Statistics of BiH, www.bhas.ba). According to its geographical position on the Balkan Peninsula, it belongs to the Adriatic basin and the Black Sea basin. Therefore, Bosnia and Herzegovina belongs to the Danubian countries group, as well to the Mediterranean countries.

Bosnia and Herzegovina has common frontiers with the Republic of Croatia (931 km), the Republic of Serbia (375 km) and the Republic of Montenegro (249 km). To the north, BiH has access to the Sava River,

Figure 1.2.1 Map of Bosnia and Herzegovina

and to the south to the Adriatic Sea (23.5 km of sea border). The land is mainly hilly to mountainous, with an average altitude of 500 meters, (0 m at the seacoast and 2,387 m at the highest peak, Maglić Mountain). Of the total land area, 5% is lowlands, 24% hills, 42% mountains, and 29% karst region. Forest lands cover about 2.5 million ha, or 49% of the total land area, which is among the highest forest coverage in Europe. Forest ecosystems cover 41% of the territory, and a relatively high number of species are endemic. Bosnia and Herzegovina ranks among the territories with the highest level of biological diversity in Europe. Therefore, forestry in BH is a very important industrial sector, and the sustainable management of forest resources is a significant factor in environmental, climate and biodiversity protection.

There are seven river basins (Una, Vrbas, Bosna, Drina, Sava, Neretva with Trebišnjica and Cetina), of which 75.5% belong to the Black Sea catchment region and 24.3% to the Adriatic Sea catchment. The source fields of surface and ground water are particularly valuable natural resources. There are also numerous river lakes (on the Pliva and Una rivers) and mountain lakes (in the Dinarides range), as well as thermal and geothermal groundwater resources. Bosnia and Herzegovina is rich in thermal, mineral and thermal-mineral waters.

1.3. Population

According to the most recent census, which was conducted in 1991, total population was 4,377,033, and GDP per capita was approximately USD 2,500, placing BiH among medium-income countries. Today, statistical data used in UNDAF document, provide us with information that population of BiH is estimated at 3,315,000, GDP per capita is 3,802 USD.

In 1991, the age structure of the population of BiH was of the type known as "verging on stationary-regressive," with an insignificantly narrowed demographic pyramid. According to the same source, the current age structure of the population is similar to that of 1991, but in the year 2000, the population was of the regressive biological type. Urban population is estimated at 80% of the total population as a result of mass war-time migration from rural to urban areas. There has been an observable rise in the proportion of people aged over 65 (from 6.4% to almost 11% of the total population) and a significant drop in the active working population in the 20-40 age groups.

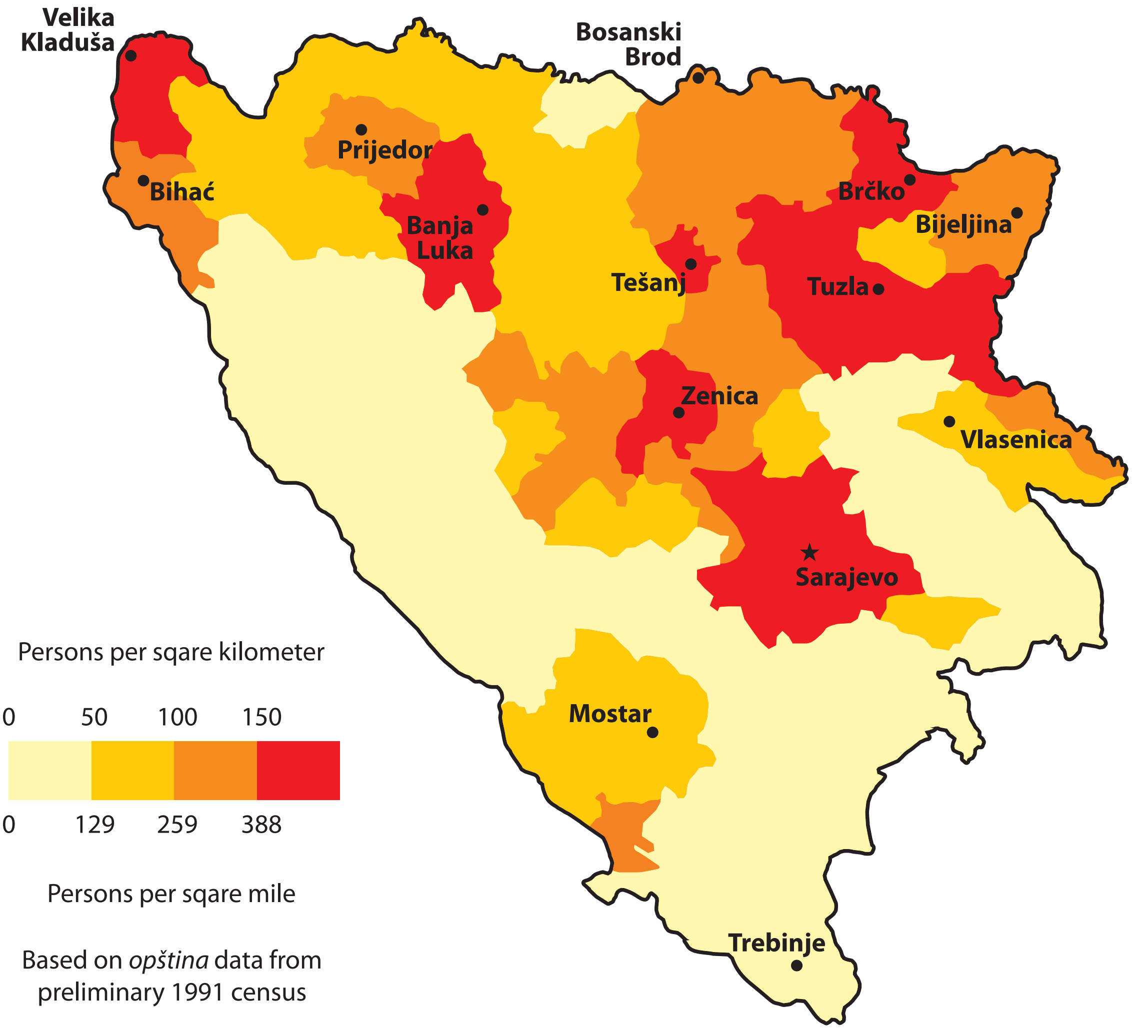

Figure 1.1.1.: Population of Bosnia and Herzegovina according to the 1991 census.

In Bosnia and Herzegovina in 2007, 33,235 babies were born, which indicates a 2.34% decrease in the birth rate compared to 2006; 33,832 people died, which indicates a 1.84% increase in mortality compared to 2006. The natural increase in 2007 is negative and amounts to -597, which means that 597 more people died than were born. This is the first time since 1996 that the natural increase is negative (Source: Agency for Statistics of BiH).

1.4. Climate Characteristics

Bosnia and Herzegovina have several conditions that have led to a wide spectrum of climate types: general atmosphere circulation and air mass streaming mount position, its dynamic relief, directions in which its mountain missives stretch, its hydrographical network, and the proximity of the Adriatic Sea. This discussion focuses on the temperate continental climate type, which is represented mostly in the northern and central parts of BiH, the sub-mountainous and mountainous type (over 1000 m), and the Adriatic (Mediterranean) and modified Adriatic climate type represented in coastal area of Neum that applies to the Herzegovinian lowlands.

General climate characteristics of Bosnia and Herzegovina are greatly influenced by characteristics of Adriatic Sea, local topography-especially the Dinarides Mountains, which are located along the coast and run from NW to SE parallel to the coast - and atmospheric circulation on a macro scale.

For the reasons mentioned above, the climate of Bosnia and Herzegovina varies from a temperate continental climate in the northern Pannonia lowlands along the Sava River and in the foothill zone, to an alpine climate in the mountain regions, and a Mediterranean climate in the coastal and lowland areas of the Herzegovina region in the south and southeast.

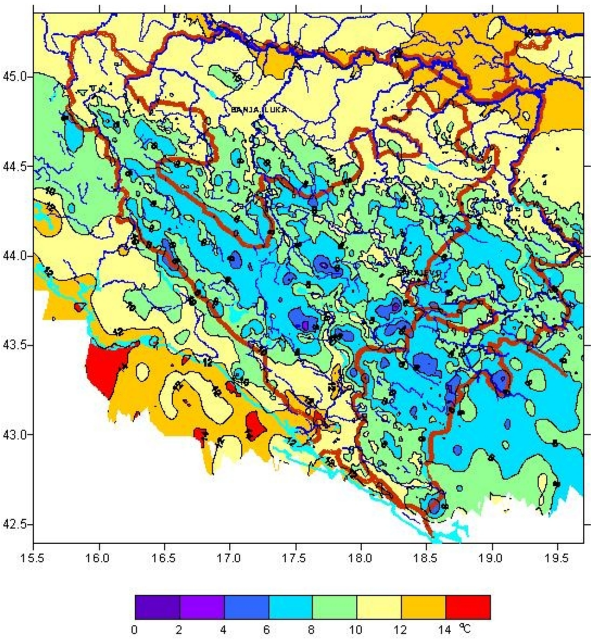

Figure 1.4.1.: Spatial distribution of mean annual air temperature in BiH, 1961-1990.

In the lowlands in the northern part of the country, air temperature generally ranges between -1 and -2 °C in January and between 18 and 20 °C in July. In highlands with the altitude above 1000m, the average temperature ranges from -4 to -7°C in January to 9 to 14°C in July. On the Adriatic coast and in the lowland regions of Herzegovina, air temperature ranges from 3 to 9°C in January to 22 to 25°C in July. Extremes of -41.8°C (low) and 42.2°C (high) have been recorded.

The lowland area of northern Bosnia and Herzegovina has a mean annual temperature of between 10°C and 12°C, and in areas above 400 m the temperature is below 10°C. Mean annual air temperature in the coastal area ranges between 12°C and 17°C (see Fig.1.2.3)

Annual precipitation amounts range from 800mm in the north along the Sava River to 2000mm in the central and southeastern mountainous regions of the country. In the continental part of BiH belonging to the Danube River catchment area, a major part of annual precipitation occurs in the warmer half of the year, reaching its maximum in June. The central and southern part of the country with numerous mountains and narrow coastal regions is characterized by a maritime pluviometric regime under the influence of the Mediterranean Sea, so the monthly maximum amounts of precipitation are reached in late autumn and at the beginning of the winter, mostly in November and December (see Fig. 1.2.4).

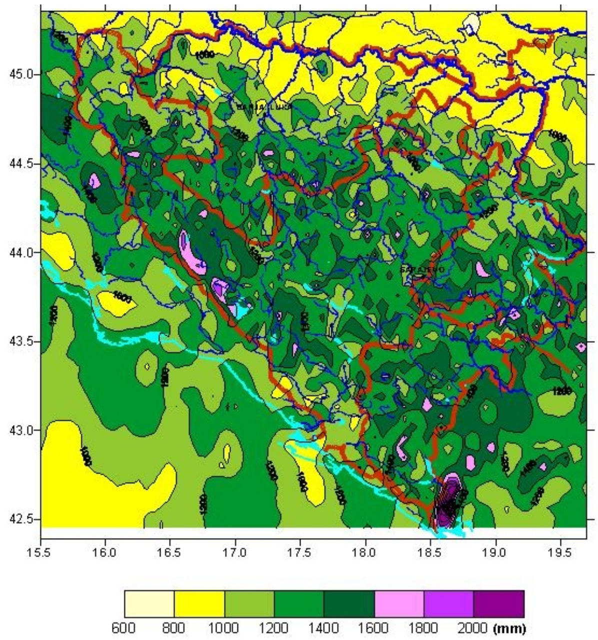

Figure 1.4.2.: Spatial distribution of mean annual precipitation in BH, 1961-1990.

The duration of sunshine decreases from the sea towards the mainland and at higher altitudes. Annual duration of sunshine in the central mountainous area is 1,700-1,900 hours, with the lowest insolation (1,700 hours per year) and the cloudiest (60-70%) conditions. Due to frequent fogs during the cold part of the year, the solar irradiation in the mainland is lower than at the same altitudes in the coastal area. In southern regions, there are 1900-2300 hours of sunshine (Mostar =

2285 hours). In northern Bosnia and Herzegovina, there are 1,800-2,000 hours of sunshine, more in the eastern part than in the western part. Cloudiness declines from the west to the east.

Average annual precipitation in BiH is about 1,250 mm, which--given that the surface area of BiH is 51,209 km^2 - amounts to 64 x 109 m^3 of water, or 2,030 m^3/s. The outflow from the territory of BiH is 1,155 m^3/s, or 57% of total precipitation. However, these volumes of water are not evenly distributed, either spatially or temporally. For example, the average annual outflow from the Sava River basin, which has a surface area of 38,719 km^2 (75.7%) in BiH, amounts to 722 m^3/s, or 62.5%, while the outflow from the Adriatic Sea basin, which has a surface area of 12,410 km^2 (24.3%) in BiH, is 433 m^3/s, or 37.5%.

1.5. Sector Analysis

1.5.1. Economy and industry

In 1997, the share of industrial production in GDP stood at about 30%, and it was estimated to have risen to 37- 38% in 2003. Assuming the consistent implementation of reforms, it is expected that the share of industry may have risen to close to 40% over the period of the implementation of the Poverty Reduction Strategy Paper 2004-2007 - PRSP (i.e., through 2007). The industrial sector in BiH is currently characterized by low productivity and poor competitiveness. According to the analysis made by the MIT Center of the Faculty of Economics in Sarajevo, which was conducted by applying the methodology of the World Economic Forum, competitiveness in BiH is satisfactory for only 18 out of a total of 116 criteria relevant to the country. According to the remaining 98 criteria, domestic industry is insufficiently competitive to participate in world markets. Major problems lie in the domain of infrastructure, but financial markets are also underdeveloped and inefficient. There are a number of deficiencies in the functioning of the fiscal system, from inconsistent implementation of regulations to low collection rates, which make the system one of the weakest points in the entire business environment. The low level of technological development and a lag in the area of business strategy and management quality also contribute to the low level of productivity. The trends of low productivity and competitiveness are reflected in the high national current account deficit due to a situation where exports cover only around 30% of imports. The trends of growth in industrial output are encouraging (5% in both entities). Poor competitiveness and insufficient productivity deter the financial sector from providing greater support to the development of industry. In 2003, however, the domestic banking sector increased lending to businesses. As a result, the share of loans to businesses in the GDP approached the share of loans to households.

The present difficult situation of BiH industry is certainly caused by devastation from the war and the loss of pre-war markets, but the consequences of the earlier model of development should not be overlooked. The command character of domestic industrial development in the pre-war period was an important cause of the collapse of most industrial capacity. Industrial development in BiH in the 1970s brought about a short-lived prosperity, but industry was massively dependent on large investments in the defense industry over quite a long period of time following the end of the World War II. Before the dissolution of the SFRY, more than 55% of the defense industry was located in BiH. This industry had a secure market in the Yugoslav People's Army (JNA), and it also successfully exported to many non-aligned countries. During the war, many of these facilities were destroyed, while the remaining ones lost most of their skilled personnel and, without subcontractors from other republics of the former Yugoslavia, could not revive major production activities. In addition, the level of domestic military purchases plummeted with the collapse of the JNA. Although many enterprises had diversified beyond the defense industry, the collapse of the defense industry system of the former Yugoslavia caused or precipitated the failure of these civilian programs. After the war ended, the major pre-war industrial enterprises did not recover.

Only relatively little final-stage wood processing is done in BiH, while the wood-processing industry is mainly reduced to exporting timber and logs. The chemical industry has collapsed, while the food processing industry is facing difficulties because of obsolete plants and the shortage of domestic agricultural products. The metal-working industry is in a crisis because of its dependence on the defense industry, while the leather and textile production industry cannot achieve adequate competitiveness because of salary levels in BiH. Despite major international aid efforts, the pace of post-war economic recovery has been much slower than expected. As early as in the year 2000, GDP growth fell to 5.7% and in 2001 to 4.9%, while in 2002 it grew to 5.8%, mainly due to increased lending to households by the banking sector, which jeopardized macroeconomic stability due to the growth of the current account. In 2003, real GDP growth remained somewhat below 4%. A vast and growing load of enterprise debt is a special problem, particularly in state-owned enterprises and companies privatized through vouchers or certificates. In the RS, outstanding debts per employee were twice as high as the average annual salary. This thoroughly explains very weak investor interest in privatization in BiH. The slow rate of privatization has exacerbated technology lag, because new technologies can be offered only by strong strategic partners (foreign investors), all the more so because there are currently no public funds in BiH to provide support for basic and applied research. Since the war ended, BiH has attracted only around KM 2.1[4] billion in foreign investment.

The situation of domestic industry indicates that BiH cannot base its development on the same foundations as in the previous period, but that a radical change in the development concept is essential. Any further retention of focus on large enterprises is unrealistic and unjustified, since it is impossible to secure the necessary investments.

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[4] 1 EUR=1.95583 KM

The most important activities aimed at enhancing the competitiveness of industry in BiH are as follows:

- improvement of the business and investment environment,
- acceleration of privatization,
- strengthening of the financial sector
- accelerated reform of labour market,
- reform of the fiscal system (introduction of VAT),
- reform of the energy sector, and
- reforms in the infrastructure sector.

The PRSP identified the following branches of industry as strategic, and found that their development should consequently be stimulated:

- wood-processing,
- food-processing,
- textile,
- leather goods and footwear,
- metal-working,
- tourism,
- energy, and
- information and communication technologies (ICT).

With a view to improving the national accounts statistics of Bosnia and Herzegovina, the Agency for Statistics of BiH has started to compile gross domestic product by expenditure (GDP). The year 2004 was chosen as the reference period for the construction of a series based on available data sources. The year 2004 is the first, for which data from a household budget survey with country-wide coverage became available, thus providing an important data source for estimating household consumption. That year is also the first for which foreign trade data were compiled with country-wide coverage based on a uniform customs declaration. Because there are still important gaps in basic statistics available for the compilation of the national accounts, and the quality of some statistics based on administrative sources or statistical surveys need improvements, these estimates should be considered as experimental. In addition, it should be noted that available data sources and methods have been used to estimate figures for GDP by expenditures for BiH as whole. GDP by expenditure is estimated at KM 24,161 in 2007, and it represents a nominal increase of 14.23% and a real increase of 12.14% from 2006 to 2007. These figures imply a rise in prices of 1.86%. Household consumption expenditures (81.96% of GDP) reached 19,802 million KM in 2007, and represent a nominal growth rate of 9.62%. At constant prices, after discounting the effect of price changes, consumption increased 8.34%. A breakdown of household consumption expenditures by purpose shows increases in all categories and in nominal as well as in real terms. Estimates made by the Agency for Statistics of BH for the year 2008 show that GDP value was 24,716 bilion of KM, while an average GDP per person was 6435 KM (Agency for Statistics BH, 2009). Estimations made by the CIA show that the real growth rate of GDP for 2008 was 5.5 %, while the world average was 6%. Composition of GDP by sectors was 10.2% agrucultuure, 23,9% industry, and 66% services (CIA, 2009).

General government consumption expenditures (18.43% of GDP) grew between 2006 and 2007 by 9.86% in nominal terms and decreased 0.08% in constant prices.

Gross fixed capital formation (26.42% of GDP) increased between 2006 and 2007 by 34.18% in nominal terms and 27.5% in real terms. As consequence of investment increases, the share of this GDP category increased from 22.49% in 2006 to 26.42% in 2007. The breakdown of gross fixed capital formation by type of assets shows increases in all types of assets. Exports of goods and services in 2007 in comparison to 2006 registered an increase of 13.61% in nominal terms and 9.43% in real terms. At the same time, imports of goods and services increased by 17.9% in nominal terms and 11.4% in real terms.

1.5.2. Energy

The operation of the energy market also determines the commercial environment and therefore affects the overall reconstruction of economy. Under the SAA (Stability and Association Agreement), cooperation in the energy sector will reflect the principles of market economy and the European Energy Charter Agreement, and the Treaty Establishing SE Europe Energy Community and will develop in the direction of gradual integration into the European energy market. Cooperation is likely to focus on the formulation of energy policy, improvement of infrastructure and development of energy resources, and energy savings. From the standpoint of the SAA, the Power III Project[5] is of particular importance.

Energy consumption is a significant indicator of the living standard. In 2000, the average consumption of energy in the world was about 70 GJ per capita. In developed countries it reached 236 GJ/capita, and in Bosnia and Herzegovina it was about 45 GJ per capita, which is clearly below average. Power consumption in 2009 is 2385 kWh/capita which is also lower than the world average and it amounted to 2752 kWh/capita, and the average for OECD countries amounted to 8477 kWh/capita (IEA,

[5] The main objective of the Electricity System Reconstruction Power III Project is to follow the BiH Energy Sector Post-Conflict Reconstruction Program, facilitating continued electricity supply at lower prices, along with the mitigation of environmental impacts, as well as a complete reform of the electric power sector. The Project is supported by the international financial institutions and bilateral creditors: the World Bank, the European Bank for Reconstruction and Development, the European Investment Bank, and the governments of the United States, Switzerland, Germany, Norway and Spain. Sub-projects include reconstruction of high-voltage long-distance power lines; reconstruction of high-voltage transformer stations; the SCADA/EMS Telecommunications Project; environmental projects for thermal power plants; reconstruction of hydro-power plants; and reconstruction of the distribution network.

2009). This is another clear indication that some BiH inhabitants live below the general poverty line. TPES (Total primary energy Supply) in 2009 is 1.49 toe/capita, while World TPES is 1.82 toe/capita and OECD TPES is 4.64 toe/capita (IEA, 2009).

One of the indicators of the efficiency of energy use in a country is the energy intensity, which represents the ratio of energy consumed per unit of GDP. In 2006, an average of TPES 0,79 toe per GDP (USD exchange in 2000) while world awerage was 0.31 toe per GDP and EU27 countries average 0.19 toe per capita (IEA, 2009).

The basic sources of primary energy in BiH are coal and hydropower. The total energy consumption in 2005 was as follows: 45.3% coal and coke, 9.6% hydro-power, 21.1% liquid fuels, 5.6% natural gas, and 20.5% wood (Study EES BiH, 2007). Above mentioned data indicates that BiH is dependent on imports, as certain energy sources cannot be replaced with domestic energy sources at present.

Overall geological coal reserves in BiH are estimated at 5.76 billion tons (of which 2.540 billion balanced, from which is 1.437 billion lignite and 1.103 brown coal. Balanced coal reserves makes only 45.5%, outbalanced 10.8% and potential 43.7%, which indicates on low level of exploration (Study EES BiH, 2007). Total hydropower potential is estimated at 22,050 GWh annually; i.e., 6,126 MW of installed capacity. The bulk of coal (about 70% in 1990, more than 90% in 1997, and about 78% in 2001) is used for power production. Taking into account the economy of coal exploitation, as well as the existing efficiency of the transformation of coal energy into other forms of energy, the amount of coal used in the production of electricity could be reduced in comparison with the existing situation.

INSTALLED PRODUCTION CAPACITY			
Fuel	Number of units	Capacity	% capacity
Nuclear	-	-	-
Coal	4	1957	49%
Natural gas	-	-	-
Hydro	13	2034	51%
Renewable	-	-	-
Total	17	3991	100%

Table 1.5.2.1.: Installed energy production capacity in BiH.

The main consumers of the final forms of energy are households and the commercial sector (often considered as one consumer category), industry, and the transport sector. The share of individual consumer groups varies depending on a number of factors, climate being one of the most important. In EU countries with similar climate conditions, the corresponding distribution is as follows: households and the commercial sector account for 40.7%, the transport sector for 31% and industry for 28.3%. According to estimates for the year 2000, households and the commercial sector in BiH accounted for 50% of consumption, industry for 25% and transport for 25% (Study EES BiH, 2007). Therefore, the share of households and the commercial sector in the consumption of energy is the highest. The energy consumed by households and the commercial sector is used predominantly for heat, hot water, cooking, lighting, and electrical appliances and equipment.

Considering that the largest share of energy is used for heating, and that the relative consumption of energy for heating in BiH is much higher than in EU countries (and according to the assessments made in EU countries, at least one fifth of the energy consumed in households and commercial sector is "easily savable"), there is obviously significant potential to reduce energy consumption in this sector. The methodology for designing energy performance indicators in buildings used in Bosnia and Herzegovina is mostly outdated, and the revision of methodology would both achieve energy savings in buildings and reduce the investments needed for energy infrastructure in newly constructed buildings.

The possibilities for energy savings in industry are also considerable. Most industries treat energy as a fixed cost and include the energy cost in the final price of the product, which does not promote energy savings. The cost of energy should be considered separately and benchmarked with the energy costs in the same activities in more developed economies, and measures should be taken to rationalize consumption. Financial incentives could present an effective solution for such measures.

Energy efficiency in Bosnia and Herzegovina, both on the production and transformation side, and on the consumption side, is low relative to the developed economies. Energy production in BiH is based on technologies developed some thirty years ago, when a number of blocks in its thermal power plants were constructed. In the case of construction of new plants and in major reconstructions of existing facilities, new technologies should be introduced whenever possible.

Generally, awareness of the savings that could be achieved by increasing energy efficiency needs to be increased. Energy savings require investments, but these investments pay off quickly.

Renewable energy sources (except for significant existing hydropower capacity), at the current level of development and at the current share in the overall energy consumption, could only complement, rather than replace major plants. However, due to their low environmental impact, these technologies are developing rapidly, and their use is increasing.

Energy facilities have a significant impact on the environment. Their environmental impact is considered in the environmental section of the PRSP. Improvements in efficiency, the application of new technologies, and the expanded use of renewable energy sources could achieve significant results in mitigating environmental impacts.

1.5.3. Transport

According to the 2007 data, BiH has 22,734 km of roads of all categories, which is 4.87% more than in 1991 when it had about 21,677 km. The most important road routes in Bosnia and Herzegovina are as follows:

1. Bos.brod/Županja-Tuzla/Zenica-Sarajevo-Mostar-Ploče
2. BiHać-Banja luka-Doboj-Tuzla-Bijeljina-Bosanska Rača-Zvornik
3. Banja Luka-Travnik-Zenica-Sarajevo-Goražde-Višegrad

The total length of all road routes in the BiH territory by entity amounts to approximately 12,952 km in FBiH, 9,575 km in RS, and 207 km in BD. The total number of registered motor vehicles in 2007 amounted to 778,474, which is 80.51% more than in 1991. In 2007, FBiH had 489,666 registered vehicles, RS had 262,708, and BD had about 26,100. Out of the total number of registered motor vehicles, 86.87% were passenger motor vehicles, 0.22% were buses, 7.92% were goods vehicles, 1.42% were motorcycles, 0.94 % were tractors, and about 2.6% were other vehicles. A very important piece of information is the fact that in 2007 the average age of registered motor vehicles was 17.3 years, and out of the total number of registered passenger vehicles, 54.24 % were over 15 years old. According to the data available, the total number of transported passengers per kilometer in road transport amounted to 1,042,466 in 1997, which was 9.4% more than the year before. With respect to cargo flows in the BiH road transportation in the reference period, they amounted to 323,151 ton/km, which is 49% more than the year before (BiH Ministry of Communications and Transport, 2005).

Between 1996 and 2003, extensive rehabilitation work and repairs of the damages sustained during the war were conducted, with repairs to the main roads, bridges and tunnels. The rehabilitation of the war damage to infrastructure proceeded with donor assistance. Under the "Emergency Transport Rehabilitation Project," approximately 2,200 km of roads and 58 bridges have been repaired, at a cost of around EUR 190 million. The Stabilisation Force (SFOR) also provided significant funds for rehabilitation of road infrastructure. A few repair and rehabilitation projects remain. Significant donor funds were spent on renewing the city transportation motor pools in Sarajevo, Mostar, and Banja Luka. Funding the road infrastructure in current circumstances means funding the maintenance of the road infrastructure.

According to the 2007 data the rail network of BiH consists of 1,031 km of railways, of which 425 km are in the RS and 616 in FBiH. Of this, 87 km are twin-track railways and 776 km are electrified. There are two main rail directions: one running north-south (Šamac – Sarajevo – Čapljina/Ploče), and another running west-east (Bosanski Novi/Novi Grad – Doboj – Tuzla – Zvornik). The Bosanski Novi/Novi Grad – Bihać - Martin Brod section is part of the north-south railway that links central and northern Croatia and northwestern Bosnia with the Port of Split on the Adriatic Coast. The Belgrade - Bar railway crosses through BiH in the eastern part of the RS for a length of 14 km. Although the density of the railway network in BiH is comparable with that of Western European countries, the volume of transport of goods and passengers per kilometer of railways is far below the European average. The existing railway network cannot be used to its nominal capacity, because the rail tracks have not been overhauled, the safety of many level crossings and some stations is inadequate, workshop capacities have not been restored and the rolling stock has not been replaced. The number of passenger cars or trains for medium- and long-distance routes is insufficient. The

age of vehicle	Total vehicles		Cars		Buses		Load carrying vehicles		Motorcycles		Tractors		Rest	
	total	1st time registered	total	1st time registered	total	1st time registered	total	1st time registered	total	1st time registered	total	1st time registered	total	1st time registered
less than 1 year	9170	3431	6431	1966	35	9	1156	382	962	674	177	161	409	239
1-2 years	18575	4591	12993	2511	101	11	2636	474	1476	990	475	218	894	387
3-5 years	27915	7580	21871	6474	92	15	3417	388	988	299	186	47	1361	357
6-10 years	98349	30357	85043	26449	333	93	8144	2531	1437	538	179	59	3213	687
11-15 years	48777	5355	38965	3593	472	288	6607	616	958	374	145	78	1630	406
more than 15 years	303922	34383	274881	28281	130	126	18185	2133	1392	544	3642	2038	5692	1261
TOTAL	505708	85697	440184	69274	1163	542	40145	6524	7213	3419	4804	2601	13199	3337

Table 1.5.3.1: Overview of Registered Vehicles in BiH, 2007. (Source: Agency for Statistics of BiH, 2008)

volume of heavy goods traffic (coal and ore) has declined sharply, which in turn has had a major impact on the cost-effectiveness of the railways. The current volume of transport is insufficient to generate enough revenues to cover costs. The volume of goods and passenger traffic in 2002 was about 15% compared to 1990.

The current state of rail infrastructure is such that normal traffic is impossible without major investments. Railway infrastructure and rolling stock suffered major damages. The restoration of the railway infrastructure has proceeded in three stages. The first was to restore the rail network for low-speed trains without repairs and renovations of the signal equipment and the telecommunications system. Donor funds of about USD 70 million were used for this purpose. The second stage consists of using EIB and EBRD loans to overhaul the tracks, secure 11 level crossings and 3 stations, replace 170 km of telecommunications cables, procure equipment for railway maintenance, repair damages at 5 stations and 3 workshops, and prepare for renovation of the rolling stock (procurement of new cars and overhaul of some existing ones). These projects were to be completed by the end of 2004, while the procurement of some of the rolling stock was to take place by the end of 2006 and beyond. A planned third stage would bring the rail infrastructure up to the standards required by international treaties.

In Bosnia and Herzegovina there are 27 officially registered airports, while only 4 of these (Sarajevo, Banja Luka, Mostar and Tuzla) are registered for international traffic (BiH Ministry of Communications and Transport, 2005). The annual number of passengers is around 450,000 for Sarajevo airport, while for Banja Luka, Mostar and Tuzla have relatively small but continuously increasing numbers of passengers. The airports of Sarajevo, Mostar, Banja Luka and Tuzla were restored during the post-war period. Total donor investment in airport renovation amounted to about EUR 36 million. Air transport and infrastructure have assumed a more significant role than before the war. The four airports registered for international air traffic are at the stage of being brought up to the level prescribed for their

A. ROAD AND URBAN TRANSPORT					
	Quarters				Total
	I	II	II	IV	
GOODS TRANSPORT					
Vehicle-kilometers covered, in thousands	43,751	52,778	56,409	56,453	209,391
Tons of goods transported, in thousands	955	1,273	1,293	1,190	4,711
Metric ton-kilometers, in thousands	351,619	427,838	440,324	428,379	1,648,160
ROAD PASSENGER TRANSPORT					
Vehicle-kilometers covered, in thousands	23,228	24,928	26,536	25,003	99,695
Passengers transported, in thousands	7,740	7,688	8,158	7,769	31,355
Passenger-kilometers, in thousands	441,771	502,280	567,043	527,485	2,038,579
URBAN - SUBURBAN TRANSPORT					
Vehicle-kilometers covered, in thousands	14,473	15,304	14,309	15,374	59,450
Passengers transported, in thousands	42,667	42,594	36,068	44,269	165,598
B. RAILWAY TRANSPORT					
	Quarters				Total
	I	II	II	IV	
GOODS TRANSPORT					
Tons of goods transported, in thousands	2,590	3,319	3,286	3,042	12,237
Metric ton-kilometers, in millions	231	300	288	269	1,088
PASSENGER TRANSPORT					
Passengers transported, in thousands	252	284	293	284	1,113
Passenger-kilometers, in thousands	14	15	17	15	61

Table 1.5.3.2.: Road, urban, railway transport and postal and communication services in BiH, 2007. (Source: Agency for Statistics of BiH, 2008)

categories under ICAO standards. The same applies to flight control. The costs of these upgrades were estimated at around EUR 40 million. The costs of equipment and its installation that are required by the CEATS Agreement were estimated at EUR 14 million, with significant other investments necessary for the development of all four airports (expansion of passenger terminals, cargo terminals, equipment and facilities).

Bosnia and Herzegovina has a very short coastline off Neum and does not have a regulated adequate access to international waters, and therefore does not have regulated sea ports. The international port that is the most important for the BiH economy is the port of Ploče in Croatia, which is closest to Sarajevo and which has developed precisely because of the Bosnia hinterland. This port's capacity is 5 million tons/year (BiH Ministry of Communications and Transport, 2005).

In BiH, the Sava River is the main navigable river, and its 333 km length in BiH is also the border between BiH on one side and Croatia and Serbia on the other. Because the Sava is a tributary of the Danube, water transport along the Sava is linked with the Danube, and the latter is considered as Trans-European Transport Corridor VII. BiH is in this way part of the network of European waterways, and this form of transport is significant for the geo-communications position of BiH. In view of its comparative advantages, water transport should also be provided with development opportunities comparable to those in the EU. There are three BiH ports operating on the Sava: Brčko, Bosanski Brod/Brod and Bosanski Šamac/Šamac. Bosnia and Herzegovina has no seaport, but it uses the Adriatic ports in Croatia, primarily the port of Ploče. For the Sava River to be used, it is essential to regulate the waterway for it to regain its pre-war category IV. In the postwar period, repairs have been carried out on the facilities in the port of Brčko. Only limited funds were invested in the rehabilitation of the Sava River waterway and the Brčko and Bosanski Šamac/Šamac ports. The equipment in the Brčko port has been restored with donor funds.

1.5.4. Agriculture

Farmland covers approximately 2,600,000 ha (around 52%) of that territory and the remaining 2,400,000 ha are woodlands (around 48%). Out of the total Bosnia and Herzegovina territory, amounting to 5,112,879 ha, FBiH takes up 2,607,579 ha, while RS takes up 2,505,300 ha.

On the basis of the population and the breakdown of farmland utilisation (Table 4.5.1), one arrives at the fact that in FBiH there are 0.56 ha of farmland per capita, specifically 0.23 ha of ploughed land and vegetable gardens, while the situation in the RS is somewhat better, i.e. there are 0.90 ha of farmland per capita, or 0.46 ha of ploughed land and vegetable gardens per capita (NEAP, BiH, 2002).

The level of rational utilization of land resources plays a key role, as well as the ownership of the land and the size of the property.

In BiH, over 95% of land is privately owned. In lowland areas, natural conditions are favorable for sustainable agricultural production and a modern market economy. The highest quality soils are to be found in the valleys of the Sava, Una, Sana, Vrbas, Bosna and Drina Rivers. In these valleys it is possible to organize the sustainable production of cereal crops (wheat, barley, soybean, corn), breeding of cattle in barns, large-scale fruit growing (apples, plums, pears), and vegetables, medicinal herbs and industrial plants (Report of BiH for the WSSD, 2002).

In the highlands of Bosnia and Herzegovina, there is less valuable agricultural land. In these areas, it is possible to organize cattle breeding and complementary agricultural production, then healthy human food and animal feed production, barley production for breweries, potato production, etc.

	ha		%	
	FBiH	RS	FBiH	RS
Total area	2,607,579	2,505,300	51.0	49.0
Woodland and bare rocky ground	1,348,783	1,206,681	52.8	47.2
Farmland	1,258,796	1,298,619	49.2	50.8
Ploughed land and vegetable gardens	508,062	671,599	43.1	56.9
Plant crops	461,360	616,548	42.8	57.2
Orchards	41,395	54,358	43.2	56.8
Vineyards	5,307	693	88.5	11.5
Meadows	248,291	236,922	51.2	48.8
Pastures	502,443	358,734	58.3	41.7
Farmland per capital	0.56	0.90		
Ploughed land and vegetable gardens per capita	0.23	0.46		

Table 1.5.4.1.: BiH land utilisation overview (FBiH and RS)

Agricultural lands in the Mediterranean region cover the territory of the southern Dinarides and the lowlands of the Herzegovina region. Karstic fields in this area cover about 170,000 ha. It could be possible to organize intensive greenhouse and open-space agricultural farming, vine-growing, large-scale growing of citrus fruits and vegetables, freshwater fish farming, and bee-keeping.

Over 30% of the sub-Mediterranean area is classified as highland pastures in which small animals could be raised (goats, sheep, cattle). It would be important to intensify agricultural farming in BiH, more so if it is taken into account that the agricultural sector is currently producing less than half the food that the domestic population needs, so that presently the main item on the list of imports is foodstuffs, which account for more than half of the total value of imports.

Erosion and flooding of farmlands in BiH endanger the harvests and sustainable use of soil. Lijevče polje, Semberija and fertile farmlands along Drina, Bosna, Vrbas, Sana, Una, Sava, Neretva and Trbišnjica Rivers are endangered.

1.5.5. Forestry

Bosnia and Herzegovina has a particularly rich biodiversity due to its location in three distinct geological and climatic regions: The Mediterranean region, the Euro Siberian-Bore American region and the Alpine-Nordic region. It is home to a number of endemic species and habitats, and the location of relic centers-refuges of tertiary flora and fauna preserved today under specific paleo-climatic conditions. BiH is one of the countries in Europe with the greatest diversity of species of plants and animals. Vascular flora accounts for about 5,000 confirmed taxa of species, subspecies, and variety and form levels. As much as 30% of the total endemic flora in the Balkans (1,800 species) is contained within the flora of Bosnia and Herzegovina. There are still no reliable data on the number of bacteria, blue-green bacteria or blue-green algae, but they are estimated at more than 2,000 species. Lichen and moss are poorly documented, as are fungi, although it is estimated that there are several thousand fungi. Fauna inventories are more advanced and indicate that the animal kingdom is rich and diverse, particularly in comparison to other countries in the Balkans and in Europe. This rich biodiversity is endangered. Today there are a large number of registered domesticated plants in fruit growing, wine growing, tillage, vegetable growing and horticultural that is only preserved in certain parts of the country. There were previously a number of indigenous breeds of bovine cattle, sheep, goats, horses, donkeys and dogs. These are now decreasing, and some breeds are becoming extinct.

BiH has extremely high level of diversity of biotopes (habitats); i.e. geodiversity. This diversity results from a unique orography, geological surface, hydrology and eco-climate. Given the area of the country and the number of registered geological rarities, Bosnia and Herzegovina is one of the countries with the greatest diversity in Europe and in the world. Even though it is under significant anthropogenic pressure, geodiversity is still locally preserved, and it requires an adequate sustainable management regime. Centuries of coexistence and a broad range of interactivity between biological and geologic diversity are best reflected in the extremely high diversity of landscapes throughout Bosnia and Herzegovina. However, many landscapes are now changed, devasted, or degraded by different anthropogenic activities and transformed into lower forms of ecological organization (NEAP, 2003).

The main species found in BiH forests are fir, spruce, Scotch and European pine, beech, different varieties of oak and a less significant number of noble broadleaves, along with fruit trees.

Forests and forest land occupy a surface area of about 27,100 km^2, or about 53 percent of the territory of BiH: about 22,000 km^2 (approximately 42%) of which are forests and about 5,000 km^2 (approximately 10%) is bare terrain. The annual increment in the forests is relatively low, because so-called economic forests (forests that can be managed on the economic basis) cover only some 13,000 km^2 (approximately 25% of the territory of BiH), and even these have low timber reserves (as low as 216 m^3/ha with an incremental increase of timber of a mere 5.5 m^3/ha, of half of the potential of the habitat). There are about 9,000 km^2 (approximately 17%) of low and degraded forests with very low incremental increase (approx. 1 m^3/ha) and with no economic value from the timber production perspective. Based on this increment, about 7,000,000 m^3 was felled in BiH before the war, and this potential should be the basis for the strategic development of the wood-processing industry. As regards bare forest lands, it should be noted that approximately 1,000 km^2 has been degraded to the extent of being permanently lost to recultivation, while the remaining 4,000 km^2 should be included in the strategy of increasing forested areas through reforestation. It is important to mention that BiH forests mainly regenerate naturally and, as a result, show marked diversity.

Due to activities such as illegal logging, ore mining, construction, forest fires and others, the areas under forest cover have been shrinking rapidly; furthermore, a significant part of the forest cover has been declared as mined (numbers indicate approximately 10%) and has evident damages due to war activities.

In addition, there are extensive unresolved property disputes and illegal land acquisition which are awaiting resolution due to complex legal mechanisms and administration.

In recent years, significant progress has been made in the area of forest certification, where three of the forest management public enterprises have undergone scrutiny of international auditing for the Forest Stewardship Council (FSC) certification, while several others are presently preparing to undergo the same procedure and promote sustainable forest management within their practices. Currently around 50% of state-managed forests in BiH have been certified according to FSC Standards and some have gone further to ISO certification in order to upgrade their operations and demonstrate their commitment to sustainable forest management.

Forestry strategy and its implementation in BiH are defined by the entity laws on forests and forest land and by other accompanying legislation, such as the Law on the Preservation and Exploitation of Cultural, Historical and Natural Heritage, the Law on Physical Planning, the Law on Plant Protection, the Law on Hunting and Fishing, etc.

The legal and institutional framework covering forestry has been structured through two entities. In FBiH there are cantonal forest management companies, which are authorized to manage the forests in their indicated areas, whereas in RS, the forestry management operations are led by a single public enterprise. This decentralization of forest management authority, legal framework (two separate laws on forests), and administration has led to further difficulties in establishing appropriate mechanisms in controlling forest operations, especially illegal logging and land acquisition in bordering areas.

1.5.6. Waste management

Two to three million of tons of solid waste of all kinds are generated annually in BiH, and this waste is mainly deposited at about 1,100 "illegal garbage dumps" due to the insufficient number of proper sanitary waste depots. Such dumping of waste directly threatens the health of the population – both of those living next to these dumps, and inhabitants of the surrounding areas because of the risk those poisonous substances might drain into ground water. The exclusive jurisdiction that municipalities have over utilities represents a huge obstacle for improving the conditions in the waste sector, resulting in an excessive fragmentation of utilities. Insufficient capacities for collection of garbage present numerous problems. No more than 60% of larger urban municipalities provide such services, while the situation is much worse in smaller municipalities. Non-economic prices of waste management services and a low level of payments represent a special problem. A solid waste management strategy in BH has been prepared within the implementation of the World Bank projects, and this strategy is now in the implementation stage. The future policy of the solid waste disposal is hereby defined according to the concept of the regional waste management through inter-municipal waste management organizations and its disposal at the regional sanitary waste disposal sites.

The PRSP Medium-Term Development Strategy envisaged the introduction of 16 sanitary solid waste disposal sites: 10 in FBiH and 6 in RS. The proposed regional solid waste disposal sites in FBiH are for the regions of Bihać, Bugojno, Goražde, Gračanica/Lukavac, Livno, Mostar, Tešanj, Tuzla and Zenica, and those for the RS are Banja Luka, Bijeljina, Doboj/Teslić, Foča/Srbinje, Gacko, Prijedor, and Vlasenica. The suggested sites are not the final locations for regional solid waste disposal sites; these will be selected after a technical and economic analysis is conducted as part of the feasibility studies. The feasibility studies have been completed for regional solid waste disposal sites Banja Luka, Bihać, Mostar, Livno Tešanj, Tuzla, Zenica and Bijeljina and there are the studies planned for, Goražde, Bugojno and other sites.

In this context, it is necessary to:

- complete the feasibility studies on regional waste disposal sites,
- start construction of the remaining regional solid waste disposal sites,
- clear illegal garbage dumps and rehabilitate the degraded areas,
- improve the waste collection and transportation system and open the possibility of involvement to private operators.

1.5.7. Water management

The territory of BiH covers two main river basins: the Sava River basin (38,719 km^2 or 75.7 % of total surface area) and the Adriatic Sea basin (12,410 km^2 or 24.3% of the total surface area). The average annual runoff from the Sava River basin amounts to 722 m^3/s or 62.5%, while the runoff from the Adriatic Sea basin amounts to 433 m^3/s or 37.5 %. The two main river basins are composed of seven main river catchment areas:

- Una, Vrbas, Bosna, Drina and direct catchment area of Sava River belonging to Sava River basin and
- Neretva with Trebišnjica catchment and Cetina catchment area belonging to Adriatic Sea basin.

Bosnia and Herzegovina possesses considerable water resources, and in the future water may become one of the foundations of the general economic development in many areas. However, the damages inflicted during the war, insufficient maintenance and inadequate regulatory framework, have brought water management, just like other sectors of the economy, into a difficult situation. The quality of potable water from the water supply system has been deteriorating steadily, the existing infrastructure is in poor condition, and water resources are increasingly polluted. Sustainable development in the field of water management is possible only with the implementation of the principles of integrated water resources management, by joint problem-solving in the main segments of water management, specifically in exploitation, protection of waters and protection from damaging effects of waters. The intensive development of water resources management in BiH began in the 1950s, when the system of flood control facilities was built alongside the Sava and Neretva Rivers. These consisted of 170 km of dikes along the rivers and 25 pumping stations with a total capacity of 120 m^3/s as a defense against ground water; regulation of 76 km of river beds; strengthening the banks along 55 km; and other measures. In this period, 28 reservoirs were constructed in BiH with the total volume of about 3.6 x 109 m^3 for power generation purposes, flood control, and water supply for households, industry and agriculture. Many water supply and sewage systems were also built, as well as several facilities for urban waste water treatment.

The unfavorable spatial and temporal distribution of water outflows require construction of water management facilities of considerable scale and complexity to permit the rational exploitation of waters,

River basin / Catchment areas	Surface (km2)	Water stream length	Average Flow (m3/s)
Direct catchment area of Sava river	5,506	1,693.2	63
Una	9,130	1,480.7	240
Vrbas	6,386	1.,096.3	132
Bosna	10,457	2,321.9	163
Drina	7,240	1,355.6	124
Sava river basin	38,719	7,947.7	722
Neretva with Trebišnjica	10,110	886.8	402
Cetina	2,300	177.0	31
Adriatic Sea basin	12,410	1,063.8	433
Total: Sava river basin and Adriatic Sea basin	51,229	9,011.5	1,155

Table 1.5.7.1.: Hydrological characteristics of the two river basins in BiH

preservation of water quality and quantity, and protection from the damaging effects of water.

The condition of flood control facilities is very poor as a result of war damage, many years without maintenance, and minefields laid around some facilities. This is particularly true for towns along the Sava River. The consequences of floods resulting from exceptionally high waters in this area, if they were to occur, would be immeasurable. The situation is not much better in other parts of the country, as is evident from the floods in the Tuzla Canton in June 2001. The major damages, estimated at more than KM 60 million, were inflicted on crops, housing and infrastructure, and in the form of the erosion of arable land and the increased incidence of landslides. The problem of flood control in urban areas is also encountered in RS: towns of Banja Luka, Čelinac, Prnjavor, Derventa, Modriča, Janja, Zvornik and elsewhere are exposed, which creates major problems, presents a public danger and causes considerable material damage.

Bosnia and Herzegovina boasts a long tradition (almost a century old) of the existence of state water authorities. These institutions were initiated during the rule of the Austro-Hungarian Empire in the region. Serious development of the water sector began at that time and continued in the Kingdom of Yugoslavia. In the period after the World War II until the early 1990s, the water sector in Bosnia and Herzegovina reached its full swing from an organizational, material, personnel and scientific point of view.

Despite relatively frequent organizational re-structuring in that period, which sometimes slowed down or hindered the development process, it nevertheless continued more or less successfully. It was conditioned, above all, by economic and some social limitations. Regardless of all that, the water sector was considered as an activity, which in many ways was a predecessor of overall development of Bosnia and Herzegovina.[6]

In January 2008 a new Law on Waters took effect. According to this law, new agencies for water catchment areas are established that replace the previous public enterprises. Two agencies are established for FBH: the Agency for Water catchment area for Sava River basin (www.voda.ba); and the Agency for Water Catchment area for the Adriatic Sea (www.jadran.ba). In RS, water agencies have not yet been established, and currently the Republic Directorate for Waters of RS is the responsible body for water management in RS. However, the Directorate for Waters in RS will soon be transformed into two water agencies, one for Sava River basin and another for the Adriatic Sea basin (www.voders.org).

Compliance of regulations of water sector is given through Project for monitoring progress of SEE countries, which was done by a specialized Danish consultancy company. On the basis of this document, it was established that regulations for water sector have been adjusted to the EU regulations to the extent of 65%, whereas secondary legislation has been adjusted to the level of 97%.

[6] At the beginning of the war, in 1992, the water management in Bosnia and Herzegovina was organized through the Republic social fund for water management, the public enterprise ˝Water Management in BiH,˝ and the Institute for Water Management, a research institute. They were all housed in a modern building with almost 300 employees, 70% of whom had university degrees in various fields (mostly in the field of water engineering), five employees had Ph.D degrees, and 14 had Masters of Science degrees.

1.5.8. Health

The main determinants of health are correlated with living conditions, environmental factors, lifestyles and biological factors, such as age, gender and heredity. Thus, for instance, policies in the area of housing, agriculture, education, working conditions, employment, water and sanitation, transport, fiscal regulations and social welfare often have a greater impact on the health of the population than the health care sector. It is, therefore, essential to stress the importance of inter-sectoral cooperation in the protection of a population's health, which, in accordance with the Ottawa Declaration, should be based on five areas of intervention: the creation of sound public policies, the creation of a sustainable environment, the strengthening of community action, the development of personal skills in public health, and a reorientation of health services. The relationship between economic development and health can be described using two terms: "the economy of health" and "the health of the economy." The "economy of health" perspective is focused on the effects of poor health and early death on economic development, and on the loss of productivity. Many countries are concerned about the financial cost of health services and social security schemes rather than about the overall cost of illness and early death for the society and for individuals. "The health of economic strategies" focuses on the health effects of various economic policies. The main criterion for the assessment of health effects of economic policies is their impact on vulnerable groups. Social deprivation, together with economic inequalities and housing conditions, results in a shorter life expectancy, and a higher rate of infant mortality in lower social classes. Unemployment will pose a major problem in BH in the future. Serious academic studies have shown that long-term unemployment can be considered as a health hazard per se, regardless of whether it results in poverty-related diseases or, rather, in well-developed social security systems in psychosocial diseases (cardiovascular diseases and mental problems). A sound employment policy implies an initiative of selective job creation for those at highest risk of consequences of unemployment, as well as an adequate financial support system. Together with disturbed social and economic determinants of health, or without them, unemployment often results in the choice of an unhealthy lifestyle by a large number of people, in particular in poorer segments of the population. Hence the evident increase in smoking, consumption of alcohol and narcotics, unhealthy diets and insufficient physical activity, which consequently results in the mass occurrence of chronic non-contagious diseases. The lack of affordability of health care services for the poor is a frequent reason for them to postpone requesting health care, until the point where the symptoms of the disease are already well advanced and where the treatment is more expensive.

Health care public expenditure accounts for 7.6% of GDP. However, if one takes into consideration that the private health care sector and the so-called informal sector ("under the table," out-of-pocket payments by the general public for public health care services) together account for a further 4.7% of GDP, total health care expenditure in B&H amounts to 12.3 percent of GDP, which is very high for a poor country like BH. Per capita health care spending in 1999 was about KM 100 in RS and KM 218 in FBH. More than a third of total resources - 37% - goes to primary health care, 35% to secondary and 18% to tertiary health care.

The state of health of the population of BiH has been deteriorating steadily since the war. The reasons are those already noted: socio-economic circumstances, unemployment, migration, the large number of displaced persons, lack of health insurance, unhealthy lifestyles, etc. As many as 22% of the BH population aged over 17 report intermittent constraints on their daily activities as a result of health problems; 24% have chronic ailments; and 4% suffer from serious ailments. In addition, there has been a marked deterioration in population health as a result of long-term stress – post-traumatic stress disorder (PTSD). Despite the fact that the war had a direct impact on the state of health of the population, age expectancy in 2000 was between 71 and 75, the same as in 1990. Immunization against TBC, diphtheria, tetanus, whooping cough, polio and measles was fairly high, at 95 percent, somewhat lower than the 1991 level of 98 percent. In 1991, BiH was one of the countries with relatively low rates of infant mortality at 7.5 per thousand, under age 1. (Average for Central and Eastern Europe was 17.5 per thousand, and the European average was 7.5 per thousand). Since the war, as a result of different reporting methods, there have been major differences in infant mortality rates between the cantons and regions, so the 1998 figure of 11.7 per thousand should be regarded with caution. As regards stillborn rates, compared with Western Europe the figures here are doubly worrying. The rate of infant mortality is one of the reliable indicators for the effectiveness of health care. The pre-war rate in BiH was 10.7 per thousand. Although no data have been published for the post-war period, estimates are that the rate of infant mortality has risen.

Almost half the male population over the age of 17 smokes and the trend is similar among adult women, 22% of whom smoke (BiH: Poverty Assessment, World Bank, March 2003). On the World Health Scale (WHO Report, 2000), which indicates a country's overall achievements in health improvement, BiH occupies 79th place. The list of leading causes of death in BiH now is almost identical with the pre-war list, and indeed with the leading causes of death in the majority of European countries. In 1991 the leading cause of death and loss of years resulting from disability (DALY- Disabillity Adjusted Life Years) was cardiovascular disorders (50%), such as hypertension and coronary ischemic disease. Malignant neoplasms were in second place (18%); their number has been rising over recent decades. In the third place were symptoms and other undefined conditions. Injuries and poisoning are also on the rise, and are now the fourth most common specific causes of death. The three most common communicable diseases in BH are respiratory ailments (influenza), childhood infectious diseases (varicella), and bowel diseases (enterocolitis).

Road accidents, physical disabilities, and mental ailments are also a major problem for public health care. Available data indicate that more than 47,000 people were disabled by the war. The number of people injured in road accidents in 1991 was 243/100,000; estimates are that the incidence of such injuries is rising sharply. The risk of injuries from landmines, and other unexploded ordnances remaining around the country in the aftermath of the war, is another important public health issue. According to ICRC data, 4,798 persons have suffered injuries from landmines and unexploded ordnances since the end of the war.

The population of BiH is faced with significant health problems and behaviors that lead to health problems (smoking, alcohol consumption, and drug abuse), anti-social behavior and violence, depression, suicide and other instances in a wide range of different physical and mental disorders. Risk factors to which the BiH population is exposed, such as smoking, high blood pressure, high blood sugar levels, high levels of blood cholesterol and other fats, physical inactivity, the risk of sexually transmitted diseases (HIV), etc., which have an impact on the health both of individuals and of the society as a whole, are markedly on the rise. Unhealthy eating habits and poor water quality also have an adverse impact on the state of health of the population, and since these features have remained practically unchanged for many years, the crisis continues, with adverse health factors coming to overshadow positive developments.

Under the BiH Constitution, the organization and management of the health care system in BiH are decentralized to the level of the entities and Brčko District. In FBiH, the health care system is subject to a shared responsibility of the health authorities in the Federation and the cantons. In accordance with the FBiH Constitution, we have opted for health care to be organized in the canton but coordinated by the Federation government. This option best suits the actual situation in the Federation and allows the possibility to build a decentralized health system, in line with the experience of developed health systems in the world. This, further, offers the possibility to create an economic and efficient health care sector, where the system, by ceding part of the responsibility for health to individuals, or families, and to local communities, mobilizes the resources that have not been tapped so far. At the same time, this option avoids the danger of a fragmentation of the system, which would have occurred had we chosen the health responsibility in the cantons to be exercised separately. Although decentralization is one of the fundamental components of the process of reforming the health care system, decision-making in FBiH must not be decentralized in the following areas: the basic health policy framework; strategic decisions in health resources development; the regulation of public safety with regard to contagious diseases; the monitoring, assessment and analysis of the health of the population and health care provision. For the effective functioning of a decentralized system, it is necessary to ensure a sufficient level of development of health management knowledge and skills at the level of cantons/regions. In building a decentralized health system in BiH, responsibility for the health of the population must be clearly divided between the state, entities, District, cantons and municipalities. The process of decentralization of the health care sector in the RS is particularly pronounced in the area of transfer of responsibility for the operation of health centres to the municipal level. The political commitment of Bosnia and Herzegovina is to establish "an uncompetitive region-based system of social health insurance." Social health insurance implies a non-profit and public insurance system established by law and functioning under the auspices of the parliament and government. This system is not funded through general taxation, but through health insurance contributions. An uncompetitive system means the absence of competition among different social health insurance funds. Region-based means that several funds exist; i.e. one in each region. Citizens do not have the possibility to freely choose a health insurance fund, or the possibility to opt out of insurance, which is mandatory for all citizens. The systemic health laws proclaim the principle of universal health insurance coverage for the population. The FBH health insurance law allows the possibility of two or several cantonal funds merging into one, if this is conditioned by the need for broader solidarity or reduced administrative costs.

1.5.9. Education

The right to education is a fundamental human right that allows underprivileged children and adults to rise above the poverty level. It is important to note that exercising the right to education lays a strong foundation for the exercise of other civil, cultural, political, economic and social rights. Education benefits the society as a whole, as well as individuals. The right to education is built into the Constitution of Bosnia and Herzegovina, which states that "The rights and freedoms set forth in the European Convention for the Protection of Human Rights and Fundamental Freedoms and its Protocols shall apply directly to Bosnia and Herzegovina. These shall take priority over all other laws." All persons within the territory of Bosnia and Herzegovina shall enjoy human rights and fundamental freedoms, including the right to education."

In 2003, there were approximately 606,000 students in Bosnia and Herzegovina. Around 367,000 attended 1,836 primary schools, and around 172,000 students attended 295 secondary schools. There are seven public universities with 95 schools and 67,000 full time students. In addition, there are numerous private universities.

Education in BiH is covered by legislation at various levels in the FBiH and RS. In the RS all education levels are covered by Entity level legislation. There are separate laws for each of the above four levels of education. In the FBiH, education is regulated by legislation at the cantonal level. Each of the ten cantons has its own law on pre-school, primary and secondary education, and the cantons that have universities also have laws on higher education. The Brčko District, as a separate organizational unit in BiH, has its own laws covering each of the four levels of education. Therefore, there are more than thirty laws at different levels regulating this area.

In the RS, the Ministry of Education and Culture is responsible for monitoring, planning and executing policy. In the FBiH, this role belongs to the cantonal ministries of education and the Ministry of Education and Science at the entity level. The Ministry of Education and Science acts mainly as a coordinating body for education policy among the cantonal institutions. The Agency for Standards and Evaluation for General Education at the inter-entity level, and the Coordinating Committee for Higher Education, should facilitate the required formulation of a coherent education policy framework. The rules and regulations for planning the funding of primary and secondary education are similar in FBiH and RS and are based on the principles of public funding.

1.6. Poverty reduction strategy

During its time as one of the federal units of former Yugoslavia, the Republic of Bosnia and Herzegovina was defined in strategic development plans as a source of raw materials and energy for the country's economic development. It was also an area where heavy industry and the defense industry were developed. Its relatively high hydropower and thermo-electric power potential and large reserves of coal and mineral ores produced more than half of Yugoslavia's coal, 70% of its iron, aluminum, lead and zinc ores and metals, and almost 50% of its electric power. Much of the chemical industry of former Yugoslavia (nitrogen- and chlorine-based) was also located in BiH. Intensive exploitation of natural resources was the policy at the time, while much of the machinery was obsolete and heavily-polluting, with devastating consequences for the environment. These developments were accompanied by state-imposed prices for raw materials and energy, all of which made it impossible to establish and maintain a balance between economic development and environmental protection – in other words, the sustainable development of BiH.

Despite the difficult situation caused by the war, BiH has succeeded in joining the process of developing a concept of sustainable development on environmental principles through a number of regional international programmes initiated since 1997. The most important of these are the European Union's PHARE and CARDS programmes, and the World Bank projects – the National Environment Action Plan (NEAP) for BiH and the Strategy for Solid Waste Management in BiH – as well as the Regional Environment Reconstruction Programme for South Eastern Europe (REReP, a Stability Pact programme), as well as other regional programmes, such as the Mediterranean and Danube basin plans under the auspices of the Mediterranean Action Plan (MAP), and the International Commission of Protection of the Danube River (ICPDR) and the Danube-Black Sea (DABLAS) programmes under the auspices of the Danube Convention and the Black Sea Convention.

The significance of the environment protection is also highlighted in the EU Feasibility Study, which foresees that, within the framework of work on the Stabilization and Accession Agreement, the cooperation between BiH and the EU can further expand to prevention of the environment degradation, air and water quality monitoring, monitoring of the pollution and promotion of the economical use of energy and the industrial safety. The classification and safe handling of chemical compounds, regional planning, and waste management, as well as the protection of forests, animals and herbs are also issues due to receive attention in the efforts to strengthen environmental protection.

Recognizing that the protection of the environment is an inter-sectoral problem and interdisciplinary by nature, BiH began to invest more effort into the development of basic legislation and programmatic documents for the environment consistent with global trends after the end of the war.

1.7. Challenges of long term development

The preparation of the PRSP, or the BiH Medium-Term Development Strategy, started in April 2002 and lasted approximately eighteen months. The BiH Council of Ministers and the Governments of FBiH and RS adopted the final version of the Strategy. The BiH Presidency also extended its support to the final version of the strategy, while the BiH Parliament emphasized its support for implementation phase and requested that the BiH Council of Ministers submit a progress report on the implementation of the PRSP every six months. Government structures at all levels led the preparation of the PRSP. The Coordination Board was in charge of defining the final priorities on the basis of the debates conducted and of the results of the activities of the working groups. The definition priority proposals and of the strategy itself was the task of 20 working groups composed of the representatives of the Council of Ministers, the entity governments, and the lower levels of government (Brčko District, cantons, municipalities). The working groups covered the following sectors: macroeconomic and fiscal framework, business environment, privatization, financial sector, labor market, the combat against corruption, foreign trade regime, public administration reform, statistics, education, social protection, health care, agriculture, forestry, water management, environment, infrastructure, energy, information technologies, mine action and industry. In view of the necessity of securing additional donor funds for the implementation of the PRSP, representatives of donors and international organizations were consulted during the preparation of the document. It is, however, pertinent to note that the representatives of international organizations took no part in the work of the working groups. It is important to note that only local scholars and experts were involved and that the strategy was the product of domestic institutions and domestic expertise.

The UNDP-sponsored National Human Development Report (NHDR) on Millennium Development Goals, which was published in June 2003, was designed to devise a relevant and realistic set of MDGs for BiH. The NHDR process involved reflecting local needs and priorities, but also fitting them within a globally-defined framework. On the whole, the authors retained the global goals, recognizing where necessary the particularities of the BiH context and the need to sharpen the rather generic nature of the MDGs. In addition, they took account of the tendency for official statistics to provide an overly optimistic and perhaps misleading picture of the country at times.

The development of the national MDGs was undertaken alongside colleagues within the BiH governments and was accompanied by an on-going consultation exercise with civil society partners. It is fitting that this approach is in keeping with the hallmarks of good governance: transparency, accountability, inclusiveness and responsiveness; as securing improvements in the quality of governance lies at the heart of BiH's future development. As a result of the consultations, three priority areas emerged; poverty reduction, gender equality, and the need for continuing and constructive cooperation with international partners. The PRSP provided a medium-term policy programme for BiH (to 2007), while the MDGs were longer term (through 2015). The vast majority of the MDG indicators, which were defined within the 2003 NHDR were incorporated into the PRSP, and thus became part of the official BiH government policy monitoring framework.

Bosnia and Herzegovina's future lies with its full integration into the European mainstream, and this integration directly implies close cooperation, followed by membership in the EU. European integration requires a series of policy and legislative changes associated with adopting the Union's treaties and conventions, which are known as the Acquis Communautaire. This is a vast body of law, and much work will be required to make BiH's legal provisions and technical standards compliant with current EU practice. This agenda is mapped out by the PRSP and is a major focus of the action plan incorporated within it. Moreover, it is likely that the accession reforms, particularly those in the economic sphere, will be difficult to accomplish and will potentially have considerable social fallout. The MDGs therefore have two roles to play; first, they afford a broader perspective by which to measure reform, bringing in social and environmental considerations; and second, they offer a vehicle by which the public can be engaged and their support retained. The MDGs offer a holistic framework for guiding BiH's long-term development on a path to becoming a prosperous and sovereign European democracy. In the above sections, this report has built on the preceding 2003 NHDR to improve and further tailor the monitoring and evaluation framework. This has included:

- Reviewing and refining the targets and indicators, improving their quality and better fitting them to the local context and the objective of meeting European standards.
- Specifying, as objectively as possible, which data sets are performance targets to be achieved, from those data indicators to be collected for analysis and diagnosis purposes.
- Dovetailing the targets with those specified within the PRSP and the EU Social Inclusion Framework. Achievement of the MDGs will require substantial policy changes and resource inputs.

Various authoritative studies have shown that BiH is facing serious weaknesses in the field of environmental management and regulation. These include:

- Weak environmental policy and legislation, especially at the state level.
- Insufficient technical capacity, which is weakened still further by the division, poor delineation, and hence duplication, of responsibilities between entities and cantons.
- An absence of public participation in the decision-making process.
- Inadequate monitoring and a lack of the equipment necessary to support monitoring activities
- No effective economic incentives (taxes, fees and charges) to promote compliance with environmental objectives (in keeping with the 'polluter pays' principle);
- Personnel issues such as an insufficient level of training and lack of expertise, poor management, and a lack of staff and funding; and
- Low political interest in environmental problems, as well as a lack of general information in the public domain.

In general, the development of legislation has been a very slow process, and this has delayed the establishment of an effective regulatory framework. Underpinning these delays is the low political priority attached to the environment and a lack of expertise and capacity within official circles. The weaknesses of the existing legislation, especially detailed bylaws and regulations, are compounded by insufficient capacity of those agencies charged with protecting the environment.

Environmental protection suffers from the same institutional sclerosis suffered by other regulatory functions in BiH. The Ministry of Foreign Affairs of BiH is responsible for negotiating the many environmental treaties applicable to BiH, whereas it is the Ministry of Foreign Trade and Economic Relations that is charged with implementing environmental programmes related to those treaties. The Ministry of European Integration of BiH, transformed in early 2003 into a directorate, has overseen environmental projects covered by the Stability Pact, while at the same time, the Ministry of Civil Affairs and Communications is responsible for formulating environmental legislation at the state level. This division among ministries is a recipe for failure. Fragmentation and duplication in policy-making extends down to the entity level. The necessary institutions are being established gradually. These include the Steering Board for Sustainable Development and Environment and the proposed environmental protection agency. Since joining the Global Environment Facility (GEF) in October 2001, BiH was obliged to establish a body to coordinate and manage GEF programmes and implement international environmental treaties. Consultations regarding the creation of such an organization in BiH took place throughout 2002. It was decided that the focal point for GEF in BiH would be the Ministry of Foreign Trade and Economic Relations. The next step was the establishment of the National Board for GEF and focal points for ozone, water protection, climate change, and bio-diversity in early 2003. The NHDR detailed a number of recommendations for the improvement of environmental protection in BiH. Among these recommendations, the following were ranked as priorities:

- Creation of a functioning environmental protection agency at the state level
- Development of by-laws and regulations to give practical effect to the law
- A unified, state-level land use policy to be adopted with mechanisms to regulate the real estate market, including property taxation issues.

The pressure for reform in these areas will strengthen as accession looms, and national laws will have to be made consistent with the EU acquis. Yet setting policy targets and benchmarks for BiH requires careful consideration. The conflict and its aftermath devastated industrial capacity and severely depressed domestic consumption and investment. Therefore, the NHDR targets were framed with the objective of preserving BiH's natural wilderness while permitting its economic revitalization and explicitly recognizing that current levels of energy consumption are unrealistic.

2. CALCULATION OF GREENHOUSE GAS EMISSIONS

2.1. Introduction

The calculation of greenhouse gas emissions is one of the essential steps in systematically reviewing and addressing problems related to climate change. Air pollutant emissions, including both greenhouse gases and other pollutants, were estimated in Bosnia and Herzegovina even prior to the preparation of this report. Although sporadic estimations used to be carried out before, regular annual reports on calculation of emissions of certain air pollutants are now within the purview of the relevant line ministries. The relevant environmental laws for FBiH, RS, and BD, provide for the preparation of the inventory of greenhouse gases (GHG) emissions; however, this inventory has not been compiled yet.

The methodology used here (i.e. the methodology that the calculations relied upon) was the European CORINAIR methodology. The Hydrometeorological Institute of FBiH, which made these calculations, has wide experience in both the application of this methodology and the preparation of emission estimates in general. The knowledge acquired, positive practice and data collected formed a solid basis for the estimation of greenhouse emissions in this report.

For the purposes of calculating emissions in this communication, the team used both the Intergovernmental Panel on Climate Change (IPCC) methodology laid out in the Convention, based on the reference manual Revised IPCC 1996 Guidelines for National GHG Inventories and Good Practice Guidance and Uncertainty Management in National GHG Inventories and the CORINAIR methodology, with its predominant use of the recommended IPCC emission factors, except in the energy sector where local emission factors were also used.

The IPCC methodology and approach ensure the transparency, completeness, consistency, comparability and accuracy of calculations. The methodology requires the estimation of uncertainty of calculations and the verification of inputs and results in order to enhance the quality, accuracy and reliability of the calculations. Also, one of the internal verifications of calculations within the methodology is the calculation of CO_2 emissions from fuel combustion in two different ways: the more detailed Sectoral Approach and the simpler Reference Approach.

2.2. Data collection and processing system

The analysis of results obtained from questionnaire feedback, as well as of the past reports on the activities of BiH regarding implementation of the UNFCCC and the existing knowledge in this field provided the indicators that are shown in detail in the following part of the Communication. Since Bosnia and Herzegovina is a signatory to the Kyoto Protocol, the focus will be on the assessment of the country's capacities for preparation of the national inventory of GHG emissions and implementation of commitments under Article 4 (commitments) and Article 12 (communication of information related to implementation) of the UNFCCC.

While some institutions do have certain experience in preparing inventories, these data cannot be considered official or sufficient for fulfilling BiH's commitments as a party to the UNFCCC. These experiences will be dealt with in more detail further in the analysis below.

It should be noted that no institution at the level of Bosnia and Herzegovina is responsible for gathering specific "activity data" needed for the estimation of the inventory of emissions according to UNFCCC. Bosnia and Herzegovina is composed of two entities - FBiH and RS - plus Brčko District, and these activities are conducted at the entity level. So far, there has been no quality cooperation in this field.

However, for preparation of this communication, UNDP Bosnia and Herzegovina hired experts from both entities in a public tender. They jointly participated in the development of individual emissions assessments by sector. This chapter represents a synthesis of individual reports drawn up by working groups using a database on emission factors and written information on the combustion of fossil fuels in BiH for 1990. This information was made available by the Hydrometeorological Institute of FBiH, as well as other available statistical data and relevant information in this field. Also, within the preparation of this report, the Hydrometeorological Institute of RS, experts from the RS Electrical Supply Company, and experts from the

"CETEOR" company gathered part of data on fossil fuels combustion and industrial processes, as well as performing the calculation of GHG emissions in accordance with IPCC methodology in the sector of energy and industrial processes.

Although both the Agency for Statistics of BiH and the entity-level statistical institutes are operational, currently they have only a very small portion of the data needed for the estimation of the emission inventory. Large energy production facilities, mainly thermal power plants, keep records on data about fossil fuel consumption. Some thermal power plants also have emission monitoring systems, but the maintenance of these systems is irregular, and these data may be only used to verify emissions calculations.

Power utility companies in both entities certainly have the data on the consumption of fossil fuels in thermal power plants and these data may be considered reliable. In addition, larger energy and heating plants in towns have activity data.

Emissions or activity data from mobile sources may be obtained through the entity-level statistical institutes. Determining the type and age of individual categories of mobile sources and annual fuel consumption must be estimated, but that is not a serious problem.

However, problems arise when data on total annual consumption of liquid fuels are needed, whether at the entity or state level. These records are very poor because the differences in calculations regarding the consumption data for the post-war period are not comparable. The problem is due to the failure to log all liquid fuels that are imported into BiH across border crossings and which are consequently not shown in statistical reports.

A bigger problem is posed by the activity data for industrial processes, as these data are inadequately presented in publications and official documents. In the post-war period, the industry in Bosnia and Herzegovina has been operating at a limited capacity, which is for the most part a consequence of wartime destruction of industrial facilities and partly a result of the failure to restore production in the existing yet technologically obsolete facilities.

The same problem is encountered with the activity data for agriculture, land use change and forestry (LUCF), and waste. There is no clear delineation of responsibilities of institutions in charge of data collection. Although it is stated that each sector is covered by several institutions, it is not clear what the responsibilities of each institution are and how much data they need to collect. The problem lies in the fact that there are no clear instructions at the entity level for reporting on the activity data.

Another problem is certainly the insufficient knowledge of the corresponding entity authorities and of the majority institutions about the commitments under UNFCCC and Kyoto Protocol. Significant changes are expected in this regard in view of the fact that the laws adopted include commitments on reporting, inventory preparation and collecting activity data.

To sum up:

- there is no institution legally responsible for data gathering,
- incompatibility between the existing data and those required under the IPCC methodology,
- lack of adequate equipment for data gathering,
- some data are missing,
- there is a lack of legislative regulations on the type and scope of the required data to gather,
- there is a need for education related to the treaty commitments.

The Hydrometeorological Institute of FBiH has some experience in collecting activity data, in particular data regarding energy, industrial processes and - to some extent - agriculture. Unfortunately, the data collected by the institute are for the pre-war period (until 1991). Activity data was also gathered on an annual basis for most energy-producing and industrial facilities (over 150) during the period from 1981 to 1991. The data had been collected methodically, as the Institute's trained staff generally went to the facilities directly and filled in the pre-designed questionnaires on location together with the responsible persons in energy production and industry. These data were archived as well as amended data of the aforementioned experts and institutions during the preparation of this communication, and they will definitely be helpful in obtaining reliable data on GHG emissions for baseline year 1990.

CORINAIR methodology and COLLECTER II, REPORTER II and COPERT III software have been used to archive the data in digital form, and these data are kept in the institute, whereas part of the database for RS is also in the RS Hydrometeorological Institute. Long experience in working with this methodology is very valuable and will certainly be useful in further work on the development of subsequent national communications under the UNFCCC.

2.2.1. Calculating emission factors

Calculating emission factors (EFs) is one of the main requirements for preparing a good inventory of GHG emissions.

The CORINAIR methodology, together with the latest software that the Hydrometeorological Institute of FBiH uses, enables a synoptic inventory of emissions not only for the purposes of the LRTAP convention, but also for the purposes of UNFCCC and IPCC. It is known that the new software offers the possibility of obtaining the necessary tabular formats in the common reporting format (CRF) very quickly.

In the coming period the problem will be the gathering of data and estimation of GHG emissions for the four wartime years, but the process will not be any less complicated for the post-war years, either.

Company CETEOR, RS Hydrometeorological Institute and to a certain extent the Faculty of Mechanical Engineering in Banja Luka, also have some experience in estimating emissions and emission factors (EF).

The Hydrometeorological Institute of FBiH calculated the majority of EFs for combustion in energy-producing facilities in the energy sector. Bosnia and Herzegovina has 12 types of coal with varying contents of sulphur, carbon and calorific values. Emission factors have been calculated for all 12 types.

As far as industrial processes are concerned, there are no solid measurement data. Consequently, it is suggested to use the factors recommended in IPCC guidelines and instructions.

As regards agriculture, default emission factors stated in the IPCC guidelines are sufficient.

LUCF and waste are more problematic due to the absence of real inputs needed for calculation, thus the recommended IPCC methodology will be used.

2.2.2. Reporting

In terms of Article 12 of the UNFCCC, the responsibility for reporting rests with the Ministry of Physical Planning, Civil Engineering and Ecology of RS in its capacity as the National Focal Point under this Convention, pursuant to the decisions of the competent BH authorities and standard procedure on adoption of national reports of BiH required under this Convention.

In the Entities the responsibility for reporting rests with the relevant line ministries in charge of environmental issues and in FBiH, additionally, with the relevant cantonal ministries in charge of environmental issues.

The complicated process of preparing the GHG emissions inventory in Bosnia and Herzegovina will certainly pose a problem. A plausible solution to this problem would entail establishment of the Agency for environmental protection at the state level which would closely cooperate with the relevant Entity ministries and the Brčko District, that is, with entity institutions which have gained certain experience through preparation of this Report. Some steps towards establishment of the Agency have already been made, but the harmonisation process will probably take longer.

Major difficulties in Bosnia and Herzegovina are:

- Lack of permanent funding sources ,
- Lack of relevant implementing regulations for implementation of the data gathering commitment,
- Lack of activity data needed for reporting to IPCC and implementing commitments under UNFCCC,
- Lack of personnel with the experience needed for preparation of data in industry, agriculture and LUCF,
- Lack of appropriate equipment,
- Lack of administrative capacities for preparation of high-quality subordinate legislation on the gathering of activity data,
- Bosnia and Herzegovina, as a developing country, is faced with a lot of problems in transition processes and combat against poverty,
- There is a need for financial resources, expert assistance in the development of institutions and the national system for preparation of the inventory, quality control and reporting;
- There are some experiences, but it is not sufficient to allow us to implement, independently and without expert assistance, commitments under UNFCCC and in accordance with the IPCC methodology.

2.2.3. Quality control (QC) and quality assurance (QA)

UNFCCC and IPCC recommendations emphasis the data quality control (QC). This is, in fact, a system of certain technical activities, estimations and quality control of the emission inventory. QC includes careful verification of the accuracy of collected data, emission factors and uncertainty estimation.

Quality Assurance (QA) activities include a planned system of review procedures conducted by personnel not directly involved in the inventory development process.

UNFCCC recommends that the inventory of emissions should be reviewed by an independent team of experts.

Bosnia and Herzegovina as an economy in transition will avail itself, in accordance with the decisions of the Convention bodies, of the possibility of inventory review by a group of international experts formed for that purpose by the UNFCCC Secretariat.

Uncertainty estimations regarding the inventory represent a crucial QC issue. It is impossible to give valid answers to these questions, only to state that some experience has been gained in working on the establishment of the emission inventory in accordance with the CORINAIR methodology.

Unfortunately, this is certainly not sufficient for full implementation of QA/QC in Bosnia and Herzegovina. It is expected that implementation of regulations concerning the preparation of the emission inventory, including the GHG emission inventory, will regulate this issue in more detail.

- It is expected that the quality of "activity data" will be the main problem in quality assurance.
- In order to properly address this issue, financial and expert assistance will be needed, as well as the permanent training of all the personnel participating in data collection, emission estimation, calculating emission factors, etc.

Potential actions at the state level of Bosnia and Herzegovina and the Entity level include:

- Inclusion of specific greenhouse gases in the data collection system;
- Increase in the number of personnel and the amount of financial resources for collection of basic data and emission data;
- Ensuring regular publication of national emission statistics;
- Delineation of institutional responsibility for systematic compilation of national GHG emission inventories;
- Expansion of financial resources for the training of personnel, calculating emissions and of emission factors, research and projections of national GHG emissions, establishment and implementation of national GHG emission inventory review system by an independent team of experts, and improvement of the quality of data archiving;
- Continued investment in hardware and training of personnel for data collection, measurements and management with the aim of improving the quality of data on emissions associated with natural gases, waste and industrial processes;
- Issuing authorisations for creation of individual emission databases in relevant institutions;
- Construction of a website for the national greenhouse gases inventory;
- Increased public awareness of problems associated with the protection of climate and potential consequences of climate change.

Bosnia and Herzegovina may benefit from international support with regard to the following:

- Preparation and implementation of the National Climate Action Plan;
- Expert assistance in introduction and utilisation of best methodological practices (e.g. for emission factors, uncertainty estimation, review, quality control procedures, etc.);
- Financial support for procurement of the necessary equipment (hardware and software) for data collection, processing, archiving and web presentation;
- Financial assistance for the training of personnel as part of the training programmes of the Intergovernmental Panel on Climate Change and other international organisations concerning national GHG emission inventories:
- Financial support for the drafting of implementing regulations and methodologies in the field of environmental statistics, emission inventories, compilation of national emission inventories, introduction of data quality control system, reporting, permanent storage, protection and confidentiality of data, etc.
- Financial support for implementation of programmes aimed at raising awareness on global warming of the atmosphere due to the increase of anthropogenic GHG emissions and potential consequences of climate change.

2.3. Methodology

2.3.1. Inventory preparation process

The 1990 BiH inventory of greenhouse gases has been compiled in line with the inventory preparation recommendations - UNFCCC Reporting Guidelines as per Decisions 3/CP.5 and 17/CP.8, including the common reporting format (CRF) and Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, which specify the reporting obligations pursuant to Articles 4 and 12 of UNFCCC (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories).

2.3.2. CORINAIR system

The inventory is based on the CORINAIR (CORe INventory of AIR emissions) system created by ETC/AE (the European Topic Centre on Air Emission).

As many other European countries, BiH uses this calculation method for quantifying emissions.

The CORINAIR system is designed for the collection of emission data and national reporting on air emissions to the European Environment Agency (EEA) using a uniform format.

This common Europe-wide database can be used for preparing certain inventories in line with the UNECE/CLARTAP and UNFCCC guidelines. A brief description of the AE-DEM software package is given below.

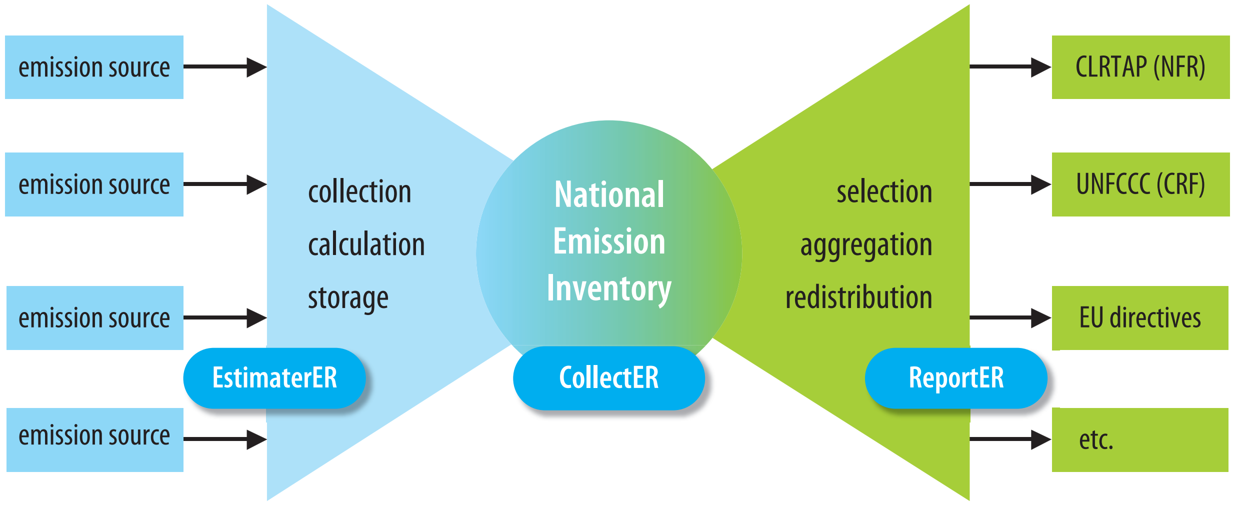


Figure 2.3.2.1.: National Emission inventory

AE-DEM software package was designed to facilitate:

- estimation of sectorial emissions (EstimatER),
- preparation of national or sub-national emission inventories (CollectER), and
- preparation of Reports (ReportER) in appropriate format.

The aim is to collect, maintain, track and publish air emission data for the purpose of the European emission inventory and database system. This includes air emission from all sources relevant for environmental problems, climate change, acidification, eutrophication, tropospheric ozone, air quality and dispersion of hazardous substances.

Because CORINAR is source-oriented, there is a clear distinction between the point source and surface source. Point sources are large stationary emission sources releasing pollutants into the atmosphere.

Categorisation of combustion facilities in Bosnia and Herzegovina is based only on the power output of the facility and does not include the classification into large, medium-sized and small, or point and surface sources. In line with this classification, reporting and measurement obligations can be summed up as: furnaces with power output over 50 kW.

Facilities or activities whose individual small emission amounts are not sufficient to be classified into point sources are added up together to make up a surface source. Together they can contribute significantly to total emissions. Emission factors are used for estimating emissions from surface sources. Information on the used emission factors have been given in the reports appended hereto.

2.3.3. SNAP and SPLIT codes

Similar to the IPCC categories, the CORINAIR system has its own nomenclature called SNAP (Selected Nomenclature for sources of Air Pollution). It is designed for estimating emissions of all types of pollutants. Specifications of the SNAP categories should be regularly revised given the new reporting requirements; old versions of SNAP codes are SNAP 90 and SNAP 94.

BiH used the latest version; SNAP 97, which has three levels:

- Level 1: 11 main categories numbered from 01 to 11.
- Level 2: 76 sub-categories of Level 1. Examples: 01 01, 11 25.
- Level 3: 414 sub-categories of Level 2. Examples: 01 01 01, 02 02 05.

The SNAP categories may be expanded with the so-called SPLIT codes consisting of three digits.

2.3.4. Fuel codes

Fuel codes allow additional expansion of the SNAP code and are defined as four-digit codes. Three of these digits are based on the NAPFUEL code. Each activity is determined by means of a combination of SNAP, SPLIT and fuel codes. Each activity has an IPCC code used for transformation of the SNAP system into CRF.

2.3.5. General methods in use

If the reporting is on emission data (e.g. by the owner of the facility), they are a basis for the inventory and emission amounts obtained. This method is mainly used for large point sources.

If this information is not available, an emission factor will be multiplied by the activity data needed for calculation of emissions from a specific source. This method is mainly used for surface sources.

For preparation of GHG inventory, preferred emission data are those reported by the source operator because these data usually reflect the actual emissions better than the calculations (the operator knows the best the circumstances in which the plant operates). If these data are not available, the calculated emission factors are used for emission estimation, or, if there are no calculated emission factors, than the international ones (IPCC or CORINAIR) are used. The most accurate method for preparation of GHG inventory should be used for key sources.

The BiH emission inventory uses EMEP/CORINAIR calculation method for quantification of emissions and the results are presented in the CollectER database. Each database stores one-year series of data and can be read by means of the CollectER II or COLLECTER III software. The databases also include information on other pollutants in line with the obligations under the UNECE/LRTAP Conventions.

BiH emissions should be converted into the UNFCCC common reporting format using the standard CORINAIR procedures for the purpose of harmonisation with the reporting obligation under UNFCCC and in order to ensure the comparability of data. For each SNAP in CORINAIR there is a corresponding source category.

The calculation of emissions from transport has been performed and processed in the COPERT III software and imported into the REPORTER software.

For preparation of this emission inventory, emissions have been calculated using IPCC software in parallel for the energy sectors (Reference Approach), LUCF and agriculture with clear and strict utilisation of the recommended IPCC emission factors. IPCC emission factors related to annual production have only be used for calculation of emissions from the industry sector.

Specific factors for Bosnia and Herzegovina have been calculated and used for calculation of emissions from the energy sector (combustion of fossil fuels-coal -(Sectorial Approach)), in line with the CORINAIR methodology, which is also in accordance with the UNFCCC recommendations given in Decision 17/CP.8.

2.4. Results of 1990 GHG emissions estimation

This section provides an overview of results of the GHG emission calculation for Bosnia and Herzegovina in 1990. The results have been first given as total (aggregated) emission of all greenhouse gases by sector and then as emissions of specific greenhouse gases, also by sectors.

Since certain greenhouse gases differ in terms of their radiating characteristics, their contribution to the greenhouse effect varies to a certain extent.. In order to allow the aggregation and total overview of emissions, it is necessary to multiply the emission of each gas with its Global Warming Potential (GWP). GWP is a measure of how much a specific gas contributes to the greenhouse effect in relation to the impact of CO_2. In this case, the emission of greenhouse gases is expressed in Gg CO_2 eq (mass of equivalent CO_2). The table below shows the Global Warming Potentials for individual gases for a period of 100 years.

Greenhouse gas	Global warming potential
Carbon dioxide (CO_2)	1
Methane (CH_4)	21
Nitrous oxide (N_2O)	310
CF4	6500
C2F6	9200
SF_6	23.900

Table 2.4.1.: Global Warming Potentials for individual gases for a period of 100 years

2.4.1. Emission of carbon dioxide (CO2)

Carbon dioxide is one of the most important greenhouse gases, especially where the consequences of human activities are concerned. Carbon dioxide is estimated to be responsible for around 50% of global warming (Source: IPCC). Almost everywhere in the world, including Bosnia and Herzegovina, the most common anthropogenic sources of CO_2 are combustion of fossil fuels (for power production, industry, transport, heating, etc.), industrial activities (steel and cement production), land use change and forestry activities (in BiH, due to annual biomass increase, there is a negative emission, or sink).

The most significant source of CO_2 is certainly the energy sector, which contributes more than 70% of total CO_2 emission. A more in-depth description of emissions by individual sectors is given below.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2[1]	CH_4	N_20	HFCs	PFCs	SF_6	Total
	CO2 equivalent (Gg)						
Total (Net Emissions)	26,461.07	4,454.52	3,127.90	0,00	0,00	0,00	34,043.49
1. Energy	23,121.74	1,627.71	139.50				24,888.95
A. Fuel Combustion (Sectorial Aproach)	23,121.74	30.66	139.50				23,291.90
1. Energy Industries	16,434.64	4,20	71.30				16,510.14
2. Manufacturing Industries and Construction	530.16	1.47	3.10				534.73
3. Transport	2,308.06	12.39	37.20				2,357.65
4. Other Sectors	3,848.88	12.60	27.90				3,889.38
5. Other	0.00	0.00	0.00				0.00
B. Fugitive Emissions from Fuels	0.00	1,597.05	0,00				1,597.05
1. Solid Fuel	0.00	1,597.05	0,00				1,597.05
2. Oil nad Natural Gas	0.00	0.00	0.00				0.00
2. Industrial Processes	3,339.33	0.84	213.90	0.00	0.00	0.00	3,554.07
A. Mineral Products	736.75	0.00	0.00				735.75
B. Chemical Industry	0.00	0.00	213.90	0.00	0.00	0.00	213.90
C. Metal Production	2,602.58	0.84	0.00		0.00	0.00	2,603.42
D. Other Production	0.00						0.00
E. Production of Halocarbons and SF_6				0.00	0.00	0.00	0.00
F. Consumption of Halocarbons and SF_6				0.00	0.00	0.00	0.00
G. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Solvent and Other Product Use	0.00		0.00				0.00
4. Agriculture		1,833.51	2,774.50				4,608.01
A. Enteric Fermentation		1,548.33					1,548.33
B. Measure Management		258.18	396.80				681.98
C. Rice Cultivation		0.00					0.00
D. Agricultural Soils		0.00	2,337.70				2,377.70
E. Prescribed Burning of Savannas		0.00	0.00				0.00
F. Field Burning of Agricultural Residues		0.00	0.00				0.00
G. Other		0.00	0.00				0.00
5. Land Use Change and Forestry	-7,423.53	0.00	0.00				-7,423.53
6. Waste	0.00	992.46	0.00				992.46
A. Solid Waste Disposal on Land	0.00	992.46					992.46
B. Wastewater Handling		0.00	0.00				0.00
C. Waste Incineration	0.00	0.00	0.00				0.00
D. Other	0.00	0.00	0.00				0.00
7. Other (Other)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Memo Items							0.00
International Bunkers	0.00	0.00	0.00				0.00
Aviation	0.00	0.00	0.00				0.00
Marine	0.00	0.00	0.00				0.00
Multilateral Operations	0.00	0.00	0.00				0.00
CO2 Emission from Biomass	0.00						0.00

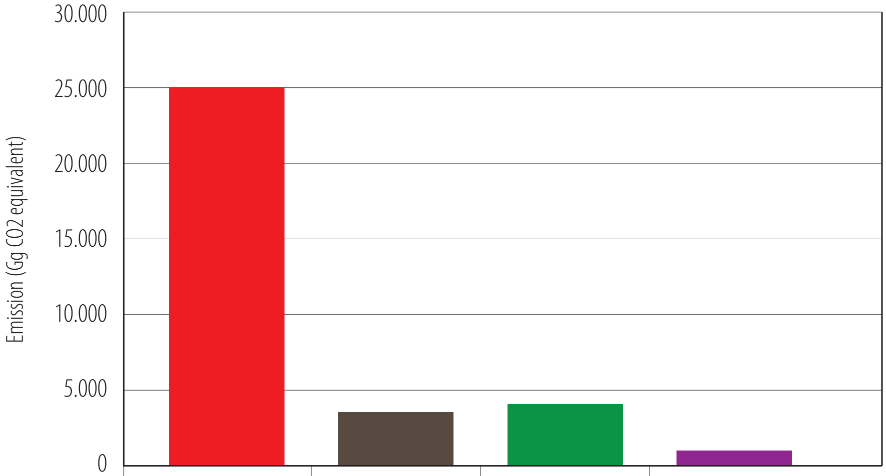
[1] For CO_2 emissions from Land Use Change and Forestry the net emissions are to be reported. Please note that the purposes of reporting the sighn for uptake are always (-) and for emissions (+).

GREENHOUSE GAS SOURCE AND SINK CATEGORIES Land Use-Change and Forestry	CO_2 Emissions	CO_2 Removals	Net CO_2 Emissions/ Removals	CH_4	N_20	Total Emissions
A. Changes in Forest and Other Woody Biomass Stocks	0.00	0.00	0.00			0.00
B. Forest and Grassland Conversion	0.00		0.00	0.00	0.00	0.00
C. Abandonment of Managed Lands	0.00	0.00	0.00			0.00
D. CO_2 Emissions and Removals from Soil	0.00	0.00	0.00			0.00
E. Other	0.00	0.00	0.00	0.00	0.00	0.00
Total CO_2 Equivalent Emissions from Land-Use Change and Forestry	0.00	0.00	-7,423.53	0.00	0.00	0.00

Total CO_2 Equivalent Emissions without Land-Use Change and Forestry *	34,043.49
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry *	26,619.96

* The information in these rows is requested to facilitate comparision of data, since Parties differ in the way they report emissions and removals from Land-Use Change and Forestry.

Table 2.4.1.1. : Summary report for CO2 equivalent emissions



	1. Energy	2. Industrial Processes	3. Agriculture	4. Waste
Series 1	24,888.95	3,554.07	4,084.00	992.46

Figure 2.4.1.1.: Summary report for CO2 equivalent emissions in BiH for 1990.

Total CO_2 equivalent emission in Bosnia and Herzegovina in 1990 was 34,043.49 Gg. Emissions from the energy sector make the largest proportion of total emissions (74%), followed by agriculture (12%), industrial processes (11%), and waste sector (3%), as shown in the graph below.

Percentage Of CO2 Equivalent Emission

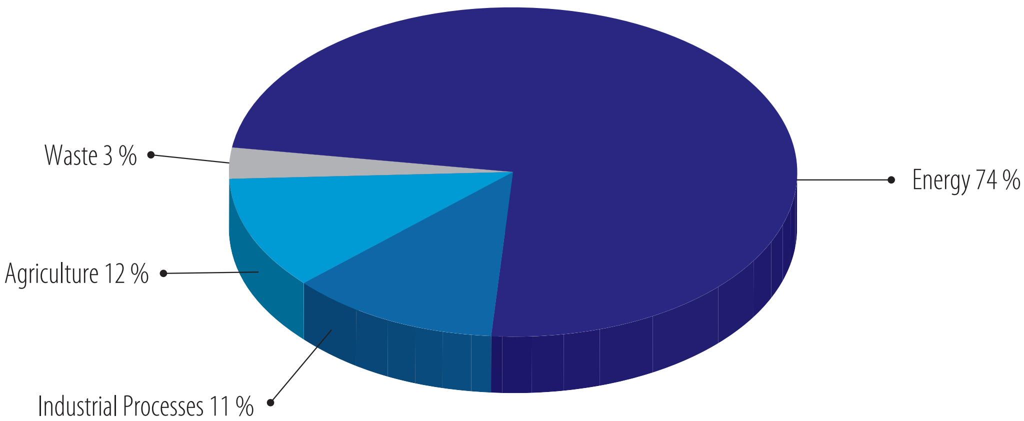


Figure 2.4.1.2.: Share of CO2e emissions by sector.

2.4.2. Energy production

This sector covers all activities encompassing the consumption of fossil fuels (fuel combustion and non-energy fuel consumption) and fugitive emissions from fuel.

Fugitive emissions occur during production, transport, processing, storage and distribution of fossil fuels. The energy sector is the main source of anthropogenic emission of greenhouse gases and contributes with 77% of the total CO_2 emission from fuel combustion.

Emissions per energy sub-sectors have been also shown below. Emission calculations have been based on the fossil fuel consumption data obtained on the basis of official written information submitted by energy entities in 1990 on individual consumption of fossil fuels, where very detailed data have been given for fuel consumption, which allows a more in-depth variant of the calculation by sub-sectors within the prescribed IPCC and CORINAIR methodology (Sectoral Approach).

Also, a simpler calculating method has been carried out (so-called Reference approach) which takes into account only the total balance of fuel, without sub-sectoral analysis. Comparison of results (type of internal control) of both calculation approaches indicated 1% difference in favour of the Sectoral Approach.

Two energy most intensive sub-sectors are energy conversion (thermal power plants, heating plants, transport...) and industrial fuel combustion. Industrial fuel combustion is most extensive in the iron and steel industry, non-ferrous metal industry, cellulose and paper industry, food, beverage and tobacco production, etc. This sub-sector also includes electricity and heat production on the factory location.

Most of the CO_2 emissions in energy conversion are from fuel combustion in thermal power plants. Distribution of CO_2 emissions from fuel combustion is shown below.

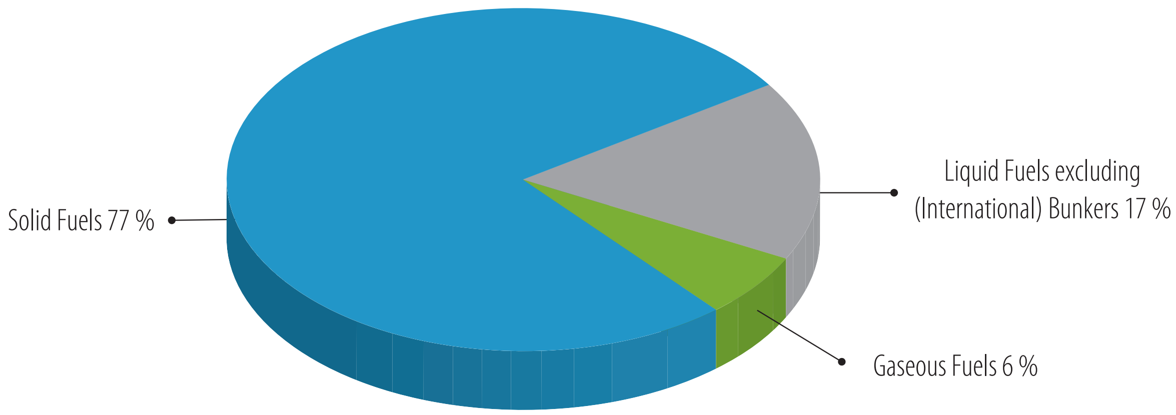
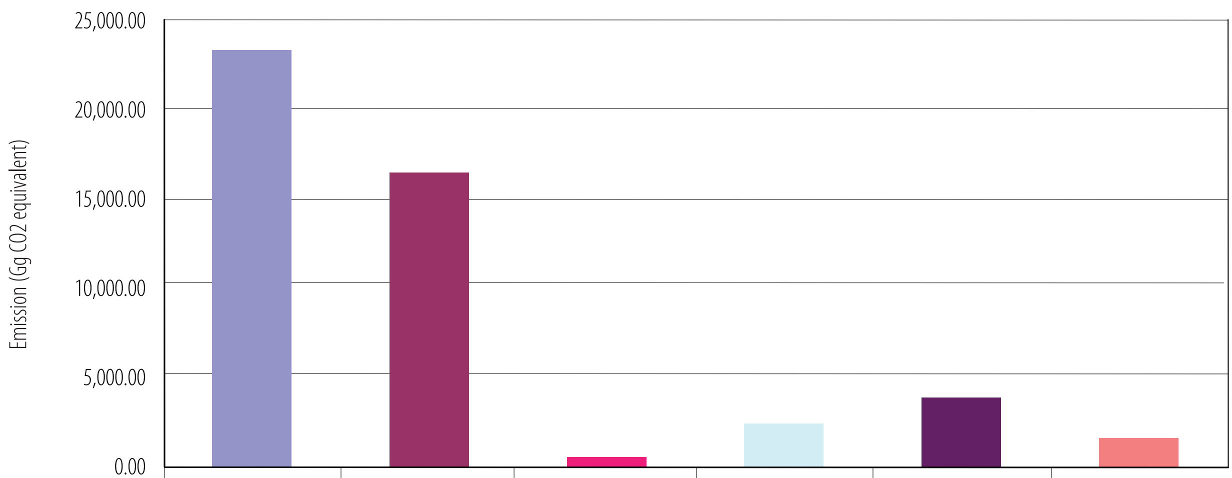


Figure 2.4.2.1.: Comparison of CO2 emissions from fuel combustion (1990).

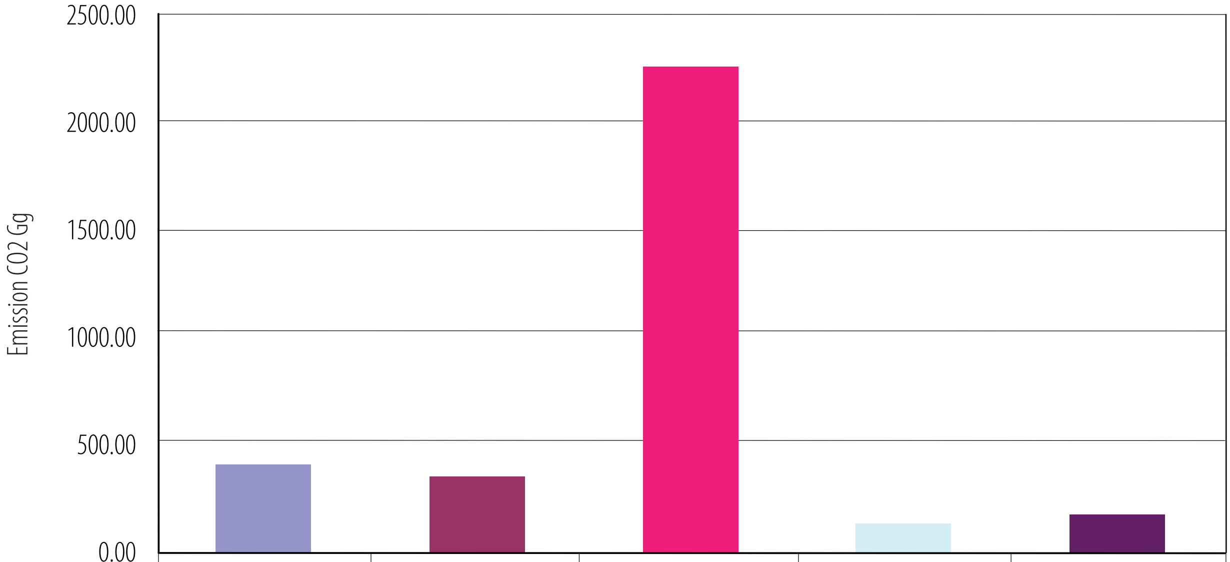
Solid fuels-coal make the largest proportion (77%), followed by liquid fuels (17%) and gas (6%).

A fugitive emission of greenhouse gases from coalmine exploitation, which contributes to the total energy sector emissions with such a high percentage, is not negligible as far as Bosnia and Herzegovina is concerned. These emissions comprise 6.8% of the total emissions in the energy sector.



	A. Fuel Combustion	1. Energy Industries	2. Manufacturing	3. Transport	4. Other Sectors	B. Fugitive Emissions
Series1	23,291.90	16,510.14	534.73	2,357.65	3,889.38	1,597.05

Figure 2.4.2.2.: Energy sector – summary report for CO2 equivalent emission 1990 year



	Cement Production	Lime Production	Iron and Steel Production	Ferroalloys Production	Aluminium Production
Series1	397.84	338.91	2,273.60	129.66	147.60

Figure 2.4.3.1.: Sectoral report for industrial processes

2.4.3. Industrial processes

Greenhouse gases may also occur as a by-product of various non-energy industrial processes in which an input substance is chemically transformed into a final product. Industrial processes known as significant contributors to CO_2 emissions are: production of cement, lime, ammonia, iron and steel, ferroalloys and aluminium as well as use of lime and dehydrated soda lime in various industrial activities. Results of the CO_2 emission calculation below also show an average proportion of individual industrial processes in the total emissions from this sector in 1990.

The largest source of CO_2 in industrial processes is iron and steel production, with more than 67%.

The IPCC methodology recommended by the Convention has been used for calculation of emissions from industrial processes (Source: Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual, www.ipcc-nggip.iges.or.jp). The data on annual economic activity, i.e., the production or consumption by individual industrial processes, have been obtained from the annual reports of the Statistical Institute of the Republic of Bosnia and Herzegovina for 1990 (Statistical Yearbook of the SR Bosnia and Herzegovina, 1991).

In cement production, which is the second largest contributor to CO_2 emissions in this sector after steel and iron production, the amount of the released CO_2 is directly proportional to the content of lime in clinker. Following this, estimation of CO_2 emissions is accomplished by applying an emission factor (in tons of CO_2 released per ton of clinker produced) to the annual clinker output adjusted by the amount of clinker lost from the rotary kiln through emission of clinker ash.

However, if information on clinker production is not readily available, as is the case here, an emission factor in tons of CO_2 released per ton of cement produced can be applied to annual cement production instead (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual).

This approach has been followed by Maryland et al. (1989), who took the average CaO content of cement to be 63.5%, yielding an emission factor of 0.4985 CO_2/cement. The data on the 1990 cement output of 797,000 tons has been taken from the statistical report (Statistical Yearbook of the SR Bosnia and Herzegovina, 1991).

2.4.4. Sinks

As already mentioned above, when absorption of greenhouse gases occurs (e.g. absorption of CO_2 due to an increase in forests), we talk about greenhouses gases sinks and the amounts are shown with a minus sign.

Total emissions and gases sinks in the forestry sector and land use change for BiH have been calculated for 1990. According to the collected data, the results of the calculation indicate that forests in BiH represent a significant CO_2 sink.

According to the data available for the baseline year, forests in BiH cover an area of approximately 2.7 million hectares (FAO, 2005). Deciduous trees (which have a high capacity to absorb carbon) account for 68.8%, with beech dominating with 39%, and sessile-flowered oak accounting for 18.9% of all trees. Coniferous trees account for 31.2% of all trees, with significant proportions of fir (12.8%), spruce (8.6%), black pine (7.2%) and Scots pine (2.5%) and only a minute proportion of other coniferous trees (0.1%. Based on these indicators and the annual increment of 10.5 million hectares (Gtz, 2001), an annual increment factor was determined in tons of dry matter per hectare (2.375). Noble broadleaves and wild fruit trees have been also included in the calculations.

Total proportion of biomass is 2,386.5 Gg of dry matter, while net annual amount of carbon dioxide is 2,024.60 Gg, based on the calculations made on the basis of instructions for changes in forest systems and other wood biomass stocks.

Using the IPCC values of carbon proportion in dry matter, the total carbon uptake was calculated at 3217.85 Gg. Based on these results and calculations of the annual release/emission of carbon, the final annual sink of carbon dioxide by forest ecosystems in BiH, for baseline year 1990, is 7,423.53 Gg CO_2.

Since the felling and consumption of fire wood is done in a planned way, the emissions from these sources have been also included in calculations, although there is a certain level of uncertainty about the firewood amounts and proportion of emissions from illegal felling because the baseline year data are not official or are not available due to absence of a comprehensive database for the forestry sector. For that reason there are segments in the databases that require improvement in terms of collection of missing data, all for the purpose of enhancing future inventories. Given the war activities in the past and current decentralisation of forest management companies and relevant pieces of legislation, the baseline year data have been collected from various national and international studies, which contribute to measurement uncertainty for some source categories.

2.4.5. Emission of methane (CH_4)

The graph below shows methane emissions (CH_4) by sectors. In Bosnia and Herzegovina, the main sources of methane are agriculture (cattle breeding), fugitive emissions from coalmines, and waste disposal.

Methane is a direct product of metabolism of herbivorous animals (enteric fermentation) and a result of organic decomposition of animal waste (manure management). According to the IPCC methodology, methane emissions are determined for every type of domestic animals (dairy cows, non-dairy cows and bulls, sheep, horses, swine and poultry).

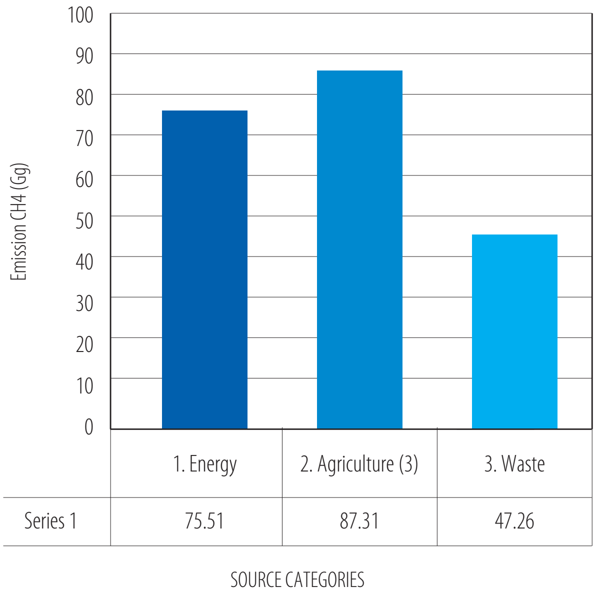


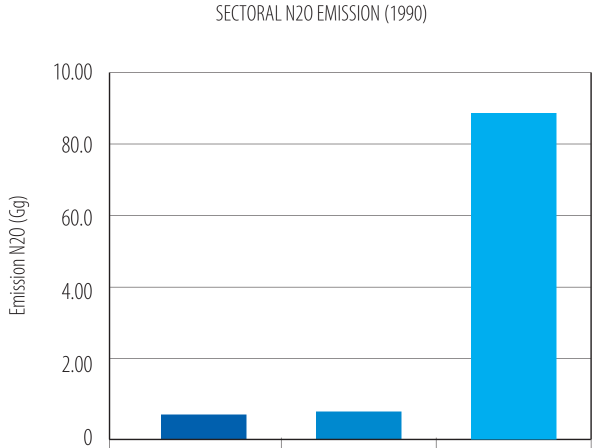
Figure 2.4.5.1.: Methane emission (CH4)

Methane emission from waste disposal sites occurs as a by-product of anaerobic decomposition of waste material with the help of methanogenic bacteria. The amount of methane released during the decomposition process is directly proportional to the Degradable Organic Carbon (DOC) content, which is defined as the carbon content of various types of organic biodegradable waste. IPCC emission factors have been used for calculation of all of the aforementioned sectors.

2.4.6. Emission of nitrous oxide (N_2O)

The graph below shows N_2O emission by sectors. Agriculture is the principal source of N_2O in Bosnia and Herzegovina. Many agricultural activities add nitrogen to soils, thus increasing the available nitrogen for nitrification and de-nitrification, which has an impact on the amount of N_2O emission.

The methodology used here identifies three N_2O emission sources: direct emission from agricultural soils, emission from domestic livestock and indirect emission caused by agriculture activities. Of the three aforementioned sources, the largest amount of emission comes from agricultural soils through soil cultivation and crop farming. This includes application of synthetic fertilisers, nitrogen from animal waste, legume and soy farming (nitrogen fixation), nitrogen from crop residues and peat-bog cultivation. In the energy sector, the emission has been calculated on the basis of fuel consumption and the corresponding emission factors (IPCC).



	Energy	Industrial Processes	Agriculture
Series 1	0.45	0.69	8.95

Figure 2.4.6.1.: Sub-nitrogen emissions by sector (N20) (1990).

2.5. Emission of indirect greenhouse gases

As mentioned above, photochemical active gases such as carbon monoxide (CO), nitrogen oxides (NOX) and non-methane volatile organic compounds (NMVOCs) indirectly contribute to the greenhouse effect although they are not greenhouse gases. They are commonly named indirect greenhouse gases or ozone precursor gases because they contribute to and participate in the creation and breakdown of ozone, which is one of the greenhouse gases. It is believed that sulphur dioxide (SO2) as a sulphate and aerosol precursor increases the greenhouse effect. The table in the graph below shows the results of the emission calculation for indirect greenhouse gases.

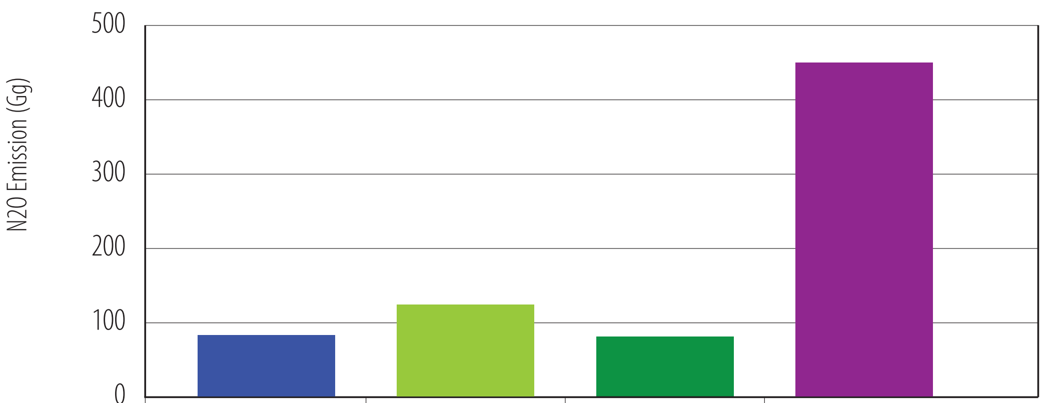
2.6. Uncertainty of calculations and verification

2.6.1. Uncertainty of calculations

Uncertainty information is not intended to dispute the validity of the inventory estimates, but to help prioritise efforts to improve the accuracy of inventories in the future and guide decisions on methodological choice. Uncertainty estimate of calculations is one of the important elements of national emission calculation and IPCC methodology. There are many reasons why actual emissions and sinks may differ from the number calculated in a national inventory. The estimated uncertainty of emissions from individual sources (e.g. thermal electric plants, motor vehicles, number of cattle, agriculture, etc.) is a combination of individual uncertainties of emission calculation elements:

- uncertainties associated with continuous monitoring of emissions,
- uncertainties associated with direct determination of emission factors, for the purpose of quality of analytical inputs - parameters for the calculation
- (quality in direct emission measurements),
- uncertainties associated with emission factors from published references
- uncertainties associated with activity data.

Some sources of uncertainty may generate well-defined, easily characterised estimates of the range of potential error. However, other



	NOx	CO	NMVOC	SO2
Total National Emissions	83.07	124.51	70.68	453.16

Figure 2.5.1.: Total emission of indirect greenhouse gases (1990).

sources of uncertainty may be much more difficult to characterise. The estimated uncertainty is either a function of instrument characteristics, calibration and sampling frequency of direct measurements, or (more often) a combination of the uncertainties in the emission factors for typical sources and the corresponding activity data.

The pragmatic approach quantitative uncertainty estimates is to use the best available estimates; a combination of the available measured data and expert judgement. However, in situations where it is impractical to obtain reliable data or where existing inventory data lack sufficient statistical information, it may be necessary to ask for expert judgements.

Experts may be reluctant to provide quantitative information regarding data quality and uncertainty, preferring instead to provide relative levels of uncertainty or other qualitative inputs.

The revised IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories (2000) may be helpful in overcoming these concerns and biases that can be introduced by the rule of thumb (sometimes called heuristics) that experts use when formulating judgements about uncertainty.

If necessary the experts should be made aware of the existence of IPCC default uncertainty ranges which would be used in the absence of their judgements.

In this communication, the calculation of greenhouse emissions in Bosnia and Herzegovina, with the exception of data on economic activity, is mainly based on the emission factor data from the Convention manual (IPCC 1996 Revised Guidelines), with the exception of emission factors for coals, which has already been mentioned in previous chapters. Apart from the uncertainty ranges known from the manual, other uncertainties were determined exclusively through judgments of experts who worked in specific areas. As no uniform method has been used in this estimation, no total quantitative uncertainty of the calculation had been expressed. Instead, relatively subjective qualitative judgements have now been collected from individual segments and sectors with the aim of methodologically formalising and maximally quantifying this judgment in the future.

Sources of uncertainty in calculation of sinks in the BiH forestry sector include the possibility of existence of unidentified sinks and emission sources, absence of data and certain concerns regarding the quality of data. Through use of the "Tier 1" method (common 1996 IPCC method), the determination of emissions and sinks originating from land use change and forestry is characterised by uncertainties associated with determination of area distribution, annual increase, loss or use of biomass, etc. The data on these elements were not collected from direct sources (archive and forestry management sources) but were collected from various studies and documents, which may lead to some uncertainties.

Most data regarding land change use and forestry have been very difficult to collect because the databases had been partly destroyed during the last war. Although some of the data have been compared with the same type of data in other documents (in order to ensure accuracy), it was not possible to do the same for all elements. The types of calculation uncertainties significant for this segment include the absence of data and likelihood of errors in the measurements.

Since IPCC working tables have been used for calculations, the tendency has been towards higher representativeness of data collected for calculations, which lowered the uncertainty of calculation. For these reasons, the uncertainty of calculation for the forestry sector has been categorised as the mid-level reliability of data with ±10% accuracy.

As already mentioned, the data on production and consumption of certain products have been derived from the Statistical Institute of the Socialist Republic of Bosnia and Herzegovina (Statistical Yearbook of the SR Bosnia and Herzegovina, 1991). The accuracy of these data is considered to be relatively high given the fact that the data were collected through direct polling of business entities. However, mid-level data reliability, i.e. a ±10 per cent error, is assumed here.

Emission factors for specific industrial processes have been calculated in line with the IPCC methodology recommended by the UNFCCC Convention (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual, www.ipcc-nggip.iges.or.jp).

In case of emission factors that could not be calculated due to the absence of some of the parameters required by the methodology, one of the emission factors recommended by the methodology have been selected based on expert knowledge and experience.

However, although some data (combustion of fossil fuels in the energy sector, industry activities) are reliable, others may not be considered so. Consequently, for the purposes of this report, the uncertainty of calculation in specific fields is summarily and preliminarily categorised into three levels: high reliability of data (±5 per cent), medium reliability of data (± 10 per cent) and low reliability of data. This categorisation is shown below.

2.6.2. Qualitative analysis of uncertainty in greenhouse gas emission calculations in Bosnia and Herzegovina for year 1990

High reliability of data

- Data from the energy sector (emission factors and activity data)
- Activity data from industrial processes

Medium reliability of data

- Emission from industrial processes – applicability of emission factors for BiH.
- Emission from agricultural soils
- Emission from municipal waste disposal
- Emission from food production
- Changes in carbon content in forests
- Emission in the agricultural sector

Low reliability of data

- Data for non-CO_2 emissions from fuel combustion
- Fugitive emissions from coal mining
- Burning of crop residues
- Land use methods and change

- CO_2 emission from road traffic have been calculated using COPERT III model and imported into the reported database that formed the basis for the preparation of the CRF.

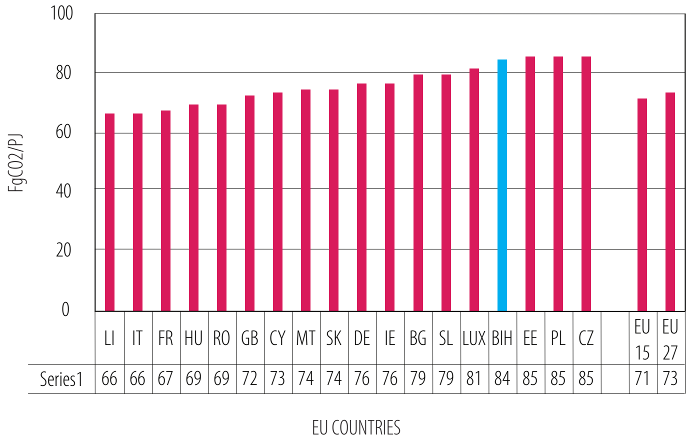


Figure 2.6.3.1.: Specific Emission Indicator (GgCO2/PJ) 1990 year for EU countries

2.6.3. Verification of estimations

Verification processes are, in the present context, intended to help improve the quality of inputs and establish an inventory's reliability. The IPCC manual recommends a set of simple completeness and accuracy checks. For example, checks for calculation errors, comparison of the national inventory with independently published estimations, comparison of national data with international statistics, checks of calculations of CO_2 emission from fuel combustion by comparing the so-called Sectoral Approach with the IPCC Reference Approach, etc.

Furthermore, verification may be achieved through international cooperation and comparison with other national inventories.

In preparation of the national inventory of emissions in Bosnia and Herzegovina, several steps have been taken with the aim of checking the completeness and reliability of calculations:

- two workshops have been organised with participation of experts and representatives of relevant institutions,
- comparison with national inventories of other countries (Slovenia, Croatia, FYR Macedonia and a number of other Non-Annex 1 countries),
- CO_2 emission from fuel combustion, under the IPCC methodology, have been calculated in two ways:
- a more detailed Sectors Approach and
- a simpler Reference Approach, and the difference is on average 1%

Comparative tables of $GgCO_2/PJ$ indicators for year 1990 have been made for European countries and Bosnia and Herzegovina.

As expected, BiH is ranked together with Estonia, Poland and Czech Republic with an indicator value in the range 84-85. This is expected for BiH because the main energy source is coal, accounting for over 70% of all energy sources in energy production.

Belgium	1.298 tCO_2/MWh
France	0,809 tCO_2/MWh
Italy	1,409 tCO_2/MWh
Luxemburg	1,511 tCO_2/MWh
Greece	1,648 tCO_2/MWh
Germany	1,463 tCO_2/MWh
EU average	1,401 tCO_2/MWh
Global	1,523 tCO_2/MWh

Source: International Energy Agency (IEA) 2006.

Table 2.6.3.1. : Specific Emission Indicator (tCO_2/MWh)

Likewise, the table, showing the tCO_2/MWh indicator, which is 1.59 for BiH, is within the expected range according to the structure and quality of coal used as fuel for production of electricity in thermal power plants.

3. VULNERABILITY AND ADAPTATION TO CLIMATE CHANGE

3.1. Sources of information on climate and climate change in BiH

The following summary of climate conditions in BiH and on future climate change is draws upon the findings of many different research reports on present and future climate conditions, as well as on all available meteorological data taken from weather stations in BiH. Analysis placed special emphasis on air temperature and precipitation as the two most variable meteorological elements. Analysis of climate extremes was conducted based on a standard index range of precipitation and days with temperatures above 30ºC. Should be noted that a great deal of data was lost in the course of the 1992-1995 war in BiH. Calculations and assessment of the missing data for air temperature and precipitation quantities indicated definite shortcomings.

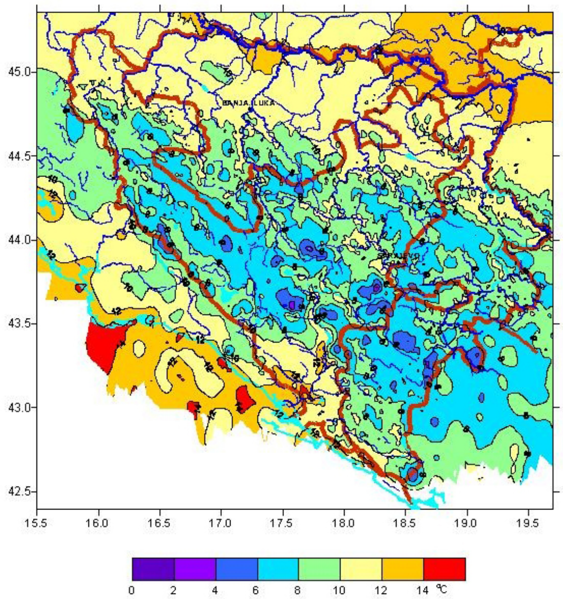


Fig 3.1.1 spatial distribution of mean annual air temperatures in BiH, 1961-1990.

3.1.2. Climate Conditions in BiH

On the basis of temperature characteristics, the territory of BiH may be divided into three temperature zones: warm, moderate and cold. The warm zone corresponds to the Adriatic coast and lowland Herzegovina. In lowland Herzegovina, summers are hot and winters are very mild. Mean winter temperatures are above 5oC, whereas summer temperatures reach 40oC (Mostar, Trebinje, Čapljina). Mean annual temperatures have the value of above 12°C. Moderate areas include plain and hilly regions in the central part of BiH. Summers are warm and winters are moderately cold. Mean winter temperatures are around 0°C, and summer temperatures reach 35°C (Banja Luka, Bijeljina, Sarajevo, and Tuzla). Mean annual temperature ranges between 10°C and 12°C, whereas in the area above 500 m, it is below 10°C. Cold regions refer to mountainous areas where summers are fair (days moderately warm and nights chilly), while winters are very cold. During at least 3 months of the year, these regions have a mean temperature lower than 0°C (Bjelašnica, Sokolac, Kupres) (Fig. 3.1.1.)

The quantity of rainfall in BiH is affected by humid air mass coming from the west (the Atlantic Ocean) and south (the Adriatic Sea). Going from the west (where mountainous areas receive around 2000 mm) towards the east, the total quantity of rainfall decreases to around 700mm (Bijeljina). Maximum rainfall in the northern part of BiH occurs most often in June or September. Herzegovina and the highest central parts of BiH are mainly exposed to an onslaught of humid mass from the south, characterized by a maritime pluviometric regime and they receive up to 2000 mm of rainfall on an annual basis. Maximum rainfall occurs mostly at the end of autumn or beginning of winter; i.e., in November or December.

Insolation (solar radiation) decreases from the Adriatic Sea towards the inland and at higher altitudes. The lowlands of Herzegovina have the highest amounts of insolation (up to 2500 hours annually in Trebinje, Neum, Mostar), whereas the lowest insolation (around 1500 hours annually) occurs in basin spaces in the inland areas (Doboj, Zenica). In the Pannonian region, insolation totals around 2000 hours annually.

Climate characteristics of Bosnia and Herzegovina are most affected by the following factors: the Adriatic Sea, the Atlantic Ocean, local orography where the Dinara Mountains are particularly prominent, and general atmospheric circulation. The climate of BiH is classified by temperature characteristics;

i.e., the thermal regime of individual spatial units. The Pannonia region belongs to the middle-European or moderate continental type, the Adriatic region belongs to the Mediterranean type, and the Mountainous region to the Alpine climate type. Borders between individual types of climate are not sharp, but there are transitional tiers. These are primarily related to the moderate continental climate type which is present in the Peri-pannonian area as well as in some parts of the Mountainous Basin area.

The area of the Pannonia lowlands has a Pannonia climate, which is a sub-type of moderate continental climate. It is a bit milder than typical continental climate conditions present in the Eastern Europe. Its features are very warm summers and cold winters. Average annual air temperatures exceed 11oC and precipitation quantities reach 800 mm. Most precipitation occurs in the May – June period. This precipitation regime is extremely favourable for vegetation, especially for agricultural production. Snow is scarce, but the snow cover remains for a long time, which is good for winter crops. Droughts are possible during the summer, thus irrigation is necessary. This climate type is found in the north-eastern flat areas of BiH (Brčko, Bijeljina, etc.).

The Peri-pannonian region is characterized by modified Pannonia climate as a variant of moderate continental climate. Characteristics of this climate are moderately warm summers and moderately cold winters. Compared to the Pannonia lowlands, the Peri-pannonian area receives a bit more precipitation (1200mm). Mean annual temperature of air exceed 10 oC. The warmest month is July with the average of above 20 oC, whereas the coldest is January, when average temperatures drop below 0 oC. There is a clear distinction between the seasons. A moderate continental climate is partly present in the Mountainous Basin area. This climate is associated with areas of up to 1000m above sea level. With an increase of altitude, the climate gradually changes to sub-mountainous (pre-mountainous) and -- above 1400 m -- real mountainous climate. The main characteristics of the mountainous (Alpine) climate are short and fresh summers and long and cold winters. Transitional seasons (the spring and the fall) are not very strongly expressed. Compared to the moderate continental climate, the mountainous climate is more severe. Mean annual temperatures range around 5oC. The warmest month has the mean temperature lower than 18oC, and the coldest month (January) has an average temperature of less than -3oC. Precipitation falls in the form of rain and snow, which remains for a significantly longer period compared to lower areas.

Closed and relatively deep basins and some river valleys are protected from breakthrough of cold winds. They have a so-called župna (mild) climate. Summer and winter temperatures are higher compared to the surrounding mountainous areas. This type of mild climate is particularly suitable for the cultivation of early fruit and vegetables. Indicators of this mild climate are areas with walnuts and chestnuts. This type of climate can be found in the Foča and Višegrad basins and in the Pounje region.

In the Adriatic area, the Adriatic and modified Adriatic climate are most prominent. The Adriatic climate is a variant of the Mediterranean (maritime) climate. It is characterized by mild and rainy winters and dry and warm summers. Mean annual temperatures exceed 14oC. The warmest month (July) has average temperatures above 23oC, whereas the coldest (January) has temperatures above 5oC. The summer period, with temperatures above 20oC, lasts for four months. This type of climate is present in the area of Neum, as well as in the valley of the lower Neretva River. The modified Adriatic climate consists of the Adriatic hinterland, which is mildly affected by the sea. Limestone inland warms faster than the coastal area during the summer, but it gets colder during the winter. In other words, in the space between the modified Adriatic climate, the summers are warmer and the winters colder compared to the coastal area of the Adriatic. In terms of precipitation quantity and annual distribution of precipitation, there are no significant differences compared to the Adriatic seaside. A typical region with a modified Adriatic climate is lowland part of Herzegovina and the areas of Trebinje, Ljubinje and Stolac.

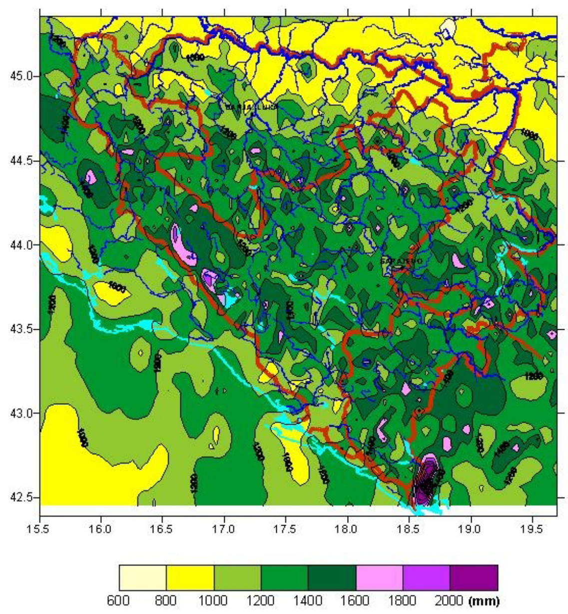


Fig. 3.1.2 spatial distribution of mean annual rainfall in BiH, 1961-1990.

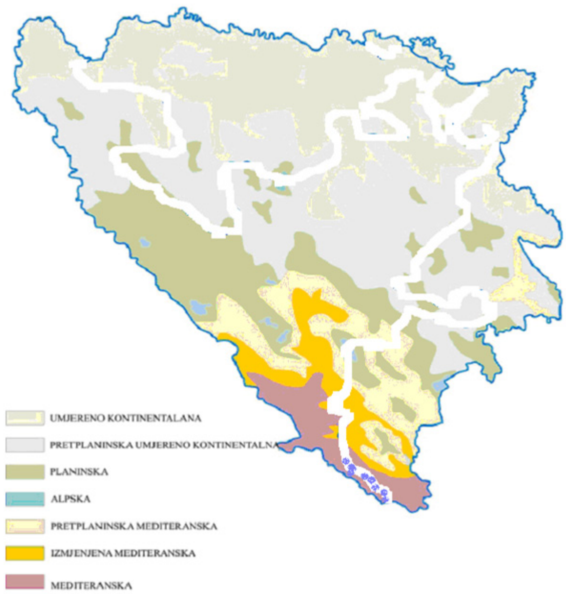


Fig. 3.1.3 Types of climate in BiH.

3.2. Climate variability and projections of extreme events

3.2.1 Projections of Future Climate Change in BiH

Projections of future climate change were made using the EH5OM global model developed at the Max Planck Institute for Meteorology (Hamburg, Germany), which includes dynamic interaction of atmosphere/ocean/precipitation. Results of the EH5OM model were analyzed for two seasons (winter and summer) and two 11-year periods over the area of Southeastern Europe: 1980–1990 (which corresponds to the present climate and which was selected because it represents the climate of the 20th century better than the last decade of the 20th century and 2040–2050. Figure 3.2.1 display the results.

The expert group involved in the preparation of this communication selected the use of the B2 SRES scenario for preliminary consideration in its work.[7] This scenario assumes a moderate mean temperature increase of somewhat more than two degrees Celsius in the next century, as well as analogous change in other climate parameters.

3.2.1.1. Projected Regional Changes in Temperature from the EH5OM

As calculated using the global and regional climate models, the temperature is projected to increase from 0.7 to 1.6°C per 1°C of global increase

The study of air temperature change over the Mediterranean for the thirty-year period 2031-2060 (the time during which global temperature is expected to reach 20°C above pre-industrial levels) shows that the global 20°C temperature rise is expected to be seasonally and spatially translated in the Mediterranean region as follows:

- The largest temperature increases would occur in summer, and in inland areas: T_{min} by 4°C and T_{max} by 5 °C on average;
- The second largest increase would occur in the fall (2-3°C everywhere);
- Spring temperatures could rise by approximately 2°C;
- Winter and spring temperatures could rise less than 2°C;
- The rise in coastal region temperatures (although less pronounced due to the sea) are expected to be in the 1-2°C range on average, and a bit more than 2°C in summer for T_{max};
- T_{max} is expected to rise more than T_{min};
- The increase in the number of summer days, defined as the number of days when T_{max} exceeds 25°C, is from 2 to 6 weeks. This translates into about one additional month of summer days on average ;
- The increase in the number of hot days in the Balkans, defined as the number of days with $T_{max} > 30$°C, ranges from 2 weeks along the coast to 5-6 weeks inland, indicating the role the Mediterranean Sea plays in moderating extremely hot weather .

3.2.1.2. Projected Regional Changes in Precipitation from the EH5OM

During the winter period (December-February), precipitation increases over most of the continent. The rainfall may also be heavier. In summer the climate will be noticeably drier, especially in southern Europe.

In addition to a large increase in temperature, the Mediterranean region that is below the geographical latitude 45° may also suffer from reduced rainfall. This reduction will be especially noticeable in summer (June-August), when already small amounts of rainfall could be halved that means the part of BiH will be affected by reduction precipitation.

All parts of the Mediterranean (including the Balkans) are expected to see a decrease in summertime precipitation and a small decrease or no change in the other seasons during the period 2031-2060. Dry days are defined as those days when the daily precipitation amount (RR) is less than 0.5 mm. On average, the Mediterranean is expected to feature more dry days. The increase is expected to be about 2 to 3 weeks in the Balkans.

[7] This scenario was selected because of the geographic location of BiH, the fact that historical climate variability has not had as dramatic an effect as in some other parts of the world, and an examination of data and trends as noted at weather stations in BiH.

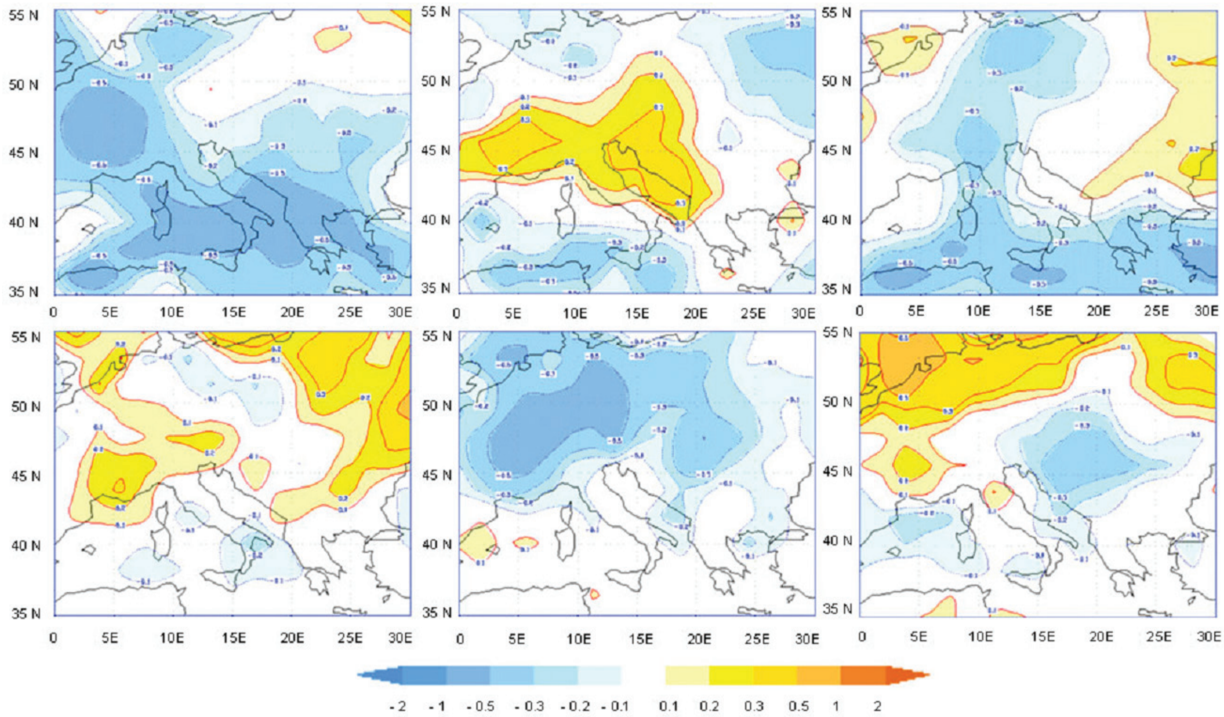


Fig. 3.2.1 Represents the climate of the 20th century better than the last decade of the 20th century and 2040–2050

3.2.2. Other projections of future climate change in BiH

3.2.2.1. Changes in temperature from various other sources

Majstorovic (2002, 2008) found that the increase in the mean annual temperature in BiH over the last 100 years was around 0.6°C. Trends were different for individual seasons. The biggest trend of increases was seen in the summer and winter. The temperature increase trends in Graphs 3.2.2 and 3.2.3 also incorporate the effect of urban heat islands hail as well as insolation, the projection of which will be the subject of future research.

The biggest increase in the mean annual temperature in Banja Luka happened after 1990, and further analysis has established that this increase was primarily related to the summer and winter.

Taking into account the following: geographic location of BiH as well as the fact that previous changes have not had such a dramatic effect as in some other parts of the world, as well as researching our data and trends as noted at weather stations in BiH, for preliminary consideration within this report, Probability levels for extreme temperatures were calculated based on maximum annual values of temperatures over the period 1950 – 2008 (Banja Luka) and over the period 1888 – 2008 (Sarajevo), as well as by application of Gumbel's Extreme Value Theory,[8] to project a return period; i.e., a theoretical function of distribution in the future. In Banja Luka, the value of T_{max} = 41,4°C, observed years 1957 and 2007. Its return period was calculated at 59 years, the probability of which is 3%). In Sarajevo, the value of T_{max} = 40°C in Sarajevo was observed for 1946. Its return period was calculated at 122 years, the probability of which is 0.82%). Even though probabilities for extreme temperatures are low, these still findings speak to the seriousness of the problem.

3.2.2.2. Changes in precipitation from various other sources

The quantity of precipitation depending on the region of BiH shows minimum changes in the previous 100 years of at most +/- 5% (Figs. 3.2.8 and 3.2.9) with a trend in the middle mountainous zone of increased rainfall, whereas in the South-western, Northern and North-eastern parts of the country there is a decreasing trend, though trends

[8] (Tmax(t)=Tm + (Int)/g))

differ according to seasons. The largest area of BiH shows a negative trend during the spring and summer, while an increase in rainfall is found in the winter half of the year (Majstorovic, et al, 2005). A special related issue is the trend of decrease of snow during the winter periods, which decreases the accumulation of water in mountainous regions (Fig. 3.2.11). All of these findings point to a serious deficit of water in the spring and summer season that is already being observed. The last decade shows a significant summer rainfall deficit in Republic of Srpska (Trebinje 18.4%, Bileća 14.7%, Gacko 12.6%, Prijedor 11.7%, Bijeljina 6.2%, etc.). However, the mountain station at Sokolac has measured a surplus of rainfall in the amount of 12.2% in the last 10 years. Also, Bijeljina has also observed a positive trend in rainfall of 4.2% annually, as the fall period has been 24.8% more rainy.

In addition, there is a current present annual deficit of rainfall in the south-eastern part of FBiH (Mostar – 9.1%); while there is a surplus in the central mountainous part (Sarajevo 6.5%, Tuzla 8.2%; see Fig. 3.2.7. and fig. 3.2.7a). On a related note, the trend of snow cover decline in the winter period, which decreases the accumulation of water in the mountainous part (fig. 3.2.11), is of particular concern. These factors point to a serious water deficit in the spring and summer season, which is being felt already.

Increasing variability in the weather has been noted in all seasons, and this variability includes rapid changes of short periods (five to ten days) of extremely cold or warm weather - heat and cold waves - and periods with extremely high levels of rainfall, as well as droughts. Those changes are very often followed by strong winds, even though it must be noted that the values of wind velocity are still lower than in other parts of the world, as is the corresponding damage. Increased oscillations of temperature and rainfall lead to an increase in the intensity and incidence of weather disasters followed by downpours, and frequently by hail. The extreme variability of weather has been observed in short weather intervals and over small areas, as well as in the deterioration of bio-meteorological conditions[9], which imply consequences to agriculture, waters supply, electricity supply, and human health.

Due to the aforementioned factors, it is expected that the duration of dry periods, the incidence of torrential flooding and the intensity of land erosion will increase over the next century. In addition, an increase is expected in the occurrence of hail, storms, lightning, and maximum wind velocity, which can represent threats to all forms of human activity (IPCC 4AR).

In the last decade in the central mountainous zone there is a trend of increase of rainfall sums at an annual level, whereas in the south-west areas (the area of Mostar) and north-west (area around Prijedor) part of the country there is a trend of decline (excluding final west – area around Bihać). In the north-east part of BiH, particularly the area around Doboj and Sokolac, there is an increase in rainfall (up to 13%) (Fig. 3.2.7).

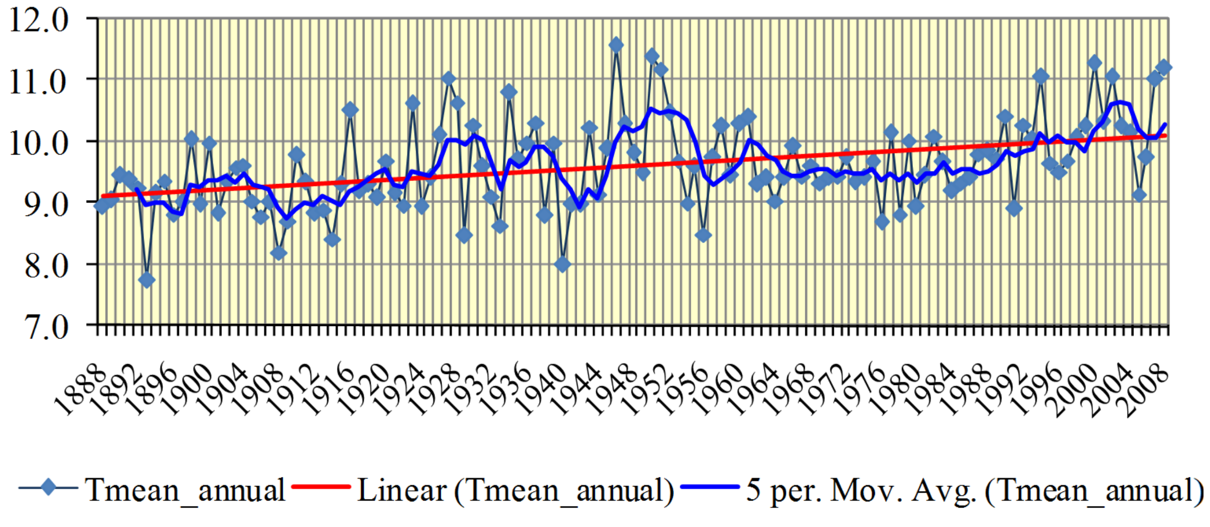


Fig. 3.2.2 Average annual temperature in Sarajevo, 1888-2008.

[9] These conditions are related to the balance of humidity in the soil and the water balance in general, as more intensive rainfall flows faster on the surface (particularly in hilly mountainous areas), whereas longer droughts increase the drying of the land.

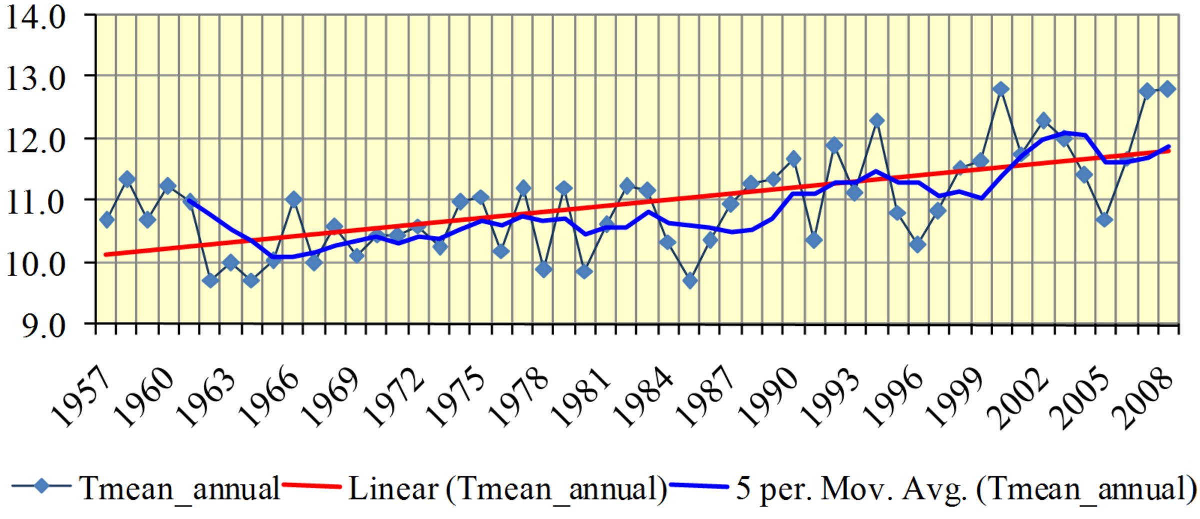


Fig. 3.2.3 Average annual temperature in Banja Luka, 1949-2007.

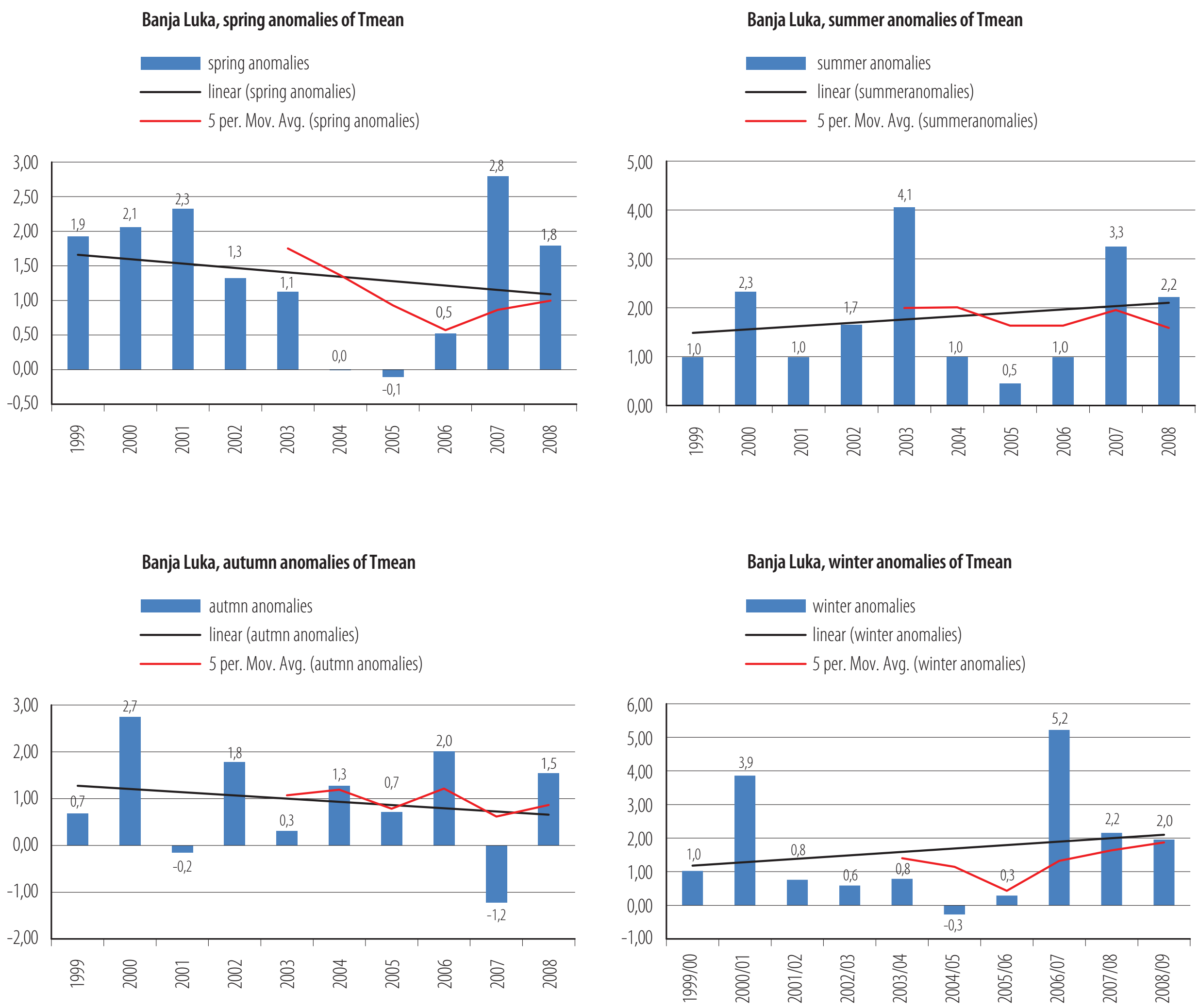


Fig. 3.2.4 Seasonal air temperature anomalies in Banja Luka, 1999-2008.[10]

[10] Note that spring and fall have a mean negative trend in temperature, while summer and winter have a positive trend)

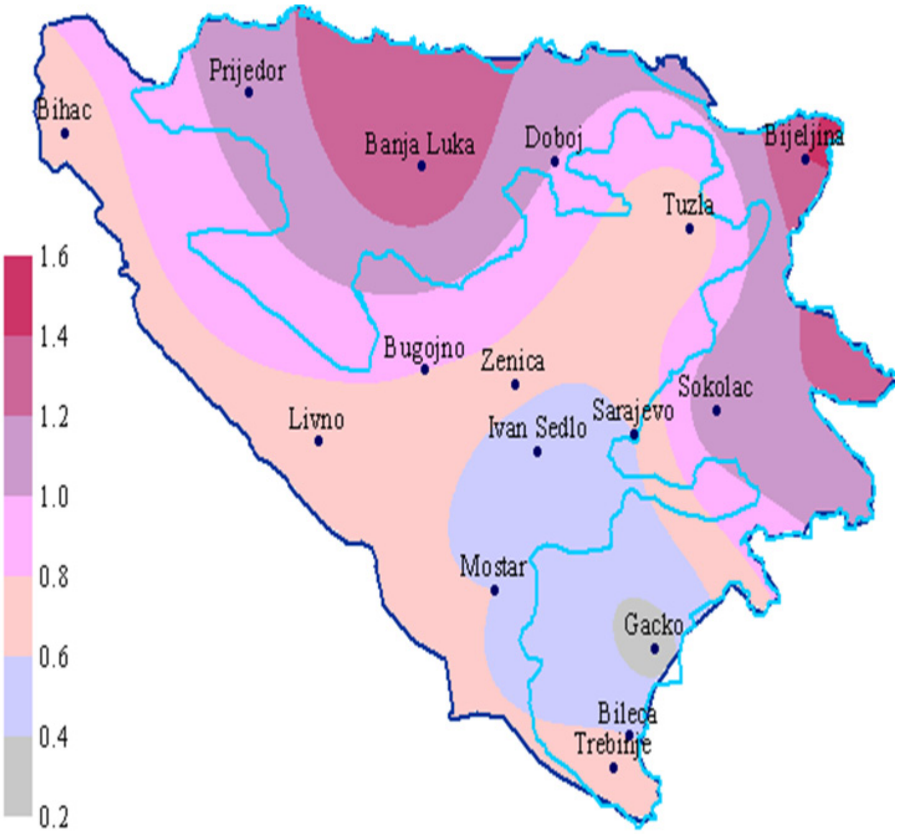


Fig. 3.2.5 Increase in average annual temperature in the last decade (1990-2000) compared to the reference period (1961-1990) in BiH expressed in °C.

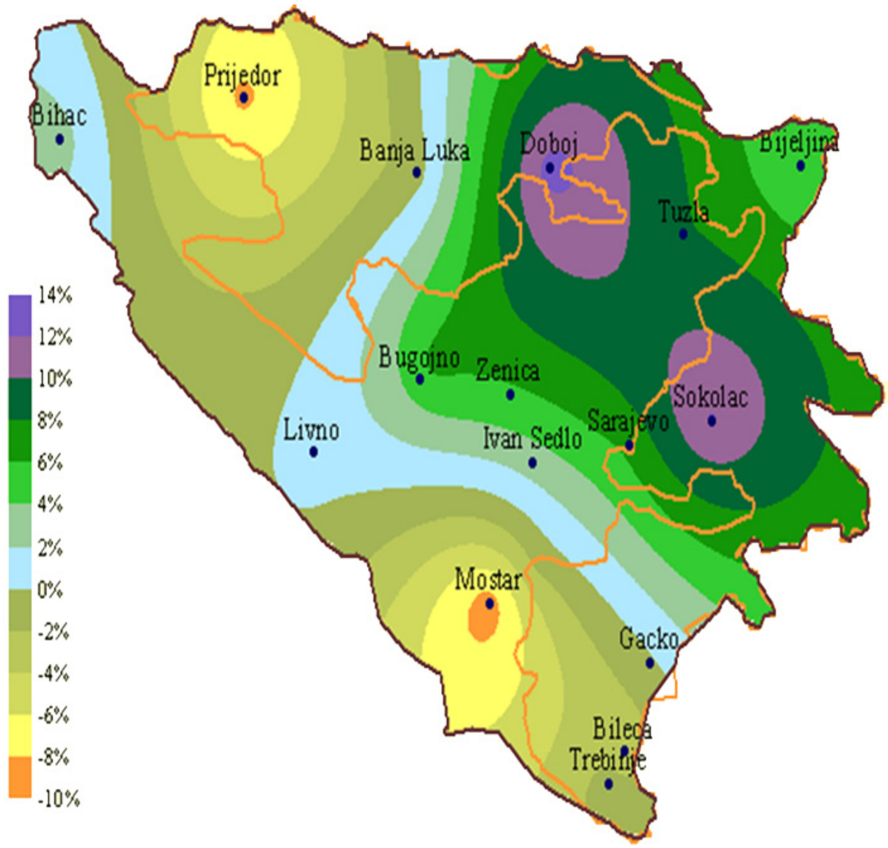


Fig. 3.2.6 spatial distribution of annual surplus/deficit of rainfall in the last decade (1999-2008) compared to the reference period (1961-1990) of BiH.

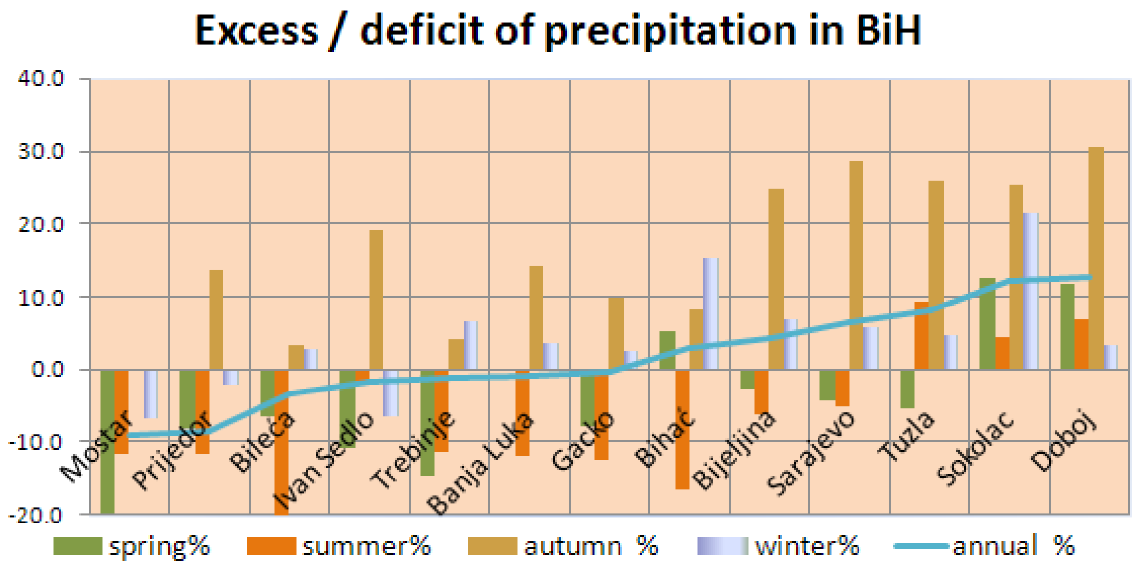


Fig. 3.2.7 Surplus/deficit of rainfall as a percentage of total average annual of rainfall in the last decade (1999-2008) compared to the reference period (1961-1990).[11]

Station	spring %	summer %	autmn %	winter %	annual %
Mostar	-19,8	-11,7	-0,1	-6,8	-9,1
Prijedor	-8,2	-11,7	13,5	-2,0	-8,5
Bileća	-6,5	-20,5	3,4	2,7	-3,4
Ivan Sedlo	-11,0	-1,9	19,2	-6,5	-1,6
Trebinje	-14,6	-11,4	4,2	6,6	-1,1
Banja Luka	0,1	-12,0	14,2	3,5	-1,0
Gacko	-8,0	-12,6	9,8	2,4	-0,3
Bihać	5,1	-16,6	8,3	15,3	2,9
Bijeljina	-2,7	-6,2	24,8	6,7	4,2
Sarajevo	-4,2	-5,0	28,8	5,8	6,5
Tuzla	-5,5	9,4	25,9	4,6	8,2
Sokolac	12,5	4,3	25,4	21,6	12,2
Doboj	11,9	6,8	30,6	3,4	12,8

Fig 3.2.7a: Surplus/deficit of rainfall (%) by season in the last three decades Compared to the reference period (1961-1990).

[11] The graph for Banja Luka does not contain the line from the first half of the century, so the increase trend appears larger.

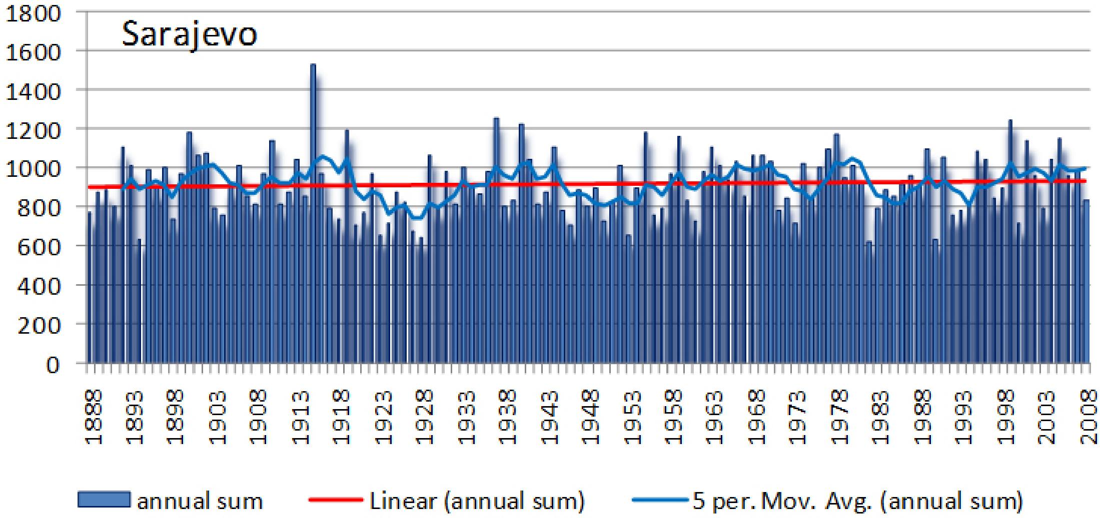


Fig. 3.2.8 Annual total rainfall in Sarajevo, 1888-2008.

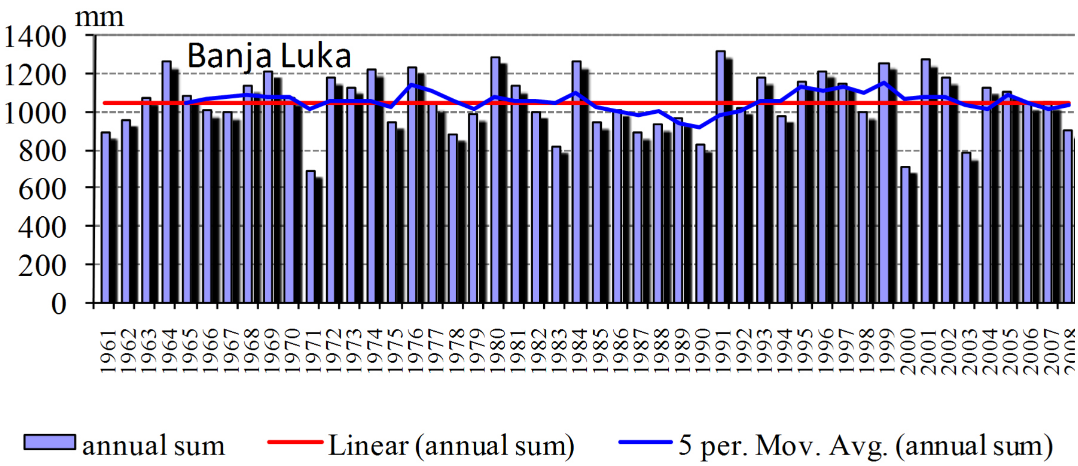
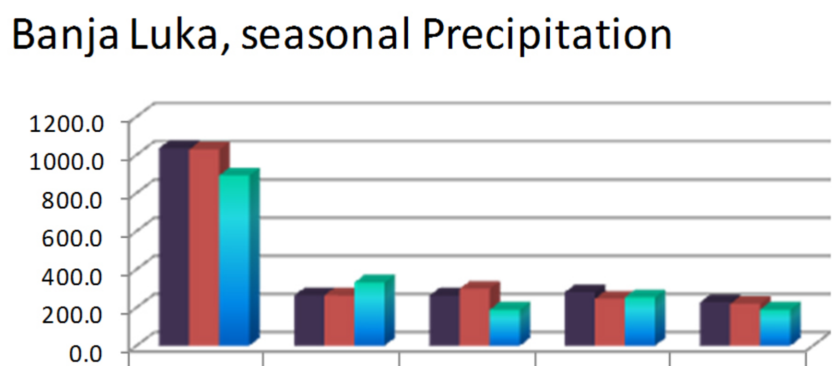


Fig. 3.2.9 Annual total rainfall in Banja Luka, 1961-2008.



	annual	spring	summer	autumn	winter
average (1999-2008)	1034.9	263.7	262.9	280.4	227.6
normals	1028.1	263.5	298.9	245.7	219.6
2008	891.8	331.5	189.1	253.7	189.8

Fig. 3.2.10 Seasonal precipitation. Comparison of the past decade, the reference period, and the year 2008.

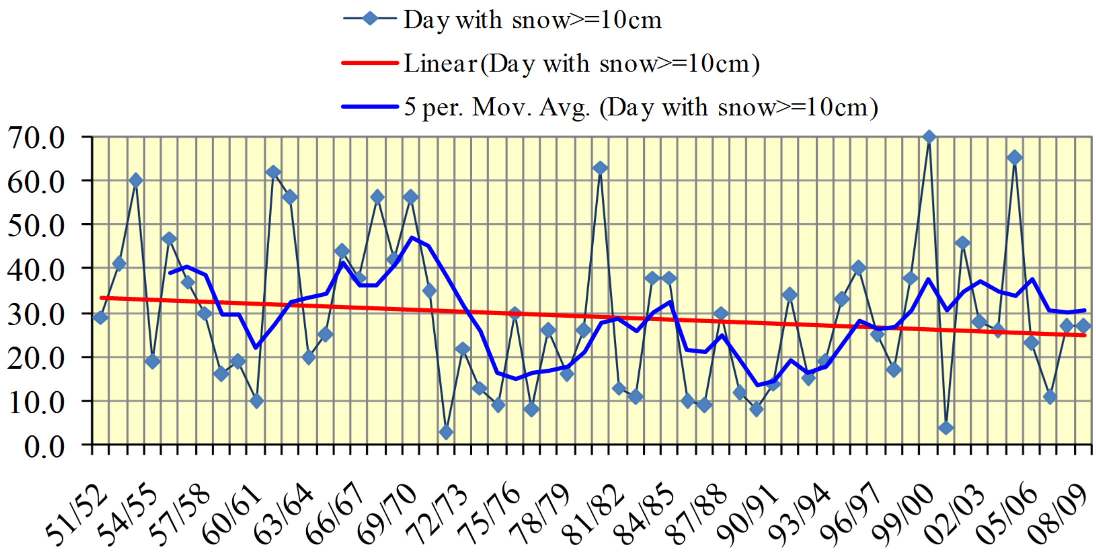


Fig. 3.2.11 Annual number of days with snow cover >=10 cm in Sarajevo (1951 -2007).

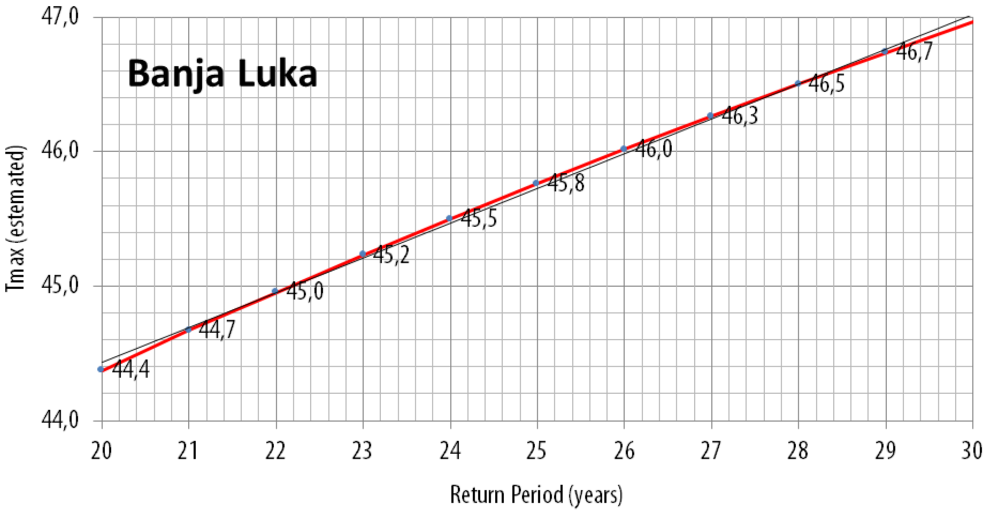


Fig. 3.2.12 Projected maximum annual temperatures of air in Banja Luka for the return period of 20 – 30 years

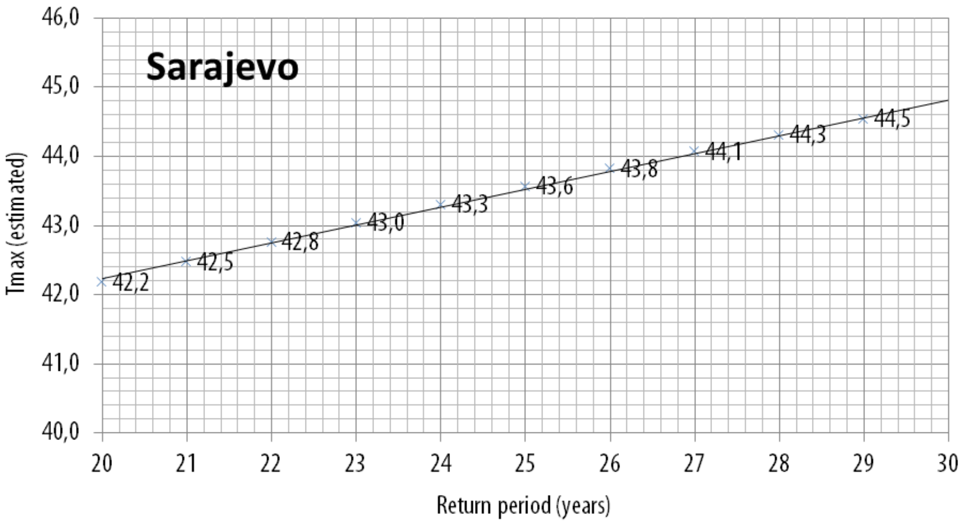


Fig. 3.2.13 Projected maximum annual temperatures of air in Sarajevo for return period of 20 – 30 years

3.3. Selection of adequate approach and methods for the development of climate change scenarios

As a result of economic restructuring and damages related to the 1991-1995 war, BiH has found itself in a difficult situation that has affected its capacity to monitor, analyze, and project current and future climate change. Basic infrastructure, including meteorological and hydrological systems for monitoring and telecommunications, which form an integral part of the World Meteorological Watch and Global Climate Observing System of the World Meteorological Organization, was destroyed and technology has become obsolete. In addition, climate monitoring during the 1990s was done poorly, which led to a decrease in reliable data on regional and local climate changes. Furthermore, considerations related to climate change are not integrated into sectoral and development policies, existing vulnerability assessments and the development of mitigation and adaptation measures are weak, and awareness of decision-makers of climate change issues is low.

Because of these difficulties, BiH did not have the capacity to select adequate methods and approaches for the development of climate change scenarios that would reflect national circumstances in a robust way. Therefore, the INC has made preliminary conclusions regarding the impacts of climate change based on a combination of two types of existing projections: 1) regional-level (low-resolution) output from a global model (Section 3.2.1.); and 2) findings from other research, including regional-level (high-resolution) output from a regional model (Section 3.2.2.).

3.3.1. Proposed steps to expand scenarios to reflect national conditions in future projections of climate change

The task of expanding scenarios to reflect national conditions in future projections of climate change is an urgent one, and it is a high priority for the Second National Communication. BiH has supported the establishment of a Virtual Regional Climate Change Centre, the Milutin Milanković Centre, in Belgrade, Serbia. The centre plans to develop climate change scenarios for the Southeaster European region.

It is expected that the next National Communication will contain new findings for the region as the result of this cooperation. While research will include a variety of socioeconomic scenarios to reduce uncertainty, the increasing availability of socio-economic data for BiH in the near term will also guide judgements on the assessment of findings from these various scenarios.

3.4. Assessment of vulnerability

BiH is exposed to substantial risk on two grounds: (i) it is located in an area where negative effects from climate change are expected, and (ii) it does not have the management, technological and economic capabilities to adapt to climate changes.

Put another way, climate vulnerability, or the risk of adverse events occurring, can be seen as a function of three factors:

1. Exposure to threats from climate change;
2. Sensitivity to threats from climate change; and
3. Adaptive capacity to address climate change.[12]

In BiH, exposure to threats from climate change will be considerable. The previous sections of this chapter have summarized findings from historical and current data that indicate increased climate variability; all of the currently-available climate change scenarios indicate long-term increases in air temperature and overall reductions in precipitation for BiH.

BiH also has a high sensitivity to these threats because of the economic prominence of "climate-sensitive" sectors, such as agriculture and forestry (and the role of hydropower in the energy sector to a lesser extent). Threats to these sectors could therefore have significant secondary impacts. Furthermore, a lack of alternative employment options in communities dependent on climate-sensitive sectors of the economy could make these problems worse.

Finally, BiH has very limited adaptive capacity to address climate risks. These capacity constraints are discussed in detail in Chapter 6 of this Communication. Complicated governance structures, a lack of key strategic documents and supporting regulations, limited human resource capacity, and financial constraints lead to very limited capacity to respond to climate threats and adapt to climate change in a systematic, integrated way; i.e., through proactive adaptation measures. At the same time, low public awareness and economic constraints in industry and households limit the capacity of those potentially affected by climate threats to undertake autonomous adaptation measures.

[12] UNFCCC, "Introduction and Overview of V&A Frameworks" (presentation: date not provided).

The following sub-sections of this chapter provide an overview of the vulnerability of five sectors in BiH that were selected because of their national significance:

- biodiversity and ecosystems
- water resources
- agriculture
- forestry
- health

There is also and a brief discussion of the secondary socio-economic impacts resulting from climate threats in these five sectors.

3.4.1. Biodiversity and ecosystems

As discussed in Chapter 1 in the overview of national circumstances, BiH has a particularly rich biodiversity due to its location in three distinct geological and climatic regions, it has some of the greatest diversity of species of plants and animals in Europe, and it has an extremely high level of diversity of biotopes (habitats); i.e., geodiversity. While the impact of climate change global biodiversity has been treated in many studies, there are lacks of studies that address regional and local impacts of climate change on biodiversity. Few studies on climate changes impacts on agriculture and forestry in Bosnia and Herzegovina have been published and no studies could be identified for BiH that discussed the problem of climate change impacts on biodiversity, including sensitivity and adaptation. Furthermore, there are not yet models to use for the valuation of possible habitat change plant and animal communities in BiH either. The biodiversity protection strategy in Bosnia and Herzegovina is pointed on climate changing problem and possible influence on some landscaping systems in Bosnia and Herzegovina. Therefore, there haven't given concrete examples for some species, and models of changing habitats haven't been created for specific ecosystems, plant and animal communities.

Based on existing research findings, the following main types of climate change effects on biodiversity, which are detailed in the following sub-sub-sections, are to be expected in BiH:

- Shift of vegetation zones (layers) in a horizontal and vertical direction,
- Shift and changes in habitats of individual plant and animal types,
- Extinction of individual species,
- Changes in the quality and quantity of the composition of biocenoses,
- Fragmentation of habitats,
- Changes in ecosystem function.

3.4.1.1. Impacts on ecosystems

The areas of Bosnia and Herzegovina which are the most sensitive to global climate change are defined by the strategy for the protection of biodiversity, including an action plan. The sensitive areas exposed to strong pressure from changing climatic conditions are as follows:

- High-mountainous ecosystems (higher than 1600m above sea level)
- Mountain ecosystems (from 900 to 1600m above sea level);
- Ecosystems of Sub-Mediterranean forests and underwoods (from 300 to 80m above sea level)
- Ecosystems of karst caves, basins and abysses;
- Ecosystems of highlands (from 600 to 900m above sea level)
- Ecosystems of Peripannonian area (from 200 to 600m above sea level);
- Pannonia ecosystems (until 200 m. above sea level).

High-mountainous and mountain ecosystems, on the basis of research conducted to date on global climate change in BiH, are exposed to the biggest impact. In other words, areas at an altitude of more than 1500 meters above sea level have a faster increase in average temperature than the areas at a lower altitude. In addition, extremes in temperature represent the biggest pressure that is being exerted on these ecosystems, and it is especially visible in the warmer part of the year, leading to melting and drying, and with it the threat that many glacial and boreal relicts and their habitat could be destroyed. Acid rain also has a negative impact on the biodiversity of high-mountainous and mountain areas. Acid rain, to a large extent, changes the pH value of a habitat, especially of surface layers composed of accumulated humus, with which are again connected to the most intensified processes of decomposition of organic matter and serve as an active part of the risosphere. Decreasing the pH value in basic species leads to a reduction in their number, which has an impact on the cycles of reproduction. This phenomenon could cause some stenovalent species and forests to disappear, especially those growing in dolomites and dolomite lime-stones. The most endangered forest ecosystems are the fir-tree forests, which, taking into account the temperature and humidity, have a very narrow ecological valence. In contrast, beech-tree forests have a very broad ecological valence, and it is expected that they will become more prevalent in forests which are composed of a combination of both beech trees and fir trees.

Ecosystems of sub-Mediterranean forests and underwoods, and of karst caves and basins, as a result of global climate change, face pressure due to the soil becoming sour.

Peripannonian and hilly ecosystems are the second most endangered ecosystems after high-mountainous and mountain ecosystems. If we take into account the projected changes of temperature, the biggest pressure would be exerted on oak-tree forests, which means forests with the cork oak tree and the English oak tree. The cork-oak-tree forests are the lowest forests on the territory of Bosnia and Herzegovina, growing at 280 to 860m (altitude amplitude is very low – 580m). Migration of the cork oak tree and the English oak tree into the areas at higher altitude is hindered due to their heavy seed (Burlica, C., Travar, J., 2001). In addition, in the event that increased temperatures are accompanied by increased dryness, slowing decay of forest ground vegetation, a layer of raw humus would be formed that would subsequently lead to subsolation in the soil and a significant decrease in biodiversity in the lower layer of vegetation.

Pannonia ecosystems (natural and cultural) are endangered most by flooding. In and of themselves, the floods have a high percentage of nutrients the lead to the nitrification of the soil and ground water. Changes of pH values that appear as a result of nitrification cause acidophil plants and pedofauna to disappear. Floods are one of the dominant factors in the expansion of invasive species. In this way, in the Pannonia region of BiH, many species of weeds have found a habitat. With the aim to prevent flooding, levees have been raised along the Sava River, which has significantly changed the shape of the natural surroundings of those areas.

A key problem related to climate change impacts on biodiversity and ecosystems in BiH is the adaptation of forest ecosystems to very rapid climate change. Undertaking responsive measures in terms of maintaining the forests can decrease to a certain amount lower social and economic consequences of a decay of forests under the influence of global climate changes. Defining the protection measures for forest ecosystems requires more advanced research of the impact of regional climate change on forests and an analysis of the social-economic consequences from forest decay.

In addition, one of the significant consequences of global warming for ecosystems will certainly be the movement of water supplies and the distribution of agricultural pests and diseases. The IPCC has already foreseen in their scenario that the Mediterranean countries, which already depend to a large extent on irrigation, will have 15 to 25% lower soil humidity during the summer.

In summary, available data and their analysis indicate that climate change will threaten all three macro-regions in BiH. Regarding threats to biodiversity, the most endangered regions are the Alpine-Nordic region and the Mediterranean region. The area of the Dinarides will be particularly threatened as a very important and rich center of endemic species in the Balkans. This mountainous chain is of exceptional biological and geomorphological significance. The rivers in karst regions and ecosystems developed along these rivers may be particularly endangered as well.

3.4.1.2. Impacts on plant species

Vascular flora account for about 5,000 confirmed types of species, subspecies, and variety and form level. For purposes of comparison, the total number of flora species on the Balkan Peninsula is 6530 species (Turrill, 1929), and the total number of flora species in Europe is 11,000 (Tutin et al, 1980). As much as about 30% of the total endemic flora in the Balkans (1.800 species) is contained within the flora of Bosnia and Herzegovina. The area of Herzegovina is particularly significant because of its transition from a Mediterranean region into a highland mountainous region, which represents a very rich area in terms of plant diversity found on the border area between the middle-European and Macronesia-Mediterranean regions (Horvat et al, 1974). In the flora of Herzegovina, endemic species that belong to phyto-geographic area of the Western Balkans are dominant. The fact that the biggest number of present species are of a stenoendemic character supports the notion of a high degree of endemic species of this area. This endemic composition is a result of geographic proximity to the mountainous mass of the Dinara Mountains, which are a very important and rich center of endemic species on the Balkan Peninsula. Amongst these endemic plants limited to the central massif and slopes of the Dinaric alps, species with specifically narrow habitats stand out, the so-called strict endemites of the southeastern part of the Dinarides, then endemic species of the Sea Dinarides, etc. This concentration of Dinaric species supports the idea that the area of study belongs to the specific Mediterran-Dinarac phytographic complex (Lakušić, 1982).

There are many reasons for this very high degree of biodiversity. They include a very diverse geological basis with domination of carbonate rocks, significant area under karst, wide spectrum of diverse climate types ranging from the Mediterranean climate to the tundra climate on high mountains, and different types of soil have all created extremely good conditions for development of a rich mosaic of biodiversity in BiH. Out of 11 main catchments basin areas, eight belong to the Montenegro catchment basin, while the others belong to the catchment basin of the Adriatic Sea. The Sava River is the most important river, which other bigger rivers flow into (the Una, the Vrbas, the Bosna, the Drina). There are also many water wells in this area. Almost half of the land (47%) is covered by forests. Combined agricultural areas on which cereals are cultivated, fruit orchards and vegetable areas are mainly concentrated on the northern flat part of the country. Valleys between mountain massifs in the central and southern parts are adequate for development of agriculture. Combined farms and permanent arable surfaces cover around 30% of the territory, while the pastures cover additional 23%. Unfortunately, almost 20% of all plant species are jeopardized due to different human activities, so that even though BiH presents a significant center of biodiversity in the region, at the same time it also has a very high proportion of endangered species in the European range.

Climate change is expected to have a significant impact on plants with habitats in the mountainous areas of Bosnia and Herzegovina, especially migration of some woody plants in the direction along the Dinarides towards the northwest with possible local impoverishment of flora. A decrease of the number of herbaceous plants of narrow ecological valence in the highest mountainous areas is also expected, as these plants may not be able to adjust their habitat fast enough. This group includes species with a circumpolar, pre-Alpine, and Alpine pattern of distribution. There are already many threats imposed on this rich flora and fauna by a wide spectrum of human activities.

Fig. 3.4.1.2.1. High mountainous zones in BiH those are most sensitive to the effects of global climate change

Furthermore, the breakthrough of alochtonous species will increase and those more aggressive ones may drive out of the habitats the autochthonous species. Simulations performed under the assumption that there will be an increase of the average temperature of 2°C point to significant negative consequences for the biome of dark coniferous forests (see Fig. 3.4.1.2.2.)

Fig. 3.4.1.2.2. Distribution of the biome of dark coniferous forests in BiH.

Generally, it may be concluded that the most affected regions will be high mountainous areas in BiH at altitudes of around 1500m, which correspond to the border of sub-Alpine tier (Fig. 3.6.1.4.2.). [13]

3.4.1.3. Impacts on plant communities

The Normalized Difference Vegetation Index (NDVI) is used for measurement of photosynthetic activities. NDVI relates to the rate of photosyntethic absorption of radiation and it presents the difference between reflection of visible radiation (where chlorophyll absorbs solar radiation to a significant extent) and infrared radiation (where sponge mesophyll in the leaf brings to a significant radiation). High NDVI corresponds to a high degree of photosynthetic activity. Data have also shown that the phase of active growth has been extended in this area by 10 days. Increase in photosynthetic activity is obvious in the period between April and end of June. Also, the phase of reduction of the active vegetation season has been extended.

New analysis of satellite data has shown that the photosynthetic activity of inland vegetation has grown by 10% in the regions that lie between 45° N and 70° N in the period of 1981–1991. Bosnia and Herzegovina is among the most endangered zones (Myneni et al, 1997; see Fig. 3.4.1.2.3.).

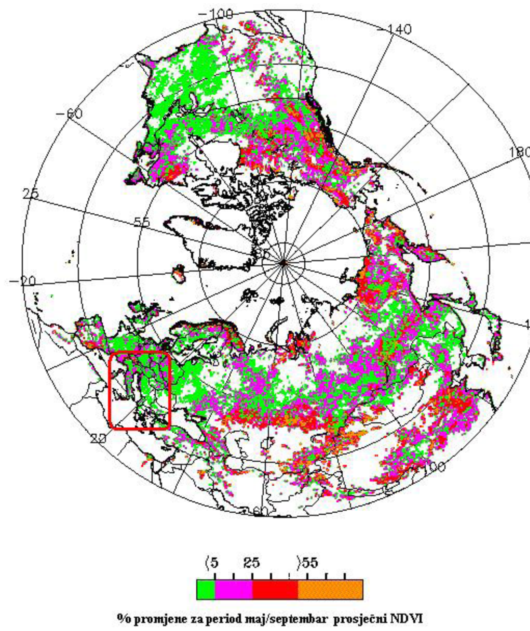


Fig. 3.4.1.3.1. Increase in the NDVI for the period May–September (1982–1990).

[13] The definition of the sub-Alpine layer of vegetation is given according to Ellenberg (1996) and Dierßen (1996), who state that sub-Alpine tier presents a tier between the upper limit of beech (mountain tier) and potential upper border of tree growth (sub-Alpine tier border).

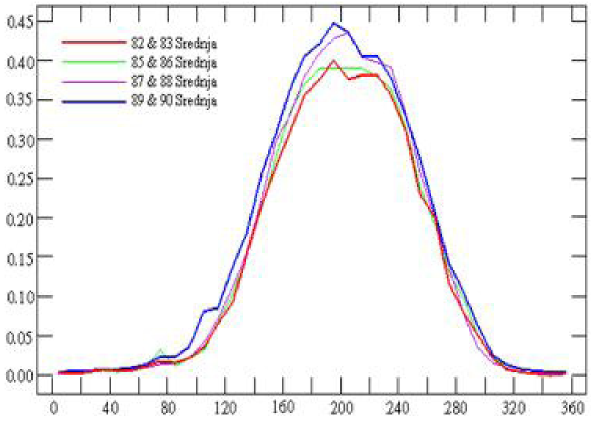


Fig. 3.4.1.3.2. Spatial average NDVI (>45º N)

The increase in temperature, as well as length of vegetation season, has positive effects on the growth of plants by stimulating the photosynthetic uptake of CO_2. Temperature increases also cause earlier melting of snow in the spring and fast mobilization of nutritious substances in the soil. Unfortunately, such melting of snow in the spring leads to the release of acids and chemicals that have been emitted by different industrial plants and have accumulated in snow and soil during the winter season. Melted snow flows into springs and rivers and from there gradually to lakes. Entry of these acids and chemicals into lakes causes a sudden and drastic change of the pH value of lakes – this is where the term "spring acid shock" comes from. Water ecosystems have no time to adjust to this sudden change. The spring is a particularly sensitive period for many water organisms, as this is reproduction time for many amphibian, fish and insects. Many types hatch their eggs in the water. This sudden change of the pH value is dangerous for them, as acids may cause serious deformities to the infant organisms or even lead to extinction of individual species, as the young spend quite a lot of time in the water.

3.4.1.4. Impacts on the biocenosis[14] of the soil

It is not very likely that climate change will directly decrease the number of species in the soil, except in the case of obligatory symbiotes with partners that have been affected by changes. The majority of biocenosis components in the soil have a wide tolerance of temperature and humidity changes. Mainly short life cycles will provide for genetic adjustment.

However, climate change may still affect the abundance of species, which secondarily may have qualitative and quantitative effects on soil ecosystems as a whole, primarily when it comes to trophic relations between biocenosis members. Warming of the soil will cause an increase in the number of microorganisms and in the processes of mineralization of nitrogen and phosphorous, by which the availability of these nutritious elements for plants will increase. In addition, interstitial fauna in narrow coastal areas (depending on local topographic features) may be directly exposed to salinization as a consequence of sea level increase. As a consequence of participation of individual microorganisms and organisms in complex ecological chains, the total direct impact of climate change on biodiversity in this group will be negative.

3.4.1.5. Impacts on the biocenosis of fresh waters

Warming of air at ground level will cause warming of the soil, as well as of the water in the soil. A projected shift of zones in mountainous areas will decrease the areas under snow, and it will also decrease the quantity of snow-related water, as well the quantity of water coming from these wells in the spring, after melting, to rivers and other water flows. Changes in annual rhythms of water levels may be expected, as well as in water quality. This will probably affect the quality of ground and surface waters and, directly or indirectly, the composition of related biocenoses.

3.4.1.6. Impacts on fauna

Numerous animal species will be endangered, directly or indirectly, by the consequences of global warming. Processes related to climate change are directly connected to changes in the ecological conditions of habitats, and high mountainous ecosystems – such as those in BiH - are particularly affected. As a consequence of changing climate conditions, endangered, rare or vulnerable organisms disappear, the endemic genofund is lost, and there is also a loss in biodiversity at genetic, species and ecosystem level. Tracking of the consequences of climate change on nature and biodiversity is done by using climate change bioindicators.

Climate change impacts will be particularly detrimental for swamps, including those in the Mediterranean part of Europe. For the majority of migratory birds, weather and food during migrations are two critical factors. Global warming has already changed both of these factors. Birds need adequate food in order to successfully fly long distances without stopping. Prior to migrations, birds may double their weight. Nowadays, many areas used during migration of birds are endangered by global warming, and changes in these areas could present a serious danger for millions of birds.

Adult animals, particularly those from higher taxonomic groups, may reduce influence of global warming by physiological mechanisms (behavior, thermoregulation, hypothermia, temperature compensation, etc.). Even though these mechanisms significantly increase resistance, they cannot eliminate the secondary effects on animal biology, especially, mechanisms related to reproduction. In terms of ecology, global warming

[14] Biocenosis refers to the ecological or biotic community, or the component of the ecosystem that is distinct from the physical environment.

may lead to a decrease in the number of fauna species in natural habitats, as well as their distribution over across geographic and climatic regions. It has been noted, for example, that some species of butterflies change their habitats even when the environment temperature changes less than 1°C. An effect on daily, seasonal and annual rhythms of activities may be particularly expected, as well as migrations, especially those of insects, and also to sensitive interactions between insects and plants. In the group of nematodes, it has been noted that different species react to soil warming differently, and that both a decrease and an increase of the number of species may be expected, depending on the group. There is still insufficient data for understanding the relationship between vertebrate populations and climatology. For example, birds in sea coastal habitats seem to experience more negative effects than the other types of ornythofauna.

In BiH, climate change will affect different groups of animals. For example, endemic animals in karst regions will be particularly affected, because shifting climate zones will disturb the physiological and ecological conditions necessary for the survival of individual stenoendemic genuses of karst and coastal lizards. Swamp areas in the Hutovo Blato park region is particularly sensitive. This region, which is located in the sub-Mediterranean zone and is categorized as a Ramsar site,[15] will be affected by disturbances in migration schedules and the availability of food resources. The loss of swamp areas, such as Hutovo Blato, could lead to the disappearance of bird and turtle populations, which live there throughout the year or are present only during the migration period.

Climate change and vegetation shift may also significantly disturb the future distribution of animals, their numbers and survival. The speed of changes, particularly combined with urban and agricultural barriers, may affect the capability of many species to move to zones that are much more appropriate for them in terms of climate and ecology. Endangered or rare species will soon become particularly sensitive to sudden changes, especially if their distribution is limited in terms of space and the width of their niche narrowed.

3.4.1.7. Impacts on coastal ecosystems

With impact of changes in the regime of temperature and precipitation on biodiversity of coastal ecosystems of the Adriatic coast, the change of the sea level will also make an impact. For the Mediterranean area, the projected sea level increase is 34–52 cm. Ecosystems that will be directly exposed to these impacts include low coastal areas; e.g., coastal sands, salines and estuaries. Changes in physical, hydro-dynamic, biological and chemical parameters may be expected, with accompanying quality and quantity changes in the components of biocenoses.

[15] A site that is included on the Ramsar List of Wetlands of International Importance, which is related to the Ramsar Convention (The Convention on Wetlands of International Importance, Especially as Waterfowl Habitat).

Serious consequences for biocenoses in fresh waters may cause warming of water surface layer and deeper breakthrough of brackish water into estuaries. Damage or disappearance of certain valuable coastal habitats in these erosive processes may be expected. The direction of changes or impacts on individual taxonomic groups is hardly predictable. Rivers in the Dinara catchment basin will be greatly affected, particularly the Neretva and Trebišnjica Rivers. The Neretva River area has been, due to its biological specificities and the Hutovo Blato swamp, protected and included in the list of valuable swamp habitats according to the Ramsar Convention. Impacts in that region could be extremely negative.

3.4.1.8. Impacts on protected areas

Climate change threats to individual species and communities that currently inhabit protected areas may lead to the need to change the borders of national parks: "Tjentište" National Park (Foča), "Kozara" National Park (Prijedor), and the newly-established "Una" National Park. One "mitigating circumstance" is that the borders of these parks have not been precisely defined even today, and they have also not been determined in accordance with biological criteria. The long-term process of addressing these problems needs to take into account the role of climate change effects on the future borders of these parks. The threat to protected areas is exacerbated by the fact that only around 2% of BiH territory has been categorized as protected areas.

3.4.2. Water resources and coastal zones

Bosnia and Herzegovina is vulnerable to a variety of climate change threats in the water sector. Figure 3.4.2.1. provides an overview of the general relationship between climate change and impacts in the water sector.

3.4.2.1. Impacts on Precipitation and runoff

As specific research has not been done in Bosnia and Herzegovina regarding the impact of climate change on hydrology and water resources, the following conclusions were reached by assessing possible indications of impacts on hydrology and water resources and assessing needs in defining real influences and adequate responses.

Climate variability as already been observed regarding precipitation. Extreme and average values of precipitation per month during the year were analyzed at Tuzla, Sarajevo and Mostar to reflect the three major climatic

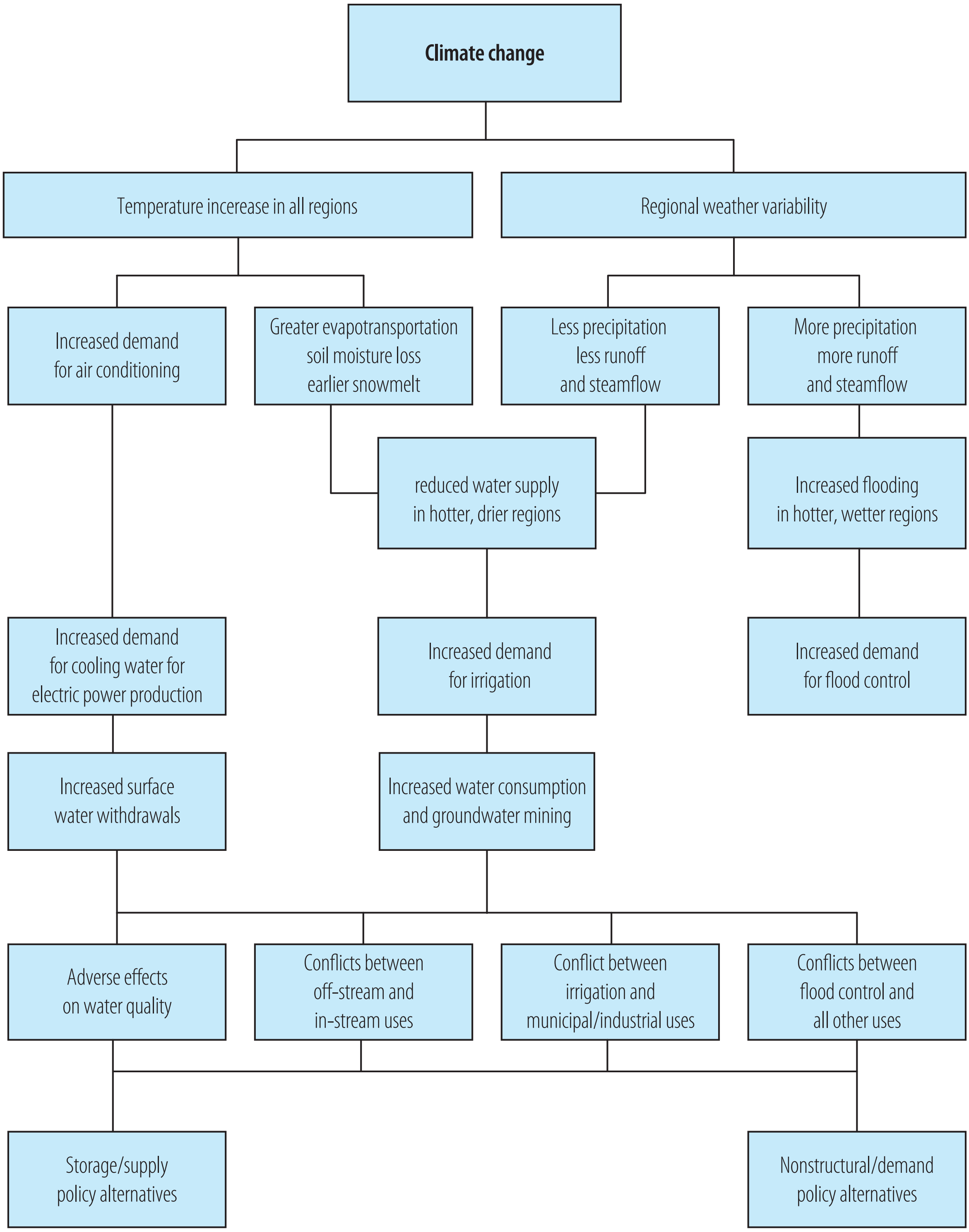


Fig. 3.4.2. General vulnerability scheme (Hardy, 2003).

regions in BiH. Figure 3.4.2.1. shows the maximum, minimum and average values of monthly precipitation, for two periods of 26 years: 1956-1981 and 1982-2007. Significant changes can be seen in Mostar, where the average amount of precipitation in the period 1982-2007 is significantly lower than in the period 1956-1981 in all months except in September.

For the continental part, it is not possible to draw conclusions about significant changes in precipitation regime on the basis of the displayed diagrams. Here are changes that can not be perceived on the basis of the average annual values, but it is necessary to carry out sophisticated analysis and studies with the aim of the research phenomena that are becoming available: increases in the number of consecutive days without rain, changes in intensity and frequency of storms, floods and droughts, including phenomena that previously occurred once every 50 years and that now occur every 5 to 10 years, etc.

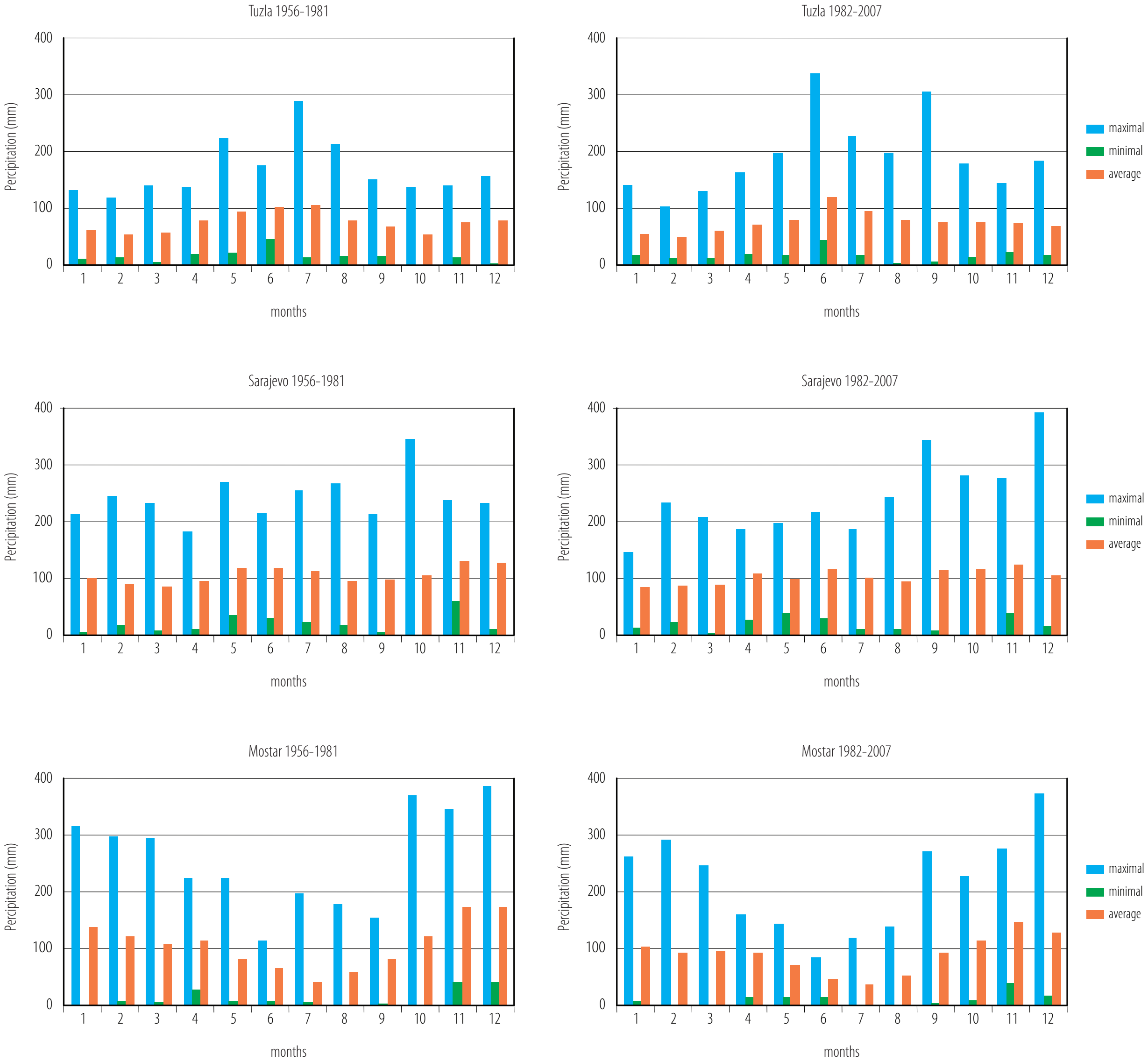


Figure 3.4.2.1 Extreme and average values for monthly precipitation in Tuzla, Sarajevo and Mostar for the periods 1956-1981 and 1982-2007.

In a variability analysis, the obvious form of preliminary inspection would be to make a simple time plot. However, this kind of plot of a hydrologic variable does not always lead to good visualization, particularly when the object is the subject of subtle changes over time. More clearly, a shift in the runoff record usually can be identified by the existence of a linear trend in the Rescaled Adjusted Partial Sums (RAPS), which reverses direction at the point at which the shift occurs.

A simple time plot and corresponding RAPS was made for the water discharges in the Sana River at Sanski Most and for water levels of the Buna River (Fig. 3.4.2.2). Those visual trends do not prove the existence of a shift, but they do draw attention to a feature that requires further analysis such as, for example, a homogeneity test of hypothesis for the shift. The RAPS hint that possible linear trends can exist in the annual discharges.

Figure 3.4.2.3. shows a water flow-duration curve for three different periods, Sana River at Sanski most. On the basis of a single-station data it is not possible to draw any general conclusion except that the chart indicates that changes in the percentage of time river flow can be expected to exceed a flow of some specified value, and that more research is needed. Using the information on the visualized trends and shifts, a further analysis linear trend test should be done across BiH to determine the existence and the degree of linear trend in the river runoff series.

Further analyses should be more detailed. BiH is mostly hilly to mountainous territory, and 24.7% of total area is higher than 1000m. It is clear that snow has an important role in the regime of precipitation and runoff. Unfortunately, the influence of snow in hydrological cycle in Bosnia-Herzegovina has not been seriously analyzed yet. In a situation where BiH is facing increasing average temperature, the question of the influence of snow precipitation becomes even more significant for analysis.

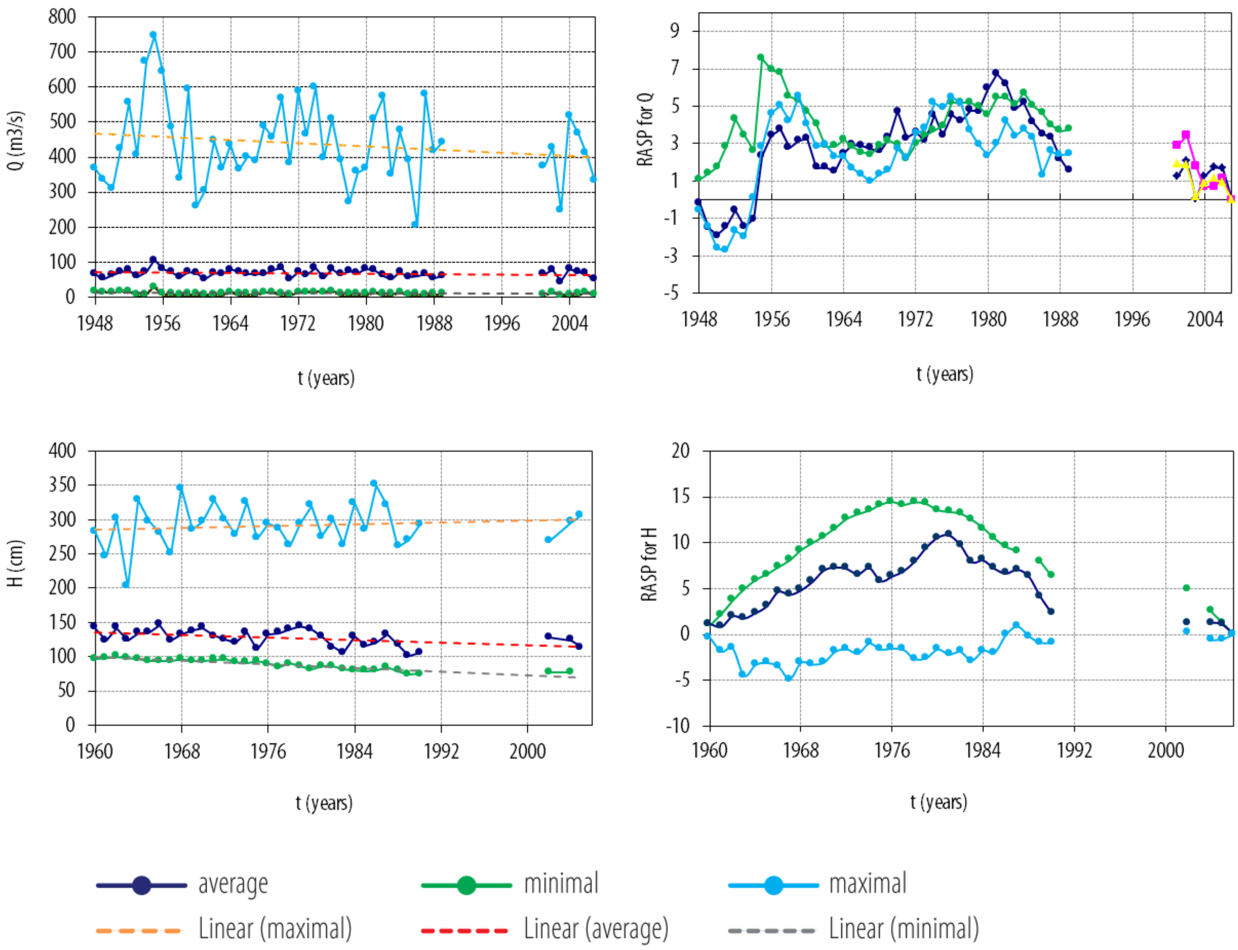


Fig.3.4.2.2. Maximum, average and minimum discharges and RAPS parameter for the Sana River in Sanski Most in the period 1948-2007 (top row) and maximum, average and minimum water levels and RAPS parameter for the Buna Rivers near Buna in the period 1960-2006 (bottom row).

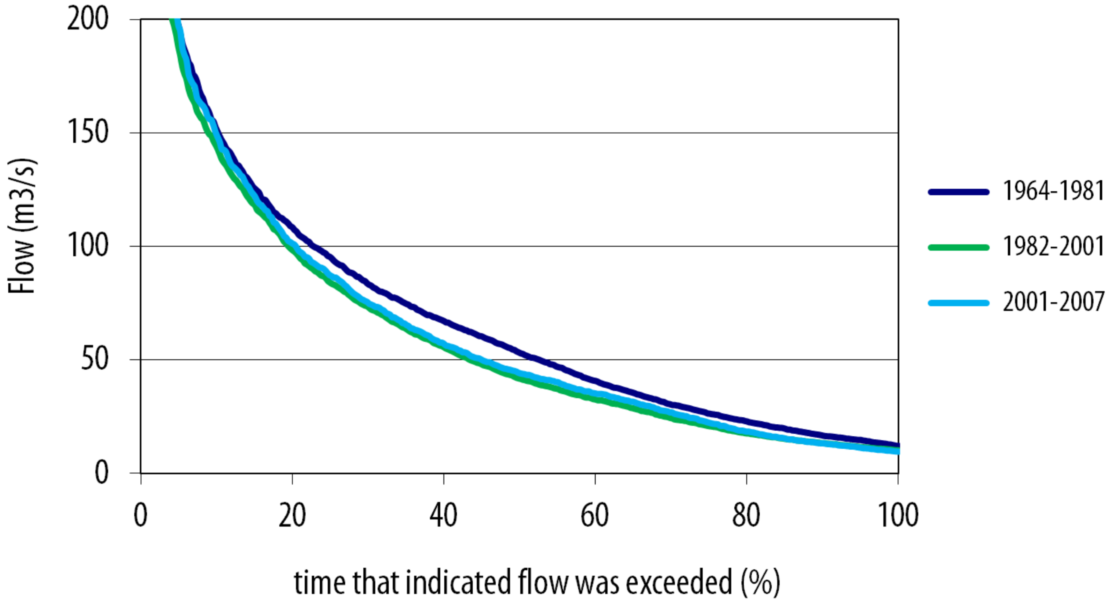


Figure 3.4.2.3. Flow-duration curve for different periods, Sana River in Sanski Most.

3.4.2.2. Impacts on coastal zones

The Mediterranean region is one of the most vulnerable areas to climate change in the world. It is expected that in coming years in this area there will be further warming, an increase of drought periods and reduction of precipitation. There will also be an increased frequency of extreme events such as storms, floods and heat waves. The sea will get warmer, sea level will increase, and there will be changes in marine currents and surface winds. Seal level rise will cause inundation, coastal flooding and erosion, saltwater intrusion and sediment influx in sensitive coastal habitats. All of these effects can be expected in BiH.

Sea-level measurements at four points on the east Adriatic coast over the last 40 years indicate differential sea-level trends: from a rise between +0.53 and +0.96 mm/y to a decrease between -0.50 and -0.82 mm/y, a range mainly due to local tectonic activity (Barić et al, 2008). It must be noted that other models, such as the model of climate change for Albania, predict the sea rise level in Adriatic up to 24 cm until 2050 and up to 60 cm until the end of the century. The scenario developed in the framework of the UNEP Programme on Climate Change in the Mediterranean Region (1990-1996) showed the most probable rise in the average sea level as 65+35 cm (REC, ECNC, 2008).

The eastern coast of the Adriatic Sea runs mostly along Croatia, Montenegro and Albania but lesser parts belong to Slovenia and Bosnia and Herzegovina. With a length of 26 km, the coastline of BiH cuts the Croatian coast into two parts. Consequently, in the absence of national measurements, findings regarding the level of the Adriatic Sea on the Croatian coast are relevant for the BiH coast, too. The main factors identified are sinking of areas close to the shore, penetration of salt water into ground water, coastal erosion (MZOPP, 2001: 73).

Ongoing intrusion of salt water into freshwater habitats in the lower Neretva delta has already caused habitat degradation and habitat loss, and this effect might be increased. In addition, species that are adapted to the freshwater rivers may be threatened or even may disappear.

3.4.2.3. Impacts on water management systems

As the temperature and precipitation regime changes in BiH, climate change impacts are expected to affect nearly all water management systems. However, the assesment of climate-related impacts on water supply systems and hydropower systems have not yet been conducted at the state level. No hydrological study has been prepared for the last two decades for the BiH as a whole. At the begining of the 1990s, knowledge regarding the water regime of Bosnia and Herzegovina was quite sufficient for planning and decision-making at the state level and for each major catchment area. However, even in that period, many kinds of hydrological information in BiH were not known, including the following:

- balances and water regimes of small and medium-sized catchments;
- extreme flows;
- distribution of water quantity during the year and during longer periods;
- water regimes, definition of underground bodies and underground water zones of communications in certain areas of karst;
- more detailed study of spatial variation of underground Adriatic - Black Sea watershed (where it is a time-variable) ;
- comparative analysis of potential coincidence of hydrological phenomena in the main water courses of the Adriatic basin and Black Sea basin in BiH (Okvirna vodoprivredna osnova BiH, 1994).

After the breakdown of the former BiH Hydrometeorological Service during the early 1990s, state-level services have never been restored. Consequently, there is no collection and processing of hydrological data on the level of BiH, so decision-makers and managers in the water sector are limited to the use of historical climate data (i.e., data generated before 1990) to design water infrastructure and to guide their management decisions At the same time, conditions are constantly changing, and the need for a secure water supply has increased over time, so extreme hydrological situations are becoming more frequent. Unless BiH starts to rebuild the basic systems to provide information about water resources, it faces the danger that new water management systems will not achieve their anticipated functions.

The National Environmental Action Plan (NEAP, 2003) for BiH recognizes the protection of the global climate as one of the main strategic goals of BIH, as well as the need for »exploration of the impact of climate changes on water resources....« Some activities to set the course for assesing climate impacts on water managment systems and their planning have been undertaken recently in both entities. The Federal Water Strategy is in the process of elaboration, and Republic of Srpska developed a Framework Plan for Development of Water Management in RS in 2006. This plan mentioned the possibility of increases in the intensity of extreme precipitation and prolonged periods of drought.

Apart from that, entity-level water laws mandate the development of river basin managment plans to the year 2012. Water Management Plans for river basins have to be developed specifically for the Sava River basin and the Adriatic Sea basin. The agencies responsible for developing Water Management Plans are Water Agencies, and the plans cover the period until 2012 for FBiH, and 2015 for RS. These Plans will be revised and updated every 6 years. The working plans for the preparation of Water Management Plans will be announced to the public at least

3 years before adoption of the Plans. These Plans should be based on recent, reliable and accurate information, so their preparation should assess climate impacts on water managment systems.

In general, water management systems and water-related sectors in BiH will be threatened by climate changes mainly due to the following:

- Impacts of extreme water events, such as floods and droughts. There are sound reasons to expect that there will be more powerful, intense storms and floods and more intense droughts. More intense rainfall will increase the cost of flood protection works, as well as that of associated infrastructure such as roads and storm-water drains. As important as the size of extreme events is how often they occur; It is predicted that extreme events will occur more often; floods and droughts that previously occurred once in a lifetime, every 50 years, may now occur every 5 or 10 years;
- Impacts of temperature increases - increase of aridity; the ratio between rainfall and evaporation. Since evaporation increases with temperature, aridity will increase in many areas, which will have direct negative impact to agricultural activities.
- Lower river flows will affect non-reliable water supply, electricity production and tourist activities, as well as resulting in lower water quality caused by flow variations.
- Lack of water will be especially significant in summers, during tourist season and intensification of water consumption.

As the temperature and precipitation regime is changing in BiH, climate change impacts can be expected in almost all water management systems.

BiH already needs additional resources to address problems with inadequate infrastructure in the water sector, and it will thus be more vulnerable to projected impacts on water quantity and quality unless low-cost options and affordable financing are available. There is also a need for detailed research on climate change impacts in the water sector. Greater variability in water availability may lead to conflicts between water users in BiH (agriculture, industries, ecosystems and settlements). The institutions governing water allocation will play a major role in determining the overall social impact of a change in water availability.

3.4.3. Agriculture

B&H covers 5,112,900 ha, of which around 50 % is classified as agricultural land, an area equivalent to only 0.58 ha per capita, or 0.27 ha of arable land per capita. B&H is very poor in good quality soil. Forty-five percent of agricultural land is medium quality hilly country (300-700 m), well suited to semi intensive livestock production. Mountainous areas (over 700 m) account for a further thirty-five percent of agricultural land. High altitude, steep slope and poor soil fertility limit use of this land to livestock grazing during the year.

Less than twenty percent of agricultural land (half of all arable land) is suited to intensive agriculture, and most of it is in lowland river valleys and karstic fields. Land base for agriculture is thus very limited in both quantity and quality.

3.4.3.1 General impacts on agriculture

Regional analysis (Bruci, 2007) indicate the following general impacts on the agriculture sector in Southeastern Europe, including BiH:

- "Increasing temperatures will promote the development rate of all winter crops such as wheat, which therefore might face extreme events and a higher intra-annual variability of minimum temperatures-yielding a higher probability of crop failure from frost damage. More hot days and a decline in rainfall or irrigation could also reduce yields."
- "Temperature increases in spring and summer will accelerate the course of crop development more crucially on short cycle crops that are sown in spring than on winter crops. "
- "Total growing season may be reduced for some crops. Cereal harvest dates would occur sooner. Lack of cold days could reduce vernalization effects and consequently lengthen the first part of the growing season for the winter cereals."
- "Warmer winters can reduce the yields of stone fruits that require winter chilling (moderate coldness) and livestock would be adversely affected by greater heat stress."
- "For summer crops, determinate crop yields would be affected by the shortened crop cycle and reduced time to assimilate supply and grain-filling periods. On the other hand, improvements in the rate of dry-matter production can be expected from enhanced CO_2 concentrations" (Bruci, 2007: 36).

3.4.3.2 Vulnerability to drought at the national level

Drought can be classified as hydrological, hydro-geological, atmospheric and soil drought. Hydrological drought provokes the decreasing of the water flow in rivers, streams and lakes; hydro-geological provokes the lowering of ground water table; the atmospheric drought provokes the disturbance in water budget of an area caused by precipitation deficiency and a large amount of evaporation and transpiration; finally, the soil drought provokes the excessive soil drying. The following analysis takes both atmospheric and soil drought into account by using a unified soil water budgeting method.

Fig. 3.4.3.2. Scheme of spatial distribution of average annual precipitation (P), potential evapotranspiration (PET), surplus of water (S) and deficit of water (D)

Precipitation

Precipitation represents the greatest water resource in BiH. Average annual precipitation is about 1200 mm, which in terms of volume amounts to 61.6 billion m^3. However, precipitation is the most variable hydrological parameter in terms of space and time, a fact that is drastically obvious in BiH (Fig 3.4.3.2.).

Average annual precipitation in the southern parts of BiH amounts to about 2000 mm, in central parts about 1000 mm and in northern parts about 800 mm. These quantities are considerably higher in rainy years, and considerably lower in drought years. Seasonal variability is characterized by unfavorable distribution of precipitation over the year, particularly manifested in the southern parts of BiH, where the major part of precipitation is coming in the colder season when the need for evapotranspiration is reduced, while the lesser part appears in the summer season when the need for evapotranspiration is increased. This is a primary characteristic of the Mediterranean precipitation regime. In central and northern parts of BiH, the seasonal distribution of precipitation over the year is more favorable for agriculture, having the characteristics of a continental precipitation regime. Annual precipitation in all three parts of BiH is higher than annual potential evapotranspiration, but because of uneven precipitation distribution the potential evapotraspiration is not covered by precipitation.

Statistical interpretation of the hydrological phenomena is always under risk because of the "stochastic and random" effects. We never know for sure what could happen in the future out of treated series. In addition, the climate is characterized by cyclic fluctuation. It would be interesting to analyze a trend of main hydrological parameters from the agricultural point of view for the Second National Communication in conjunction with climatologists.

Fig 3.4.3.3. Geographical situation of studied locations in Bosnia and Herzegovina Bihać, Banja Luka, Bosanski Brod, Bijeljina, Livno, Mostar, Sarajevo Tuzla i Trebinje)

Potential evapotranspiration (PET)

PET is a more stable parameter than precipitation. The annual average PET in BiH is about 725 mm, which is considerably higher in southern parts (900 mm), while it is lower in central (650 mm) and northern parts (700 mm).

The basic characteristic of seasonal distribution of PET over the year is the discrepancy between precipitation and PET, being higher in southern than in central and northern parts of BiH.

Real or actual evapotranspiration (RET)

The average annual RET throughout BiH is about 600 mm, about 125 mm lesser than PET, but the differences between RET and PET are the greatest in the southern parts (about 300 mm), lower in the northern (about 100 mm) and lowest in the central parts (about 50 mm) of BiH.

Soil water deficiency or irrigation water requirements

Drought can be expressed in two ways: through the quantity of soil water deficiency in mm and through the relationship (ratio) between real and potential evapotraspiration (RET/PET), the "drought coefficient."

The average annual soil water deficiency in BiH is about 125 mm, which is greatest in southern parts (300 mm), considerably lower in northern (100 mm) and lowest in the central parts (50 mm). The average situation can serve just to illustrate general conditions which do not exist in nature. Agriculture has to be protected not only from average droughts but from those occurring once in ten years. Because of that, it is necessary to take into account the frequency of drought phenomena. Experience shows that to calculate the frequency of a once–in- ten-year's drought from average values, the average values have to be multiplied by the following coefficients:

- In BiH 125 mm x 2.75 .... 344 mm
- Northern parts of BiH 100 mm x 3.0 .... 300 mm
- Central parts of BiH 50 mm x 4.0 .... 200 mm
- Southern parts of BiH 300 mm x 1.67 .... 501 mm

These quantities of water should be ensured by irrigation in the event of droughts occurring once in ten years, but they should not be used during the average years.

The highest coefficients (4.0) are in those areas (central) where the average values are the lowest. On the contrary, the lowest coefficients (1.67) are in those areas where the average values are the highest ones.

The analysis presented above is important to design infrastructure for irrigation systems, which could of crucial importance in the prevention of extreme seasonal drought and could serve as a stabilizing factor for the food supply security system. This analysis can help decision-makers to set priorities for future irrigation system planning in BiH. The southern part of the country will be on the top of the list of priorities because of its detrimental drought effect and soil water deficiency.

The determined annual water deficiencies could serve as annual irrigation water requirements when irrigation becomes actual. Besides, these data could serve to decision makers for the future irrigation planning and for choosing the irrigation preferential areas in competition with other areas. Irrigation expansion strategy, as a main measure for drought prevention, has not been developed in BH, at any level, so far.

3.4.3.3 Vulnerability to drought at the local level

Eight localities were included in this analysis, and a soil water balance the period 1951-1980 was estimated to show the differences between them.

Frequency distribution of drought severity

It was found that the strongest droughts have occurred in the Mostar area, where in 1952 a catastrophic drought with annual soil water deficiency of over 400 mm occurred. Very mild droughts or no drought at all were see in Bihać. The other localities are between them. The sequential order of decreasing drought of once in ten years occurrence is as follows: Mostar > Bijeljina > B.Brod > Tuzla > Sarajevo > Livno > Banja Luka > Bihać

3.4.4 Forestry

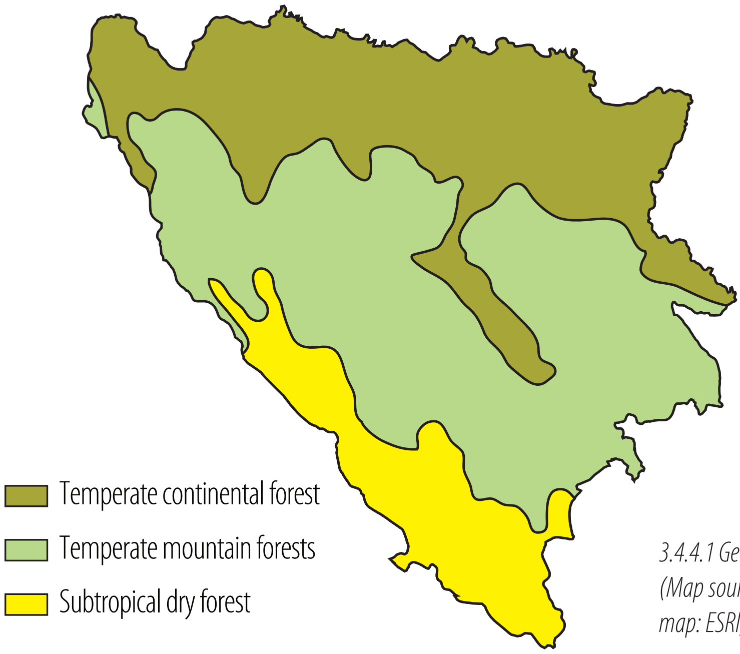
3.4.4.1 Vulnerability of forest ecosystems to climate change in BiH

Due to their natural and diverse structure as well as extensive natural regeneration, forests in Bosnia and Herzegovina represent one of its crucial natural resources. Forests and forest land in BiH encompass an area of approximately 2,709.800 ha, or around 53% of the entire country. Due to its diverse soil foundation and climatic influences, BiH has over one hundred tree species. The main species found in BiH forests are mostly fir, spruce, Scotch and European pine, beech, different varieties of oak and a less significant number of noble broadleaves, along with fruit trees.

The following map shows the geographic spread of forest land by climate zones, where they can be grouped into three regional segments: temperate continental forests, temperate mountain forests, and subtropical dry forests.

Locality	Annual soil water deficiency in mm					
	0	1 -100	101 - 200	201 - 300	301 - 400	> 400
	Drought scale					
	No drought	Very mild drought	Mild drought	Strong drought	Very strong drought	Catastrophic drought
Bihać	17	10	3	0	0	0
B. Luka	12	12	4	2	0	0
B. Brod	4	8	13	5	0	0
Bijeljina	3	6	13	7	1	0
Tuzla	12	13	2	3	0	0
Livno	6	17	5	2	0	0
Sarajevo	8	11	10	1	0	0
Mostar	0	8	9	10	2	1

Table 3.4.3.3. Frequency distribution of drought severity



3.4.4.1 Geographic spread of forest resources in BiH (Map source: Global Forest Resources Assessment 2000, base map: ESRI)

Forest ecosystems in BiH will sustain direct impacts from the following sources:

- temperature and precipitation changes;
- increased atmospheric concentrations of CO_2 (changes in tree growth and water use); and
- altered fire regimes and changes in the range and severity of pest outbreaks;

There is a possibility that climate change could influence the forests in BiH in ways that could potentially transform entire forest systems over time, shifting forest distribution and composition.

It has been proven that increased atmospheric CO_2 concentrations can have an effect on individual tree productivity, but can also alter leaf chemical composition, affecting herbivore fitness as a result (Saxe et al. 1998).

Severe temperatures and climate conditions such as frost and heat stress, as well as changes in the form, timing, and amount of precipitation (e.g., snow versus rain, drought versus flood) can effect individual trees and stand and forest system levels because these changes can increase susceptibility to pests, pathogens, and severe weather events (Schlyter et al. 2006).

Another significant threat to forest ecosystems is caused by an increase in forest fires. It is estimated that 3000 ha of forests is destroyed by fires annually in BiH. Increased risk of forest fires due to increased temperatures and changes in precipitation patterns is expected in some parts of BiH, which calls for fire protection capacity to be expanded.

All these aspects (weather, pests, pathogenes, and fire) can in the long run cause lower productivity and health status of the forests in BiH.

Another issue is the implications of climate change on forest biodiversity, ranging from shifts in timing of events that were synchronized in the past, such as bud burst, hatching and food demand by nesting birds (Walther et al. 2002).

3.4.4.2. Impacts on Forest Biodiversity

The fir-tree forests within BiH forests have a chance of showing high effects of climate change as they have a very narrow ecological niche and might face decline or loss. Due to their growth in mixed stands with beech, which has a broader niche, the beech trees have a high chance of pushing out the fir within the stands due to changes in humidity and temperature. Species with narrow niches will likely face decline or loss (Kirschbaum 2000) and may in the case of BiH start to move to the edges of their habitats, which shows a shift of vegetation due to climate change, therefore making other species more dominant (and potentially causing a decline in the economic value of these forests).

In terms of biodiversity within forest ecosystems, the changes in precipitation and water availability may have an effect on bird and animal species communities by leading to concentration of population in specific areas and increasing their vulnerability to pathogens.

In the area of subtropical dry forests (more precisely sub-Mediterranean forests) of BiH, the threat exists of a change in soil structure. This might cause a decrease in pH levels and lead to increased soil acidity which will not be acceptable for the current species. Moreover, mountain forests and high mountain ecosystems are very much endangered due to the temperature alterations. The highest threat will be upon the specific species of oak tree forests which mostly grow on low altitudes (less than 860m). The threats can undoubtedly cause species migration.

Additional discussion on the impacts of climate change on forest biodiversity is provided in Section 3.4.1.1.

3.4.5. Health

Table 3.4.5 provides an overview of the pathways through which climate change can directly and indirectly affect human health.

Health outcome	Effects of weather and climate change
Cardiovascular, respiratory, and heat stroke mortality	• Short-term increases in mortality during heat waves • V- and J-shaped relationship between temperature and mortality in populations in temperate climates • Deaths from heat stroke increase during heat waves
Allergic rhinitis	• Weather affects the distribution, seasonality and production of aeroallergens.
Respiratory and cardiovascular diseases and mortality	• Weather affects concentrations of harmful air pollutants
Deaths and injuries, infectious diseases, and mental disorders	• Floods, landslides and windstorms cause death and injuries. • Flooding disrupts water supply and sanitation systems and may damage transport systems and health care infrastructure • Floods may provide breeding sites for insect vectors and lead to outbreaks of disease • Floods may increase post-traumatic stress disorders
Nutritional deficiencies, respiratory diseases	• Drought reduces water availability for hygiene • Drought increases the risk of forest fires, which adversely affects air quality • Drought reduces food availability in populations that are highly dependent on household agriculture productivity and/or are economically weak
Vector-borne illnesses	• Higher temperatures shorten the development time of pathogens in vectors and increase the potential of transmission to humans • Each vector species has specific climate conditions (temperature and humidity) necessary to be sufficiently abundant to maintain transmission
Water-borne and food borne diseases	• Survival of disease-causing organisms is related to temperature • Climate conditions affect water availability and quality • Extreme rainfall can affect the transport of disease-causing organisms in the water supply
Source: Adapted from Kovats et al., 2003b.	

Table 3.4.5. Summary of the health effects of weather and climate change

3.4.5.1. Direct Impacts on Health

Climate change that is primarily related to temperature change may result in the following health problems in BiH:

- An increase in the number of those suffering from cardiovascular and cerebrovascular illnesses with subsequent disabilities of various degrees;
- An increase of the number of those suffering from respiratory illnesses (due to increase of air humidity, and indirectly through changes in the pollen calendar) (Keser, 2003, Santić and others, 2008);
- Deterioration of existing chronic illnesses (rheumatologic, immunologic, systematic) (Jovanović, 2007);
- An increase in the number of patients with psychological traumas (Sample et al, 2005; Hotujac et al, 2006);
- An increase in the mortality rate as a consequence of circulatory disturbances (cardiovascular and cerebrovascular illnesses), particularly as the result of heat waves and particularly among the elderly.

3.4.5.2. Indirect Impacts on Health

The population of BiH may also be at risk for the following indirect impacts on health.

- The combination of increases in temperature and pollution in Southeastern Europe as a whole would lead to an upsurge in respira¬tory illnesses, particularly among urban populationsWater shortages and damaged infrastructure would increase the risk of cholera and dysentery.
- Water pollution, already a major health hazard in the region, would become even worse as pollutants become more concentrated with reduction in river flows.
- Higher temperatures would affect the spread of vector-born illness, increasing the incidence and extent of infectious diseases. Snow melt, especially in the case of rapid warming accompanied by rain, could cause violent flood waves. These are characteristic and frequent phenomena of the Danube and Tisza River catchment areas further north in Central Europe. In the Mediterranean, intense precipitation falling on small catchment areas may cause rapid onset floods. Recent floods in Southeastern Europe highlighted for the population the need for security, including the protection of residences.

3.4.5.3. Vulnerability of Human Health

Events such as the heat wave in 2003 and recent flooding highlight the diverse vulnerability to climate change in BiH. Currently, there is a need to change the current paradigm of public health planning and disaster management from one of defensive action to one that strengthens regional cooperation in climate-related disaster risk management, including early warning system development, as a means reducing vulnerability (RCC, 2008).

BiH is particularly vulnerable to climate threats to human health because of the low adaptive capacity in the public health sector. BiH lacks a uniform basis for statistical data on monitoring the incidence and mortality rates for specific diseases (there is not even a standardized database for monitoring statistics of malign diseases, nor is there any standardized screening and monitoring program for these diseases). Monitoring of mass communicable diseases is only slightly better.

3.4.6. Socio-economic impacts

According to the FAO Report of 2007 (FAO, 2007) up to 11% of arable land in developing countries may face significant impacts from climate change, including the decrease of cereal production in 65 countries as well the decrease in agricultural production as a share of GDP for around 16% of countries. According to this report, socio-economic impacts are as follows:

- Decrease in crop yield and agricultural production;
- Decrease in agriculture as a share of GDP;
- Fluctuation of prices on world markets;
- Increase in the number of people who lack sufficient food;
- Migration and social unrest.

According to some scenarios (B2 scenario) in the sectors of agriculture, forestry and fishery, decrease of yield of agriculture products is likely (due to occurrence of extreme weather conditions), degradation or land erosion, loss of arable land, frequent death of cattle and decrease of cattle fund and vice versa. In 2008 FAO Report (FAO 2008), which is based on the IPCC Projection of 2007, the biggest decrease in crop yields in Europe is expected in the Mediterranean, the Southwestern Balkans and the Southern region of the European part of Russia. It may be expected that there will be a geographic redistribution of certain crops (e.g. sunflowers or maize, which will be cultivated in northern areas, unlike today).

In addition, it is expected that there will be increased needs for irrigation, an increase in risk of forest fires, increases in 'barren' land, a decrease in biodiversity, etc. The Summary for Policymakers of the IPCC Report (IPCC, 2007) states clearly that "The most vulnerable industries and societies are those which are mainly along the sea coasts and flooded river valleys, whose economy is closely related to resources sensitive to climate change, which are in the areas of frequent extreme weather conditions, especially in those areas in which accelerated urbanization happens." According to this document, it is projected that climate change in Southern Europe will worsen the situation (high temperatures and draught) in an area that has already been vulnerable. Other risks include decreased availability of water, reduced water potential, reduced summer tourism and, generally, reductions in crop yield. Due to heat waves and frequency of fires, health risks are also expected.

Bosnia and Herzegovina has certain specificities that may affect its vulnerability that should be taken into account. Primarily, these relate to refugees/displaced persons and returnees, as well as the existence of significant areas which have been mined. The following possible risks related to climate change impacts on socio-economic development should be taken into account in Bosnia and Herzegovina:

- Intensified migration to urban areas;
- Strained resources in urban areas caused by migration, which may lead to additional infrastructure problems, water supply problems, higher unemployment rates, and housing shortages;
- Reduction in employment in industries that process agricultural raw materials;
- Changes in the tourist economy, including a probable decrease in visits to mountainous destinations (due to a decrease in snowfall), which might negatively affect general development and employment in these areas Changes could also limit the regional development potential of villages of ecological tourism, which may in turn hinder the development and sustainability of rural areas;
- Failure to adapt workplaces to extreme weather conditions, which may negatively affect not only the health of employees but also their productivity. Outdoor work (construction sites, road building and such), where negative effects of extreme weather conditions are most observed, will be particularly at risk;
- Increase in the unemployment rate, increased emigration of the young and highly- educated population, increase in stress due to employment instability, and intensive changes in the labor structure of economic sectors;
- Increase in the number of users of social aid / protection that will additionally burden state funds and budgets;
- Increase in wider social dissatisfaction, an increase in the gap between the rich and the poor and potential social unrest.

3.5. Analysis of potential and elaboration of adaptation measures for vulnerable sectors

3.5.1. Biodiversity

Currently, adaptive capacity in the area of biodiversity is limited by the following factors:

- Unclear and uncoordinated strategic and development-related documents in the forestry, agriculture and water management sectors;
- Lack of applied research in biodiversity and the implementation of relevant international conventions and directives;
- Very low public awareness of the importance of biodiversity in preserving fundamental environmental values and in regulating climate change;
- Very few experts and institutions dealing with biodiversity in BiH;
- Lack of financing for scientific research in the field of climate change and biodiversity, as well as for the field of environment as a whole.

Priority tasks to support adaptation in this sector include the following: Development of a framework that defines long-term activities to address climate change;

- Developing a framework for a national strategy of adaptation to climate change and an overall plan for adaptation;
- Identification of measures and activities for alleviating the impact of global climate change on biodiversity and ecosystems in BiH;
- Improvement of knowledge about global climate change and its potential impact on the biodiversity of BiH;
- Completion of a sensitivity and vulnerability analysis of ecosystems (including agro-ecosystems);
- Development of monitoring and guidelines for conservation and restoration;
- Evaluation of the existing ambient monitoring program to determinate whether additional biodiversity monitoring will be needed as new climate change information emerges;
- Development of scientific tools to evaluate the affects of climate change on local fish and wildlife populations and habitats;

- Analysis of the vulnerability of forest resources to climate change (with special attention paid to understanding and developing management practices to reduce the risk of forest fires and insect disturbance to the extent possible);
- Extensive educational assistance to small land owners, increased ability to implement fire management planning, and sound management of public lands;
- Development of a climate impacts database and products on emerging forest practices (e.g. reforestation techniques and pest management) that are considered most adaptive to climate change, as well as information on how to reduce the risk of forest fires and insect disturbance.
- Provision of outreach information and updates to stakeholders across the Southeastern European region and national adaption teams through seminars, workshops and various media outlets about the impacts of climate change on forest health.

3.5.2. Water resources

While climate change impacts are expected in almost all aspects of water resources and water use, current adaptive capacity is fairly low. Significant shortcomings include a lack of data and analysis to support decision-making and strategic planning in the sector, an existing water management infrastructure that is inadequate, and a lack of coordination at the national level and at the level of the Southeastern European region on research, planning, and management. These problems are all exacerbated by a low level of awareness (both among the public and decision-makers) of the potential impacts of climate change on water resources and use in BiH.

3.5.2.1. Hydrological Information System (HIS) development

One proposed measure to address shortcomings in current knowledge regarding the impacts of climate change on the water sector is the development of a hydrological information system (HIS). The HIS is not simply a database or archive, although it incorporates an archive. It is a logical and structured system to collect data that are subsequently entered into the computer, checked and stored and where data may also be compared, associated, related and combined to provide information in a format suitable for users.

In addition, a study should be conducted on climate change impacts on the water sector in BiH. One cause of the wide uncertainty about the future impact of climate change is the fact that water managers are still using historical climate data to design water infrastructure and guide management decisions. This has been aggravated by a worldwide decline in the availability of hard water data over the past two decades. A study should cover all hydrological stations in BiH in operation during a reference period (1960 - 1991 as a minimum), and after the war. Updating existing knowledge of the water regime in BiH is very important, including applied research on as-yet-unknown hydrological relationships. The proposed study should identify areas / regions in BiH that are particularly affected by the climate change. It could also provide information to support various planning documents. Especially interesting aspects for consideration are:

- Changes in surface and groundwater systems
- Floods
- Droughts
- Water quality; climate-related warming of lakes and rivers

3.5.2.2. Water demand and water supply adaptation measures

Even though specific research has not been conducted in BiH on the influence of climate change on hydrology, water resources and water management systems, there have been general observations that the intensity of rainfall has increased, and that the drought periods have lengthened in recent years. Generally, the impact of climate change on water demand in households and the industrial sector is recognized as likely to be rather small. In contrast, increased variability of precipitation would generally lead to increased irrigation water demand, even if total precipitation during the growing season remains the same (IPCC: Climate Changes and Water, 2008).

BiH needs to invest in water infrastructure (irrigation systems, waste water treatment plants, hydropower plants and storage facilities), but it also needs to invest in improving water resource management. The irrational usage of water (total losses are greater than 50%) in BiH means that the country should manage waters according to Integrated Water Resources Management (IWRM) principles, particularly implementing one of the basic management instruments: Water Demand Management. Demand management focus on the better use of existing water withdrawals -- reducing excessive use -- rather than developing new supplies. Even in the absence of data on the effects of climate change, introducing demand management practices should be an urgent priority for BiH, as they not only support adaptation to climate change but also provide immediate economic and social benefits.

BiH needs to create water efficiency strategies and integrated plans, depending on the situation and needs of different users, focusing on conflict resolution and as equal an allocation of water between them as possible. In any given situation, demand adaptation measures are of higher priority than supply adaptation measures for household and industrial water supply, while for irrigation, these two types of adaptation measures seem to be equally important.

For household and industrial water supply, some demand adaptation measures are somehow stressed in most strategic and planning documentation developed for BiH ((PRSP BiH 2004) and (NEAP BiH, 2003)), but the draft FBiH water strategy and RS framework for water strategy highlight the problem of water losses in the systems (particularly domestic water supply). The implementation of demand-side measures is the first priority, efficient management of water supply systems, including regular maintenance of water supply systems, installation of accurate water meters and rational water usage campaigns are equally important. Regarding supply adaptation measures, taking into account that only about 50% of the population is supplied from public water supply systems, it is obvious that the water supply infrastructure needs to be improved as well.

Generally, the efficiency of water usage in irrigation systems in BiH is not currently an issue of great concern. Therefore, demand management adaptation measures are of great importance for this sector, starting from information collection on lend used for agriculture, quantities of water usage, modes of irrigation and continuing with regular systems maintenance and the introduction of rational water usage measures. Supply-side adaptation measures are likely to be priority when investing in irrigation infrastructure (reconstruction and extension of systems). Only about 0.5 % of cultivable lend, or 0.8% of arable land is irrigated in BiH, and estimates of real irrigation needs in BiH indicate that this is not sufficient when taking into account spatial and temporal variations in precipitation.

3.5.2.3. Bulkheads and reservoirs as adaptation measures

The role of water reservoirs in climate change has been recognized in the RS framework for water strategy: «In other words, the extreme intensity of rainfall will increase, and the drought periods will be extended. These phenomena are already recognized in some hydrological events in recent times. This will require increased application of the active measures of protection, accumulation and retention, but also the reconstruction of a certain canal protection systems» (Okvirni plan razvoja vodoprivrede RS, 2006). Reservoirs are one of the basic tools for addressing water management problems in every basin. They represent a way to achieve optimum use of water resources (flood control, creation of water reservoirs for dry periods, water supply, irrigation, navigation, fish-farming, recreation and, of course, electricity production) under given conditions.

The construction of new bulkheads in BiH should remain an option for satisfying ever-increasing water demand, but as the choice of sites is becoming more difficult as the economic, environmental and social costs are increasing, bulkhead construction plans should be carefully considered. An alternative option to bulkheads building might be to increase the storage capacity of existing bulkheads, since by increasing the size of bulkhead, one can regulate the water output from the reservoir by the more effective use of inter-annual variability.

The approach to planning, construction and management of reservoirs in BiH must be drastically changed, as while it has started to change, this change is somewhat too slow. From the aspect of environmental protection, the most important fact is that, no matter how long they last, bulkheads are not everlasting, and hence there is the issue of sustainability. In the eyes of the public, the largest problems are the loss of water quality in the reservoirs and the loss of natural waterways, land and landscapes. If all of the main negative impacts of reservoirs are simplified, they come down to the size of artificial lakes; in other words, the area and storage capacity taken by them.

3.5.3. Agriculture

The most effective way of fighting drought is irrigation, but irrigation in BiH is not yet developed on a wide scale even though old, small irrigation systems (using irrigation wheels) exist from the Turkish period in the Trebinje and Buna area. Only about 10,000 ha was irrigated before the last war. Some of this area was irrigated by furrow irrigation (an old system for row crops), and some of it by sprinkler and drip irrigation (new systems). Most irrigation systems were used for "cash" crops and vegetables in suburban areas. During the last war, most of these irrigation systems were damaged or totally destroyed. New irrigation programs have not been developed, nor have the old systems been reconstructed.

There is a high potential for irrigation in BiH because the abundance of water is one of the main characteristics of the water balance on the state level. However, most of the Bosnian rivers and streams have a torrent flow regime with high waters during the period of rains and snow melting, provoking floods, and very low waters during the dry periods which cannot provide even the biological water minimum in some streams. In order to bring the water flow regime under control, several reservoirs should be constructed. These reservoirs would secure enough water for irrigation and other needs.There was a plan was to irrigate about 200,000 ha in lowland area and about 150,000 ha in upland areas, but this plan has been remained unexecuted, as if it were just a dream Study Paper on Sustainable Development of Irrigation Surfaces in the area of Republika Srpska finds that, in the future, irrigation of 80,000 ha surface of Republika Srpska could be provided, while a similar document is being prepared for the Federation of BiH..

3.5.3.1. Conditions for adoption of drought-proofing practices by farmers

Technology adoption and adaptation has only been successful where adequate attention was paid to farmers' initiatives and their interactions on "products" released by research, extension services and the private sector.

Farmers have to be involved in the development of new technologies from the outset. The more changes required in farming systems, the more essential farmer involvement becomes. Most technologies on soil drought-proofing require a profound change in farming practices, not just the change of a component (as with improved crop varieties or fertilizers). This means that farmers have to learn how to integrate new practices into their systems. They will have to pay for this learning with setbacks in the first few years, as successful adaptation usually takes some time. Pioneers in a community are viewed critically and risk becoming outsiders. This is especially valid for arid regions in BiH. Additional barriers to adoption include insufficient access to information, inputs, credit, etc.

Farmers want advice on how to improve their way of farming and how to become more profitable. Researchers and extension services are often too output-oriented, forgetting the production costs and the risk of not covering even production costs when adequate markets and prices are lacking. The implementation of improved soil moisture management systems will be hindered by government legislation and counter-productive incentives.

The main reason for farmers and communities not to implement appropriate soil moisture management is lack of information, education, and training. It has also been determined that the most important reason for not adopting soil fertility options is that farmers lack capital, and credit systems are poorly developed and relatively inaccessible. Financial support is in many cases required during the transition period, as soil depletion is financially far more attractive for farmers than soil improvement. The creation of an enabling environment at a regional or national level requires important investments.

This confirms the view that farmers who are comfortable with their current situation would not look for a change, especially if it is an unknown and, hence, risky one. The conditions necessary for adoption can be summarized as follows:

- the technology should result in an immediate and significant improvement in farmers' profits;
- the benefit/cost ratio should be high;
- the investment (monetary and labor) should be within the fiscal and physical capacity and within the existing work habits and traditions of the farmers;
- there should be frequent follow-up;
- an integrated (holistic) participatory approach should be taken;
- credit should be available for the transitional period and for adaptation to a new technology and changes from traditional to sustainable agriculture;
- a well-designed marketing strategy is necessary for new products according to the new technologies.
- In general, conservation agriculture is perceived as more profitable by farmers, while researchers and extensions perceive it as more risky. Only about 3 percent of the land in the world is being farmed using conservation agriculture (CA) principles.

Generally, the farmers' opinion is: "If farmers truly perceived conservation agriculture (CA) as more profitable most of them would become adopters. There are many reasons for not adopting, but tradition and fear are among the main ones. The perception is that they do not see enough upside potential for them to make a change. They would if they really perceived more profit in changing."

The reason for the lack of uptake is that farmers usually do not know about conservation agriculture (CA) and its potential. The critical mass of this knowledge has not yet been reached. In addition, there are forces working against it; e.g., the oil industry and the agricultural machinery industry, which have paramount importance and power in developed countries. It is not difficult to imagine that they would not be happy with a technological change that reduces oil use and replaces the use of huge machinery with a few smaller machines.

3.5.3.2. Anti-drought measures

Starting from the beginning of October through the end of May, usually there is no drought in the greater part of BiH. The need for potential evapotranspiration is covered by precipitation. In June, available soil water reserves from the preceding period are used. July and August are usually dry months, especially in the southern parts of BiH. Sometimes September can be dry, but usually it marks the beginning of the recovery of available soil water reserves.

According to this situation, the main steps of drought mitigation could be the following:

- Modification of crop rotation according to the natural soil water regime. This would mean the introduction of more "winter crops" (wheat, rye, winter peas, oil rape) in crop rotation system (rainfed agriculture, dry farming system); in the cool period, water deficiencies would not appear;

- Popularization of new technologies addressing soil structure stability and soil treatment for enlarging the active layer of the root zone for enlarging water uptake;
- Selection of proper drought-resistant crops, plant species and varieties;
- Installation of windbreaks in windy areas, because the windbreak trees reduce wind velocity and draw water from deep soil layers, in turn giving up the water by evapotranspiration to the neighboring area and thus decreasing potential evapotranspiration;
- Drainage, especially of heavy soils, could have an important role in drought mitigation; it is known that drained soils allow field labor in the spring earlier than un-drained soils; one day of crop planting delay provokes one percent of yield decrease; earlier planting in spring enables earlier plant growth and root development to take up the water from deeper parts of soil during dry period; in addition, drained soils increase infiltration and decrease runoff; during the dry period the warm air enters through the drain pipes into the subsoil and after cooling increases the soil humidity by condensation; in BiH, there are about 600,000 ha of these heavy soils;
- Popularization of mulch technology for increasing infiltration into the soil and decreasing soil water loss by evaporation;
- use of local water reserves by constructing farm ponds for catching precipitation runoff; these waters could be used against fire and for irrigation;
- Social awareness about drought must be raised, and the information system of drought monitoring must be improved;
- During the last war, some rural areas were abandoned. Some of them are mined, and without de-mining it is not possible to return people to their properties; these abandoned forest and shrub areas are at risk for fire damage; the first step is de-mining and then house reconstruction;
- An information and monitoring committee for early warning of drought must be established;

These measures have not yet been implementing in the agricultural sector in BiH because no strategy on the state, entity, regional or local level has been developed for agriculture, much less for the adaptation of the sector to climate change.

Many European countries suffer frequent economic and ecological damages from droughts. Southern countries, like Bosnia and Herzegovina, are exposed to drought more than others. The first step in organizing pre-drought preparedness is to develop people's awareness about drought. People need to know how often droughts are occurring, what their duration and severity are, and what damages result. A basic document that could be used for this evaluation is the BiH drought sensitivity map. Drought vulnerability is different in different countries and regions. Through these maps, is possible to evaluate in which region drought is most serious problem. On that basis, it is possible to organize interventions against drought. The construction of a drought map must be coordinated by an expert team, which has to choose the method of work, select the scale of mapping, and identify the responsible institutions (from agriculture, forestry, hydrometeorology sectors as well as universities) to create a network across BiH and links with neighboring countries.

The financial means for the production of the drought map and the resulting interventions will have to be provided by European Commission agencies, the state budget, and on a commercial basis as well.

One of the most important general preventive actions is forecasting and the use of all methods to raise awareness in the public, giving as much detailed information as possible. An early warning system should be established and operated as a foundation for additional decisions in due time before a severe drought situation develops, especially in those areas where drought is occurring frequently. For this reason, drought sensitive regions should be determined in each of the countries involved.

3.5.3.3. Measures for protection of cattle from high temperatures

As domestic animals are much more vulnerable to high temperatures than humans, they should be protected by certain measures. More attention should be paid in the future to protection of animals from high temperatures in order to prevent heat stresses, and a management system to ensure their protection should be introduced. Domestic animals have certain requirements that are related to climate (and microclimate), out of which the most important ones are: temperature, air humidity, light and concentration of harmful gases. Optimal temperatures for the majority of domestic animals are in the range of 0-20° C, whereas optimal air humidity is 60-80% (Koller at al, 1981). Domestic animals are much more vulnerable to high than low temperatures, as they have a significantly lower ability to thermally regulate because of a reduced ability to sweat (for example, cattle sweat 90% less than humans, and pigs do not sweat at all). The comfort zone for most animals stops already at an air temperature higher than 25°C. If temperature above 26° C is related to relatively high humidity, it is very difficult for animals to maintain normal body temperature. The combination of temperature and relative air humidity is called the temperature-humidity index (THI), "discomfort index" or "heat index" and it is a measure of comfort for domestic animals.

When it comes to planning of cattle breeding in BiH, attention should be paid to new temperature zones, as in some of them it will not be possible to breed cattle, whereas in some areas breeding will be possible only with special measures (shelters, moistening of animals with water, etc.).

3.5.4 Forestry

3.5.4.1 Needs and possible adaptation measures

Sustainable forest management practices need to receive more promotion in the context of the significance of climate change (reforestation, sanitary practices, pest and fire management) and promotion of protective functions of forests in terms of high conservation value forests, non-wood forest products (diversification of services) and increase of areas under protection, as well as improved capacities of forest management enterprises to manage these areas. Apart from this, monitoring and observation plots need to be established in the most vulnerable areas, which might expand options for consideration of approaches. Needless to say, establishment of current databases is essential across the forestry sector, where data are inconsistent, missing and not centrally organized.

Reforestation practices are important in order to decrease erosion and regulate the water regime, apart from the storage of CO_2. This practice needs to take into consideration which species should be applied, which ones were indigenous, and how the planted species will be affected by the future climate patterns, therefore choosing the most appropriate ones. Breeding resilient tree variations and recovery of vegetation in degraded and bare lands are both measures that a require a more planned approach with new or increased funding mechanisms. Promoting carbon sequestration through forestry practices should be increased, especially in areas where there are extremely low soil carbon levels and where there is potential for afforestation.

The occurrences of illegal activities in forestry sector of Bosnia and Herzegovina are frequent and have great implications. The emerging issue of illegal logging in BiH has been widely recognized by numerous stakeholders even though its degree cannot be precisely specified. Further possibilities of reducing illegal logging need to be assessed, in order to reduce the surplus emissions and protect forests. As the problem of illegal logging in BiH has emerged and become recognized at several national levels the government initiative included signing of the "Petrograd Declaration" at the Ministerial Conference in Russia in 2005 where BiH obliged itself to develop and adopt an Action Plan to combat illegal activities in forestry and wood-processing industry sector. In terms of illegal logging the Action Plan encourages conducting independent assessments on type and volume of illegal cuts, export of illegally cut timber, assessment of government's financial losses; combining mentioned assessment with financial control (Akcioni plan Federacije Bosne i Hercegovine; (2006).

Even though these entity action plans have been developed in 2006 and significant reduction has been evidenced after the war, this issue needs to be addressed further with enforcement and control mechanisms, including the judiciary system. The implementation of existing legislation, fines and sanctions need to be enforced, and new regulatory and informational instruments need to be included (raising awareness, improving transparency in the timber market, etc.).

Protected areas comprise an extremely small amount of territory in BiH, and they are among the smallest in regional data assessments. Therefore, it is urgent to increase these areas with a significant view to climate impacts that will identify new areas for consideration. An increase in protected areas also calls for an assessment of capacities of the forestry professionals to manage these areas and enhance the integral concept of forest management with monitoring measures.

The ecological, social, and economic impacts of climate change on forest ecosystems need to be assessed in greater depth. This aspect might be enhanced within forest management areas and throughout the forestry profession by introducing sustainable forest management principles of forest certification into public forest management companies. This might lead to increased awareness-raising, information dissemination, inter-sectoral cooperation, and greater inclusion of the forestry sector in the adaptation and mitigation aspects of climate change. It might indirectly contribute to progress on issues such as the establishment of mixed stands, application of indigenous species, support to natural forest dynamics and encouragement and promotion of biodiversity conservation, increases in sanitary activities, production capabilities, and species effects evaluations by micro-region.

Concerning the limitations in existing financial and institutional mechanisms in BiH in relation to technology transfer in the forestry sector, new policies and institutions are required to promote it. In terms of climate change and forestry a wide variety of practices are possible to be implemented such as improvement in silvicultural practices as well as sustainable management practices, promotion of genetically superior planting material, enhancing protected area management systems, substitution of fossil fuels with bio-energy, efficient processing and use of forest products, and monitoring of area and vegetation status of forests, particularly under afforestation practices of bare lands. The concept of clean development mechanism (CDM) as a technology transfer mechanism should be considered more expansively within the forestry sector in BiH. Currently, there are inadequate information on the processes and potential benefits it might bring, limited technical capacities which are all supported by unclear property rights and lack of methods for monitoring. Technology transfer within BiH should be stimulated through funding, be it to forest departments, research institutions or wood processing industries. Financial incentives could be set aside for adopting sustainable forest management principles and improving technical capacities in promotion of forest research in relation to climate change. In BiH, more significant incentives should be made to the local governments to manage forests as carbon sinks. The capacity building includes also enhancing existing institutions (such as DNA) and establishing new ones which will facilitate adoption of mechanisms in regards to technology transfer, increase private sector participation and include and promote forestry mitigation projects. Additionally, establishment of national or entity-based sectoral action plans from the perspective of adaptation and establishing training to assist capacity development of administrative officials in charge of those issues would improve the operating techniques of these institutions.

Finally, human resource development and strengthening organizations in governmental research institutions that focus on impact/ vulnerability assessment of climate change in the forest sector could lead to the inclusion of these aspects into policy-making. Furthermore, developing and implementing pilot projects for improving adaptive capacity while disseminating and integrating the results into strategies and forestry programs is another potential way to include climate change measures into forestry practices in BiH.

3.5.5. Health

Adaptation measures may roughly be divided into: (i) Able-bodied; i.e., the conditionally healthy population and (ii) At-risk population (children and the elderly). It is important to note that in the area of health, there is no clear-cut division in illnesses of these two groups. There are only illnesses which appear more commonly in one or the other groups. That is why living and working conditions must be very similar, if not identical, for both of these populations, primarily because in the able-bodied (healthy) population there are those who work, but suffer from certain forms of vascular and circulation disturbances, such as respiratory problems (increased blood pressure, cardiac insufficiency, chronic/obstructive bronchitis, allergy laryngitis/bronchitis…; see Rubin et al, 1994; Cotran et al, 2001; and Pranjić, N. 2007). Special attention should be paid to the working population in outdoor conditions where it is necessary to determine specific working hours, length of breaks, hydration, type of nutrition, and body protection.

3.5.5.1. Information necessary for adaptation in the health sector

According to the project "Prevention of Acute Health Affects of Weather Conditions in Europe (PHEWE; Michelozzi et al, 2007), adaptation measures to changed climate conditions, primarily those caused by temperature variability, need to be based on previously considered and analyzed data using the following approach:

- Analyze the connection between meteorological variables and cause-and-effect daily reception due to cardiovascular, cerebrovascular and respiratory illnesses during the warm periods,
- Analyze the connection between meteorological variables and cause-and-effect daily reception due to cardiovascular, cerebrovascular and respiratory illnesses during the cold periods,
- Analyze the connection between meteorological variables and cause-and-effect daily mortality due to cardiovascular, cerebrovascular and respiratory illnesses during the warm periods,
- Analyze the connection between meteorological variables and cause-and-effect daily mortality due to cardiovascular, cerebrovascular and respiratory illnesses during the cold periods,
- For all of the above, analyze the relevant time interval between exposure to extreme temperatures and possible delayed effects to the organism (cumulative effect),
- Analyze specific synoptic time categories possibly connected to an increase in the incidence and/or mortality of the aforementioned illnesses.

3.5.5.2. Awareness raising as an adaptive measure

In the area of adaptive measures designed to protect human health possible measures include the following:

1. Work on educating and informing the general population about the possible consequences of exposure to changed climate conditions (extreme temperatures, change of atmospheric pressure, humidity impacts) and possible symptoms (competent Ministries and primarily the Ministry of Health in terms of legislation, whereas realization should be done through family medicine, industrial medicine, Public Health Institutes, mass media),
2. Work on educating and informing the general population about measures of self-protection and self-aid in the case of changed climate conditions with the aim of the best adaptation of human organisms possible (competent Ministries and primarily RS Ministry of Health and Social Protection and FBiH Ministry of Health in terms of legislation, whereas realization should be done through family medicine, industrial medicine, Public Health Institutes, mass media),
3. Education and information dissemination done via public media (RTV, daily and weekly magazines).

3.5.5.3. Adaptive measures to protect human health in the buildings sector

1. Special attention should be paid to types of construction materials when building housing and business premises and types of heat isolation. Outer blinds of constructions should be planned – buildings, houses (for example, putting blinds on the windows, light – sun impermeable blinds), providing of outer and inner temperature indicators – thermometers, providing of supply of potable water. Pay attention to the orientation of the construction (for example, individual construction, bedrooms - east, living room - South - South-West, bathroom - North).

2. Plan existence of air conditioners and filters in building of all the planned housing and business buildings. Plan for individual or group related (few connected premises) regulation of temperature instead of systematic / central.

3. Special attention to be paid to control of temperature and humidity, the other pre-school and school institutions as well as institutions specifically intended for the old and the sick. Previously make a photo of the existing state of such institutions.

4. Work on noting cardio- and cerebrovascular illnesses as well as respiratory illnesses first of all at the level of health institutions (dispensaries, community health centers, hospitals, clinic centers), reporting should be forwarded to Municipal/Cantonal Epidemiological Institute, and then to State Epidemiological Institute. Reporting to be updated on a monthly basis.

3.5.5.4. Secondary health impacts of adaptation responses in other sectors

One issue that has received less consideration in decision-making is the potential health impacts of climate change adaptation measures in other sectors. These, impacts, which are summarized in Table 3.5.5.3., should be considered when developing and implementing an adaptation strategy and framework for BiH.

3.5.5.5. Summary adaptive measures to protect human health

The IPCC believes that in the area of human health, "The most important and cost-effective measure is to rebuild public health infrastructure." (IPCC TAR, WGII, 2001). In order to forecast the potential impact of climate change on health, and also for response of the health sector, it is necessary to be familiar with vulnerability of the population and the capacity of the healthcare system to respond to new conditions. Measures in this area should include the following:

- Strengthen mechanisms for early warning and action (strengthen correlation between the public health and meteorology because of duly warning),

Global change factor	Sector	Adaptive response	Health effect
Change in local temperature	Buildings	Increased cooling	Increased energy demand leading to air pollution and other hazards from energy supply
	Transport	Increased cooling	As above
	Energy supply	Increased energy demand due to lowered efficiency of thermal conversion devices, e.g., power plantsa	As above
Change in local precipitation	Water supply	Build large hydro schemes to transport water	Vector-borne and parasitic disease, accident and population displacement risks.
	Land use	Shift populations	Impacts of social and economic disruption
Change in sea level	Land use	Shift populations	Impacts of social and economic disruption

Table 3.5.5.3. Potential health impacts of various adaptation responses

- Work and adopt a platform (IHR 2005) for early detection of illnesses and symptoms caused by climate change, and strengthen public health capacities with the formation of a complete infrastructure.
- Adopt long-term planning.
- Establish national "emergency systems."
- Encourage cooperation between the health sector and other sectors (establish certain necessary norms, and work with the transport, energy, construction, and other sectors).

3.5.6. Adaptation and socio-economic development

Adaptation measures in the case of the social dimensions of climate change impact are possibly the most complex, because they are related to all of the following: natural elements and factors (finding of adaptation measures in the sectors of agriculture, measures of protection from natural disasters, measures of protection for endangered ecosystems), economic elements and factors (providing economic policy that will lead to employment and sustainable development of economy, creation of new technologies and techniques in the economy, restructuring of the economy within the context of negative climate impacts), political and legal elements and factors (modifying the Law on Health and Safety, introducing adequate social policies, decisions on stimulating some segments of the economy, decisions on the introduction and application of different development policies within the energy and development sectors), and health-related factors (education on measures of self-protection and self-assistance, monitoring of illnesses that are a consequence of negative impact of the climate change, early warning system).

In addition, measures for decreasing risks may be conditionally divided into short-term, medium-term and long-term, depending on general significance, financial, technical and technological requirements of measures, the necessity of changing legal regulations, etc. Therefore, for example, education of the public or monitoring of illnesses that are related to the climate change may be realized in relatively short time period and without high costs. According to some forecasts, more serious negative impacts of climate change on agriculture are expected in 2025, so measures for alleviation of these impacts may be considered as medium-term measures. All other measures that include significant planning and investments in restructuring of the economy, introduction of new technologies and similar activities may be considered long-term measures.

At the Workshop held in Nairobi in 2007 (UNFCCC, 2007) dedicated to the planning and implementation of adaptation measures, among other things, it was concluded that planning and implementation of adaptation measures is particularly important for the governments, regional authorities and local communities to decide which plans decrease risks from the climate change to the greatest extent and which plans can be most efficiently implemented. In this sense, it is necessary to pay special attention to education of all stakeholders, especially government officials, both line ministers and decision-makers in general. Climate change impacts on society and the risks of social stresses should be more intensively researched, and the business community, decision-makers, and the general public should be concerned. The causality of development of cities and villages and their residents makes the risks and measures of adaptation from negative impacts of the climate change even more delicate. Stagnation, depopulation and the deagrarianism of villages may finally lead to overpopulation, construction that is not permitted, a lack of infrastructure solutions, a lack of employment and poor food supplies in urban centers. In this context, it may be concluded that both rural and urban areas are almost equally subject to risks from the climate change.

3.5.6.1. Proposed measures related to socio-economic development

Proposed adaptation measures and measures to decrease climate change risks to socio-economic development include the following:

- Introduction of adequate development policies for agriculture sector, which will include adaptation measures to climate change and provide for a satisfactory degree of employment and food production (repair and adjustment of the existing irrigation systems, as well as building new systems for irrigation, seasonal movement of planting dates, introduction of new varieties of plants that are cultivated, protection from erosion), afforestation, planned and conscious management of forest farms, intensive cultivation of xerothermic and/or xerophyte types resistant to higher temperatures and lower moisture, additional protection of certain ecosystems such as Bardača, Hutovo Blato and other similar places;
- Adjust non-agricultural and service activities to scenarios of future climate change, taking into account the aforementioned risks (for example, tourist offer should have more of spa and sea tourism, especially if it is assumed that the bathing season on the Adriatic will extend, and that there will be increasingly less days with snow, which is of key significance for the winter mountainous tourism);
- Introduce general, long-term economic policies that will provide for economic growth, decrease unemployment rate, improve life standard, and which will also include aspects of decreasing risks from possible potential impacts of climate change. It is essential that economic development strategies (at least short-term and medium-term) are adjusted to projected climate change scenarios;

- Protect potentially endangered populated areas and population, especially in the coastal areas, but also in the areas in which bigger floods may be expected as well as landslides, torrents and such (potential to endanger human lives and loss of property should be maximally decreased);
- Environmental policy, social policy, energy policy, policy of water resource management, forest farms and other significant documents for socio-economic sphere should also include an emphasis on risks from climate changes for individual areas of human life and work, as well as adopt appropriate adaptation measures (specific adaptation measures, thus, should make an integral part of development programs, plans and policies);
- Increase activities to educate the population about climate change, its negative impacts and risks, as well as the necessity of adapting society and the economy (here it is particularly important to educate the young, but also decision-makers at the state, entity and local levels);
- Intensify efforts on resolving specific problems of BiH (de-mining, full integration into socio-economic flows of the displaced, refugees and returnees) that may be a burden in the creation of strategic development policies and programs for alleviating the negative impacts of climate change;
- Perform a census of the population in BiH that would give an insight into available resources and their geographic distribution, as well as allow future development plans and strategies to adjust to the realities of the current situation.

3.5.7. Spatial and urban planning

3.5.7.1. Spatial planning

Climate change represents a changing source of risk for spatial planning options. First, climate change science and the supporting evidence base on impacts are still evolving. Second, globally predicted climate change effects will be influenced by local circumstances and will locally result in various form of impacts to receptors (areas, habitats, people, infrastructure). If some general urban adaptation measures could be already proposed knowing global climate change aspects (change in temperature, average rainfall etc.), spatial planning options and land-use policy for wider rural areas need to be customized for each particular area. Climate adaptation measures require first identifying what the climate risks are for a particular area before taking decisions that allow the potential impacts of climate change to be reduced or adequately managed. Spatial planners should also consider whether decisions that they make significantly constrain the ability of others to adapt to climate change.

3.5.7.2. Legislative measures to support adaptation in spatial planning

Legislative reform carried out by entity authorities should introduce a new decision-making framework that will support good decisions related to the risks and uncertainties associated with climate change. Such a framework should take a balanced approach to managing climate and non-climate risks and help to identify which decisions are climate-sensitive. Where decisions are climate-sensitive, the framework should help to identify and appraise measures to reduce climate change impacts (or exploit opportunities), focusing first on actions to manage priority climate risks. It should provide a structured way to consider climate change and non-climate change risks and uncertainties alongside each other, integrating the consideration of climate change impacts into the decision-making process. The framework should be conceived to be particularly relevant to decisions on the direction of long-term land use.

Before evaluating the potential to integrate climate change adaptation measures into a future spatial plan, it is necessary to identify how important climate change is relative to the overall plan objectives. Then, the legislation should introduce into the new decision-making process several tools or procedures that can be integrated into following steps in spatial planning. First, it is necessary to define criteria to be used to appraise adaptation options for a spatial plan of an area. Practically, risk assessment parameters or risk assessment endpoints should be defined by spatial planners in collaboration with other stakeholders. It means identifying climate change thresholds (what are intolerable levels of risk posed to receptors), which form an important link between objectives and the options appraisal process.

Then, the legislation reform should introduce relevant tools for climate change aspects integration into the planning process. There is already existing one legislative requirement that is still not used in practice for planning purposes: Strategic Environmental Assessment (SEA) introduced in the entity environmental laws in 2002 and 2003. The SEA should be completed with other techniques for assessing climate change impacts and highlighting the need for adaptation measures. For example, constraint mapping is a technique that could allow identifying the receptors at risk of climate change though overlapping constraint layers in GIS. Moreover, intention for a spatial-planning database constitution already exists but data is still not shared between cantons and entities. A suggestion to planning authorities would be to highlight the climate change indicators in databases and link them with climate change thresholds. Eventually, a unique database is needed at the BiH level.

If SEA is effectively retained as a tool for taking account of climate change impacts, then planning authorities should publish for spatial planners a specific guidance on SEA use in spatial planning related to climate change. Moreover, in Federation BiH a vulnerability study of an area is required as preliminary document for the spatial plan of that area. However, vulnerability studies do not deal with climate change aspects neither they are connected with SEA. Planning authorities should provide methodology for preparation of vulnerability studies, integration of climate change aspects and connection to other tools such a SEA. An equivalent study should also be also required in RS.

In order to highlight evidence of vulnerable groups and significance of any particular risk to each, spatial planner should be provided with appropriate assessment tools. For example, planning authorities should provide following studies for climate change risks already identified in BiH:

- increased flood risk – need for flood risk database including flood vulnerability of some rivers and evaluation of potential damages;
- increased landslide risk – need for landslide risk database
- lacking water resources – maps of areas at risk
- moving northwards of climate zones – evaluation of possible change of environmental designations of some areas and associated change of land use policy (protection of new areas, stopping protection of currently protected areas etc.)

Since options or strategies may have very different approaches and costs, the government should adopt a national strategy for climate change adaptation as a leading framework document for spatial planners. In this strategy, for a particular area, accent could be put on prevention of effects through technological measures (ex. increase water storage capacity), legislative measures (changes in planning policy, design standards), avoiding risks (locate housing away from flood risk area), etc.

Then, choosing the most appropriate adaptation measure turns to be appraising measure against decision criteria with reference to the risk assessment. Since number of factors should be taken into account (social, economic, environmental) there is a need that spatial planners develop appropriate appraisal techniques or tools (for example decision trees).

However, choosing the most appropriate adaptation measure is impossible without meteorological input data of good quality. Entity and canton spatial plans currently in preparation are based on data of a very poor quality in the sense of its completeness (missing many years of monitoring). Hence, an effort should be done to ensure an appropriate monitoring and summering of gathered meteorological data into relevant climate maps.

Decision may include a combination of measures or options to achieve the desired objectives. Planning authorities should ensure policy backing and appropriate mechanisms to implement decisions at the site level. Monitoring the implementation of decisions should be ensured through planning methodology as early as the decision making stage. SEA includes monitoring measures that need to be worked out and completed.

3.5.7.3. General adaptation measures in spatial planning

Many general adaptation measures could be suggested to spatial planners but their relevance for a particular risk on a particular area can only be evaluated through decision-making framework steps described previously.

Flood risk measures could consist of maximizing development densities in low-risk areas and managing residual risk through structural adaptation measures (drainage or sewage systems, stream barriers, safe evacuation routes, procedures to ensure essential services). Similar measures could be suggested for unstable lands with landslide risk.
When it comes to water resources shortage, adaptation measures could consist in planning water accumulations, irrigation infrastructure, forbidding small water power plants at some rivers or locating development away from water resource shortage areas. Planners should also take account of permeable/impermeable surfaces in order to maximize water retention on site and ensure viable water supply and treatment through planned interventions of other stakeholders.

Adaptation measures for higher temperatures should be focused on urban areas. As impacts from higher temperature are much harder to accommodate on rural areas, main measures would be to locate vulnerable uses away from hottest areas and plan green infrastructures.

As far as forest surfaces are concerned, the Law on Forests strictly forbids all deforestation. The administrative procedure to get a permit for any project including deforestation is very complicated (e.g. includes entity governmental decision), so there is very little change in land use policy regarding forest surfaces.

Regarding current spatial organisation, most of the options are defined by plans dating from 1980s. Spatial plans are currently being prepared for many areas (municipalities, cantons and FBiH), but climate change aspects are not taken into account. Moreover, climate aspects in general seem to be less considered in recent years than they were in the 1980s. This is due to several factors: a loss of skilled experts during the last war, the loss of relevant climate data, and preparation of spatial plans in a very dynamic context of illegal developments.

3.5.7.4. Urban planning

An analysis of natural and created conditions of a location, as well as the impact on future energy consumption in newly projected populated areas and buildings, should proceed each spatial and city planning exercise, as a specific elaboration which will be prepared by joint experts of several professions (the new approach). The rules of professions to make plans based on conditions of the location and principle of bio-climate planning and projections are not sufficiently adhered to, thus it is necessary to set out stricter conditions to respect them, as well as to monitor their implementation. Comprehensive analyses by planners when making city plans; that is, active opinions on the issues of energy consumption in residential areas, zoning of functions in residential areas, typology of residential areas and construction, location analysis and orientation of buildings, organization of green surfaces in residential areas, ways of resolving traffic in residential areas (pedestrian and bicycle traffic, public traffic and similar) could significantly contribute to easier co-existence with climate change, as well as contributing to its mitigation.

Changes in the way of life – new functional, aesthetic, energy and other requirements impose changes in cities that can be implemented in two ways – demolishing existing urban structures and building of new ones or urban renovation. Maintenance of urban and construction heritage, urban regeneration of cities,[16] finds its justification in opinions that it is necessary to preserve all the inherited construction funds in order to save energy. By renovation and reconstruction of housing areas, illegally built residential areas, industrial complexes that do not work, abandoned or incomplete buildings, it is possible to save energy and thereby contribute to a decrease of CO_2 emissions. Reconstruction of the existing building stock and improvement of its energy characteristics not only saves energy when occupants use renovated buildings, but also saves energy that would have been used for the construction of new buildings.

When it comes to the regeneration of cities, it is necessary to include the component of the climate change as well as mandate that planners include, along with all of the principles of preservation of the city heritage when renovating the cities, principles of climate change adaptation and mitigation. When renovating, it is necessary to use all of the achievements of modern technology that may help in adapting to climate change. With the use of new technologies, it is recommended to apply measures known to old builders – deep canopies, colonnades, entrenchment of buildings, natural shade by planting trees, application of protection elements against excessive sunlight (blinds, window shutters), etc. The way that public areas in towns are used, as well as their shaping, must consider climate change, and there should be aspirations to create green islands, with water surfaces, which decrease temperatures, but also to take into account types of plants for planting. Due to possible bad weather, floods, and flash floods, it is necessary to reshape river banks, as well as sea coasts, with special care.

Considering the occurrence in bigger cities of urban heat island effects, it is necessary to issue parameters for recommended population density per area, as well as other elements of urban structure, with which it is possible to prevent or alleviate impact of high temperatures. Warm winters will decrease these impacts to a certain extent. However, hot summers will pose a problem, and lower population density is better for alleviation and easier dealing with it.

[16] Numerous European documents point out significance of urban regeneration and they are subject of resultions brought by Associations of Town Planners, but also Ministers of European countries

A typology of construction with population density (coefficient of degree of occupancy, construction index) may contribute to a decrease of energy consumption. Considering that around 70% of the population in BiH lives in family houses, the percentage of population living in rural areas has decreased, and aspiration should be aimed to increasing population density in urban areas intended for individual accommodation (family houses) by application of house typology in a row and atrium houses. By doing this, it is possible to decrease costs of infrastructure network construction as well as operating costs. In the areas with bigger slopes, construction with entrenched buildings should be recommended. Construction typology should reflect possible consequences of the climate change: high temperatures, floods, stormy winds, draughts, etc. as well as to adapt to these; that is, provide for easier survival of the population.

Planning of green surfaces may be one of the significant elements which can prevent occurrence of urban hot islands, decrease temperature in cities, as well as ease the process of adaptation to life with increased temperature. Above the grass surfaces, temperature may be 3-4 degrees lower than above traffic roads (Pucar et al, 1994). For an easier and more pleasant life in cities, it is necessary to increase the standards of green surfaces in the cities, expressed in m^2 per capita, the recommendation being minimum 30 (the standard now is 25 m^2 per capita), or in percentages a minimum of 30% for new residential areas, and for the existing ones 10-20%, depending on the location compared to the central city zone. Except for the quantity expressed in m^2 of the surface, distribution of typology – parks, squares, grasslands, line of trees, botanical gardens and such -- is also important. It is necessary to foresee lines of trees for all the streets, whose profilation would provide movement of population at high temperatures. It is necessary to create smaller green oases in residential areas to make movement of the population at high temperatures easier. In city suburbs, it is necessary to establish bigger green facilities intended for residence, sport and recreation, as well as places where the population will be able to spend their free time.

In all urban plans, it is necessary to emphasize the construction of bicycle paths, in order to provide for increased usage of this type of urban transport, as well as to decrease consumption of energy and emissions of hazardous emissions from automobiles. Bicycle paths should be accompanied with lines of trees, with the purpose of protection from excessive sunlight. In order to popularize this type of transport, it is necessary to organize different campaigns for raising awareness of the population and increasing the popularity of bicycle traffic. Pedestrian traffic in towns should be in the form of green roads, linked to green oasis in town, which would provide for easier movement of population and for lowering temperatures in town.

In the construction of buildings, there should be a requirement to adhere to the principles of bio-climate: proper orientation of the building, level of insolation, space organization, inclination of the terrain, winds, micro-climatic conditions, shape of the building, roof, number and size of openings towards the four directions, and the selection of materials – application of renewed materials, protection from overheating (canopies, blinds…), greening of the plot, cleaning of the surface around the building, rain-water treatment, etc. "Green" buildings, roofs and facades should be promoted. Finally, one of the most abused planning parameters should be precisely defined and controlled: distance between buildings, as well as parking.

3.6. Frameworks for adaptation to climate change in BiH

A bottom-up approach to addressing climate change consists of the following steps: (1) Assessment of vulnerability, (2) Identification of measures for adaptation of socio-economic development and protection of the environment from climate changes, (3) Application of mitigation measures, (4) Capacity building of the State, and (5) Implementation.

An analysis of adaptive elements is here given by application of the DPSIR methodology which is used by the European Environment Agency.[17] This analysis consists of determining of the following indicators:

D – Driving force
P – Pressure
S – State
I – Impact
R – Response.

Some of these indicators are descriptive, while others are quantifiable and can be monitored, either in one state, during a certain period of time, or compare several states in a certain period of time.

The characteristic driving force (D) related to the vulnerability of BiH, in relation to climate change, is: (i) Climate change in BiH was caused by anthropogenic greenhouse gas emissions, (ii) B&H is located in an area where adverse climate changes will be relatively severe, (iii) BiH does not have the institutional capacity to either research vulnerability elements caused by the climate change or forecast vulnerability in the future decades, neither does it have the capacity to undertake proactive adaptation measures, (iv) There are international mechanisms to support adaptation measures in BiH that have not yet been used.

The Pressure (P) comes from climate change (UNEP Handbook, 2009):

- Increase in solar radiation intensity,
- Changes in the precipitation regime and decrease of precipitation quantity, particularly snow, the result of which is change of annual precipitation quantity, seasonal changes,
- Changes in cloud cover during the summer and winter,
- Changes of daily and night temperatures in the seasons,
- Changes of quantities of snow and time of the first and last snow in the winter season,
- Shifting of the climatic layers.

Pressure is reflected on the change of State (S) in nature. As development of society is based on the use of natural resources, it is convenient to divide change of state into three categories: (i) nature, (ii) nature as a resource and (iii) quality of life (Knežević and Husika, 2008).

The Response (R) of society (community, the state) encompasses the following: (i) Dealing with the changes (collection of water from 2 km distance, work in overheated factory plant, etc.), (ii) Risk insurance (via insurance companies, particularly for the cases of loss

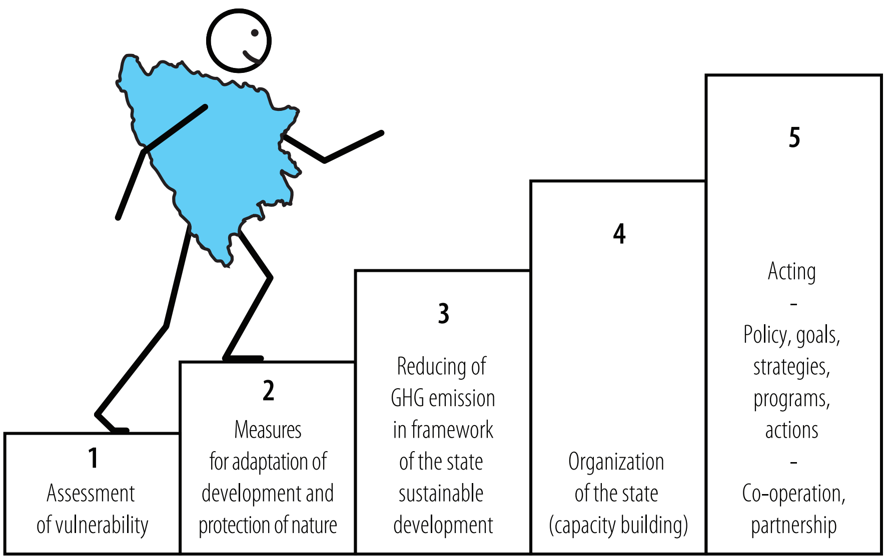


Fig. 3.6.1. Phases of dealing with climate change in the country

[17] This methodology was used when preparing Strategy on Environment Protection of the Federation of Bosnia and Herzegovina.

of yield in agriculture due to bad weather conditions), (iii) Adaptation (interventions related to insurance of natural resources, change of production programs, change of technology for insurance of quality of comfort and work conditions), and (iv) Change of behavior (change of the picture of consumption, greater consideration of natural resources and production goods).

The response of the society is related to human activities; that is, industrial branches: (i) Preservation of biodiversity, (ii) Water resource management, agriculture, forestry (industrial branches which are directly linked to nature as a resource), (iii) Energy, construction of buildings, industry, traffic, waste management (branches and activities under the impact of strong technological development – technical background for adaptation to climate changes, as well as for decrease of emissions of greenhouse gasses, (iv) Tourism and recreation (feeling of changed conditions for renewal of business activities), (v) Public health and health safety at work (changed conditions of life and work comfort), and (vi) Social policy (acting of the state in the case of a loss of existential basis of part of population caused by climatic changes).

Adaptation has changed previous practices. Planned adaptation is based on knowledge of the potential for change and barriers opposing the changes Knežević, A, Husika, A, 2008) Natural resources (for example, intensity of the solar radiation good for production of useful forms of energy),

- Technical resources and barriers (e.g., lack of technology for the conversion of solar radiation energy),
- Economic resources and barriers (cost-effectiveness of construction and usage of devices for conversion of solar radiation energy into electrical energy, for example),
- Market resources and barriers (supply and demand of technologies, products and services), and
- Social resources and barriers (awareness and education of the stakeholders).

Adaptation measures are related to the protection of nature and sustainable development of society and economy, which make compatibility of economy, society and nature in a given state. The key role in directing development to sustainability is made of economic incentives, which may be general in the state (for example, ecological fund, financing via development banks) or result from possibilities that developed countries may meet some of their obligations by decreasing emissions of GHG in other countries, non-Annex 1 countries, through the Clean Development Mechanism.

Key development documents that should reflect a Climate Change Adaptation Strategy include spatial plans (use of space for human activities), technological development (aimed at decrease of risks brought by climate changes, as well as achievements towards decrease of greenhouse gas emissions), and human development plans (wide range of components). Adaptation considerations should also be reflected in state economic policies, particularly those affecting the economic system and international trade (which is particularly significant for small states).

3.6.1. Adaptive Capacity

The primary institutions for dealing with climate change issues are entity-level governments and their ministries. Monitoring systems (Meteorological/Weather Service for example) are also in the competence of the entities.

At the state level, significant institutions are: (i) Ministry of Foreign Trade and Economic Relations, part of which is Sector for Resources, Energy and Environment, (ii) Economic Planning Authority, (iii) Agency for Statistics, (iv) Standardization Institute. All these bodies (state and entity governments) should work in a synchronized way in the area of the climate change adaptation. In this, it should be taken into account that the climate change is not a separate issue, but a development issue, therefore this component should be looked at in an integral way, then incorporate it into all sectors and all levels of decision-making (state, entity, and lower administrative levels.

Furthermore, considering the diversity of the climate in BiH and the fact that climate regions in BiH do not correspond with administrative regions, adaptation to climate change should rely on climate specificities of individual areas. Therefore, a methodology of gathering and processing data, as well as analysis of impacts and potential adaptation measures should be adjusted to the geographic specificities

Administrative areas (Entities)	Adaptation Measures Management
Geographic regions	Homogenous areas from the aspect of adaptation measures
Climate zones	Areas of identical vulnerability level (vulnerability)

Fig. 3.6.1. Concept of regionalization of BiH territory with respect to vulnerability, adaptation and management

of individual regions. Methods and plans of observation and research should be adjusted to specificities of individual geographic areas and implementation of measures to governments according to their constitutional competencies. In this way, duplication of activities related to the preparation of methodologies and research would be avoided.

Starting from administrative structure in BiH top to bottom and observed climate zones top to bottom, it is necessary to establish "geographic" areas with common adaptation characteristics. Professional materials that would relate to possibilities of adaptation, as characteristics of the area, would serve as background for brining a program of work of entity and cantonal governments (Fig. 3.6.1.).

The National Capacity Self-Assessment, which will further understanding of administrative capacity to carry out measures in response to climate change, has been initiated in BiH and is discussed in a subsequent chapter of this Communication.

3.6.2. Approach to adaptation measures

There are two types of adaptation of economy to the climate change:

1. Adaptation with the aim to decrease vulnerability caused by climate changes (for example, change of the type of tourism after decrease of snow precipitation, building of accumulation and irrigation, as compensation to decrease of precipitation, and such), and
2. Adaptation in the sense of change of production programs caused by technological changes in the world (for example, production of wood briquettes or pallets and fire-boxes for usage of bio-mass, production of thermo-isolation of construction material),

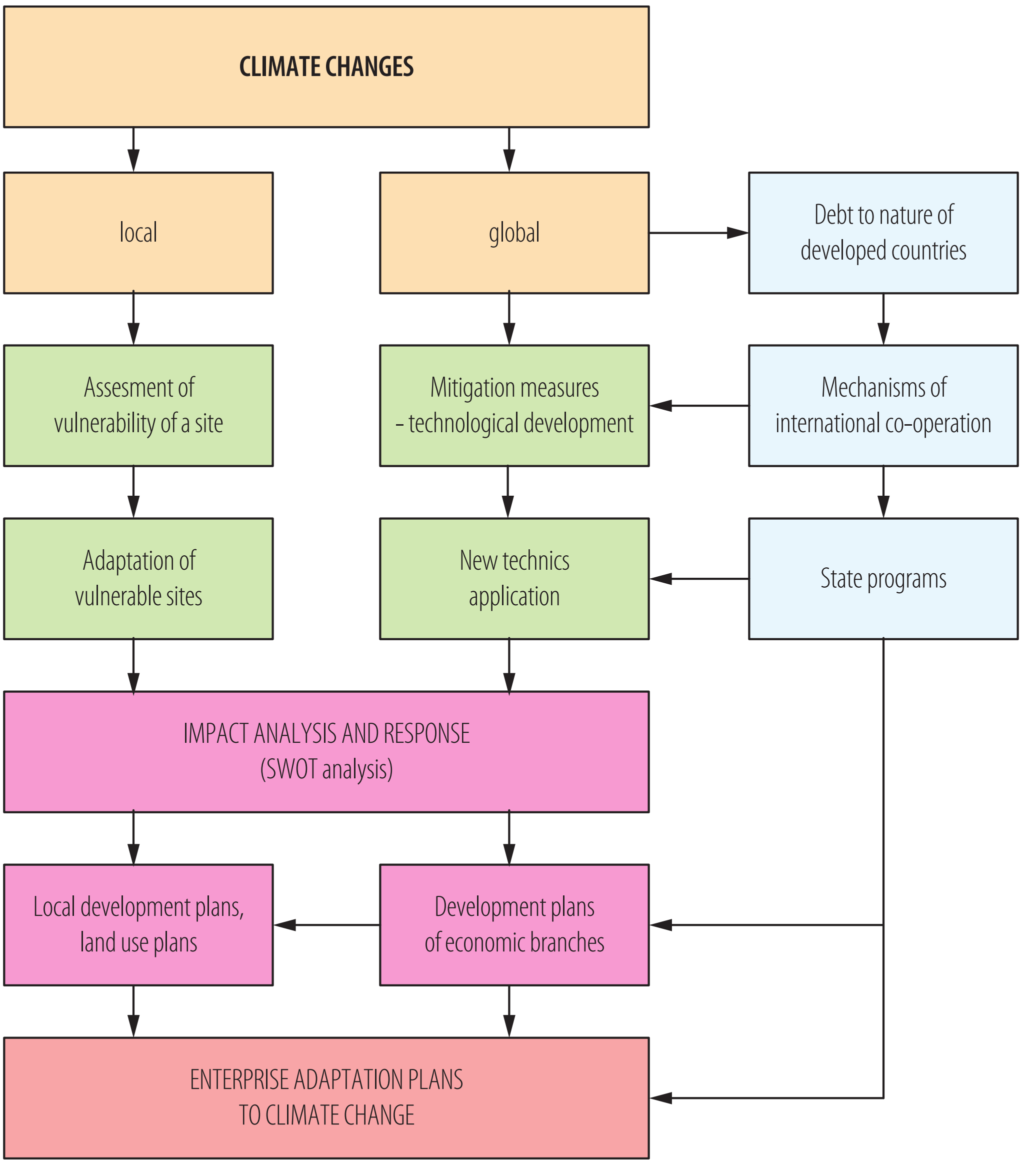


Fig. 3.6.2.1. Economic Adaptation Model to Climate Changes

In the first case, adaptation is related to the reaction to changes in the local climate, whereas the second case refers to the integration of BiH into international processes to decrease global GHG emissions.

Who should encourage the business community to undertake adaptation measures? The most important is reaction of management. And the task of the state is to provide them with information of both types: vulnerability of the area in which business is done and flows of technological development in the world. The task of the state is also to provide certain assistance (within the limits of their readiness for the task, in the widest sense of the word, as well as to provide transfer of assistance from developed countries which are obliged to do so (Fig. 3.8.2.1 – right column). Developed countries are obliged to do so, and they do it on the basis of exchange of debt according to its nature. These countries have developed using resources of the Planet that belong to other states as well and they cause climate changes. In order for existing countries not to develop in the same way (inadequate for environment), developed countries are obliged to invest funds to more sustainable development of the rest of the world. Starting from 1979, almost all international environmental agreements have mechanisms of support to environmentally acceptable development of the developing countries. However, according to findings of Agenda 21 of the Rio Conference (1992) developing countries are often not capable to identify their environmental problems, thus they ask for and implement assistance.

In addition to actions taken by the state, local communities and trade associations should react. Local communities should assess vulnerability of each area, therefore vulnerability of the economy on the whole, as well as chances which the economy has through adaptation to the climate change. Also, trade associations from the territory of the state, entities, regions or cantons should make analyses for the given type of those activities. The best tool to use for this is SWOT analysis (Table 3.6.2.1.).

Within preparation of the local development plan, spatial and master plans, that is, development of industrial branches (agriculture, energy, construction . . .), an assessment of individual strengths and weaknesses in various regions and sectors of the economy should be done, including the opportunities and threats which climate change presents. An analysis of results should be included in development plans.

	USEFUL for achieving adaptation	**DETRIMENTAL** for achieving adaptation
Internal (state attributes)	**Strengths:** 1. BiH economy is in the process of ownership, that is, technological transition, which is good for implementing "climate" transition, 2. There are potentials for saving of raw materials and energy in the industry and households, 3. There is significant natural potential in renewable energies.	**Weaknesses:** 1. Climate change has a negative impact (state aspects for the given community or branch of economy), 2. Economy does not have sufficient knowledge about environment and the market, 3. The state environment administration is distributed across many institutions and not connected, thus being inefficient, 4. No economic instruments to stimulate environmentally acceptable behavior of economy have been introduced, 5. International assistance and incentives are almost not used.
Externally (influences from abroad)	**Opportunities:** 1. There is a big number of mechanisms of international cooperation and financial and professional assistance. 2. There are possibilities of transfer of environmentally acceptable technologies / know-how, 3. Decrease of dependence from import of energy 4. New occupations and employment positions, 5. Increase of employment in the area of renewable energy sources, 6. Promotion of best practices in the country, 7. Introduction of education about the environment at all levels.	**Threats:** 1. Decrease of foreign investments due to lack of systematic solutions in the state, 2. Decrease of foreign investments due to lack of usage of international incentives, 3. Loss of the positions on the world market, 4. Generally low degree of public awareness on problems and issues of climate change impacts, 5. The public is often inadequately sensitive about the issues of environment and climate changes.

Table 3.6.2.1. SWOT analysis in the area of climate change

3.6.3 Climate Change Adaptation Policies and Policy Frameworks

BiH has endorsed the creation of a Climate Change Framework Action Plan for Adaptation in Southeastern Europe (SEE/CCFAP-A) under the auspices of the Belgrade Climate change Initiative (SEE, 2007). This framework and its related activities are described in the chapter on International Cooperation in this Communication.

In implementing a framework for adaptation, it will be important to develop a system of indicators and capacity building for monitoring of the effects is a primary task. Four measures should be undertaken in order to build capacities for management of development in the atmosphere of climate changes:

1. It is necessary to select a stable system of statistical data on climate changes, results of adaptation to them and indicators providing for the application of internationally recognized methodologies of analyses and monitoring of effects of supporting sustainable development under changing climate conditions. The first two components may be integrated into the existing system of meteorological information and the third into the system of regular statistic reporting via entity institutes and the BiH Agency for Statistics.
2. It is necessary to improve the existing system of meteorological observations – observing the climate changes and results of adaptation, including early warning system. Development of these – professional – capacities should be joined in a terrestrial climate observatory – integrated into an international system for observation. This should be further elaborated in a special project, probably on the very beginning of establishment of the Climate Change Adaptation System.
3. Professional (1) and political (2) bodies should be appointed to manage development in an unstable climate environment. Professional bodies (at the level of BiH Council of Ministers: Economic Planning Authority) should become skilled, in addition to classical planning and proposing of economic measures in parliamentary structure, also for alleviation of consequences of the climate changes and adaptation to them. Political body is necessary for political responsibility for sustainability of development in changing climate conditions.
4. Perception of the public should be created about the need for society on the whole to deal, more seriously to the climate change, measures providing for survival and further development, means to be used to make the changes endurable and the development more stable.

However, the biggest potential for adaptation policies and measures lies in developing a complex approach at the state level with international cooperation (see Fig. 3.6.3.1.). Two "macro-projects" of this nature have been identified: 1) Rural Development at the Crossroads, which is related to water, food and hydropower supply; and 2) Demand-Side Energy Efficiency, which is related to increasing energy efficiency.

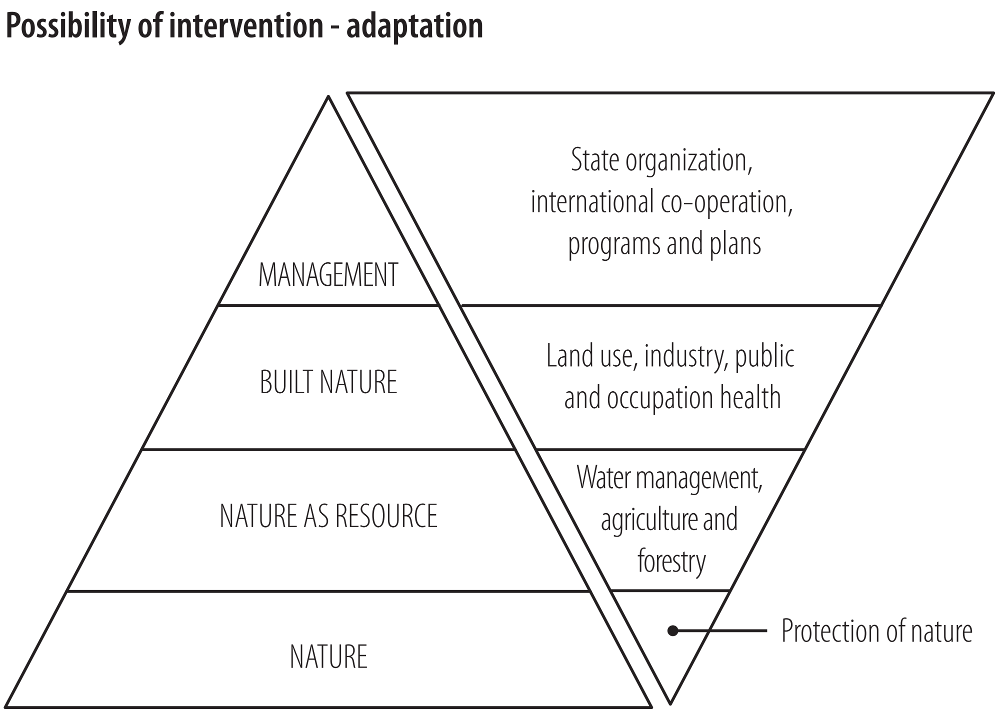


Fig. 3.6.3.1. Levels of impact of the climate change and potential interventions.

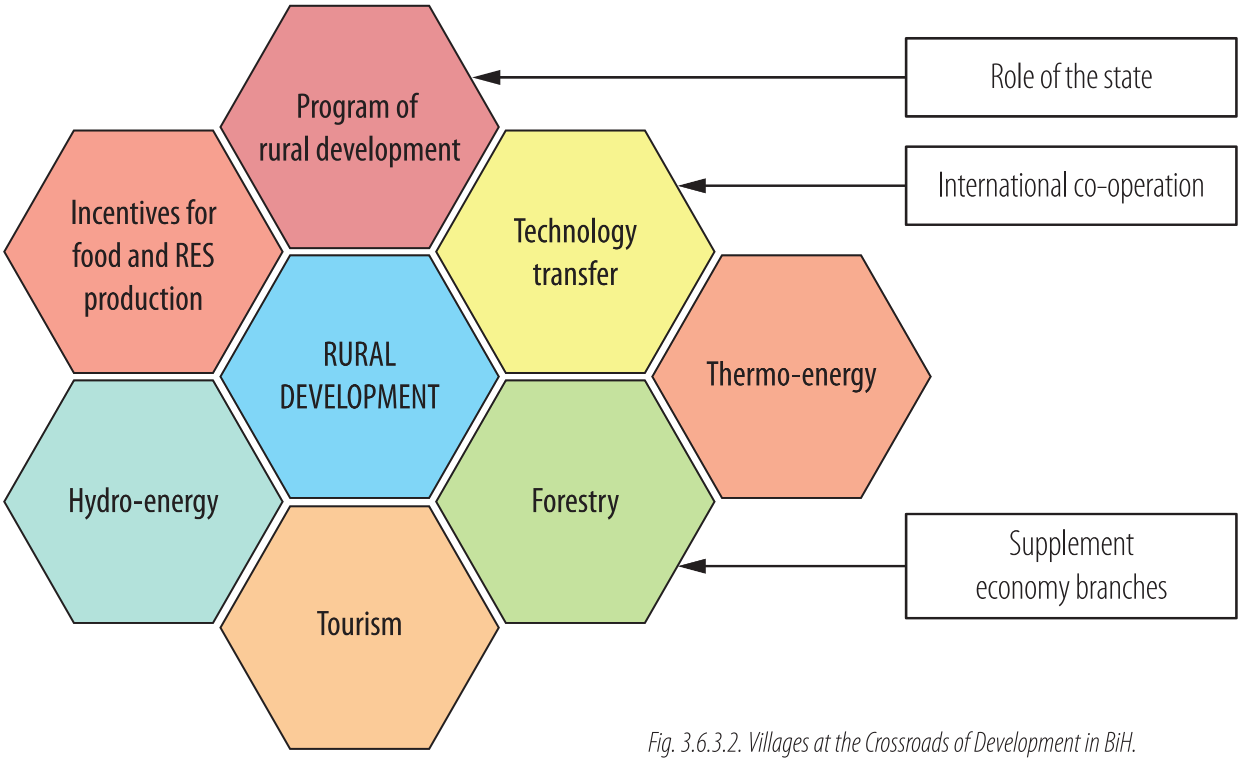


Fig. 3.6.3.2. Villages at the Crossroads of Development in BiH.

Macro-project: Rural Development at the Crossroads

In BiH, the biggest threat from climate change is to rural development. Villages suffered the biggest damages during the 1992-1995 war. There must be an integrated development plan for villages, containing not only post-war reconstruction and return of population, but also the risk of climate change. This risk should not be a limiting factor, but an input factor on which adaptations to climate change will be built as a component of supporting village development.

BiH imports significant quantities of goods. It should become a significant producer of food. In open market conditions, villages in BiH cannot stand the competition of food producers coming from the neighboring countries. Incentives for development of villages are necessary. Additional incentive should be production of bio-mass, renewable source of energy, based on waste from agriculture and forestry, but also on the basis of specially cultivated plants for such purposes.

Rural development should be linked to:

- Development of hydropower supply (accumulation for production of hydropower supply, irrigation),
- Development of forestry (employment, primary production, usage of waste from forestry and wood processing),
- Development of thermo-electric power plants (supply of cities with biomass).
- Necessary transfer of technologies / know-how: agricultural techniques, biomass-fired boilers that can be used in cities. Rural development is a central point in BiH development, including climate change adaptation.

Macro-project: Demand-Side Energy Efficiency

Former socialist states are characterized by a high degree of energy intensity. Bosnia and Herzegovina uses twice as much energy to produce USD 1000 of GDP than the world average. Such high energy intensity is not a result of low efficiency in the conversion of primary forms of energy into secondary, but the result of low efficiency of transforming energy into products and quality of life. Housing stock built after 1945 mainly belongs to classes of energy efficiency F and G[18]. Researches have shown that the biggest number of the available measures for repair of energy losses returns from 5 to 8 years. Under conditions of recession, after the number of orders for building new buildings decreased, construction could be oriented to repair of the existing buildings. It is not difficult to prove that this would be the most cost-effective investment in BiH. In addition to employment of local labor force, effects would be decrease of energy imports and – of course – decrease of greenhouse gas emissions.

The situation is similar in industry, too. Compared to the value of production, energy consumption is very high. This is not just a

[18] Study Paper, CETEOR Sarajevo, 2008, [xx]

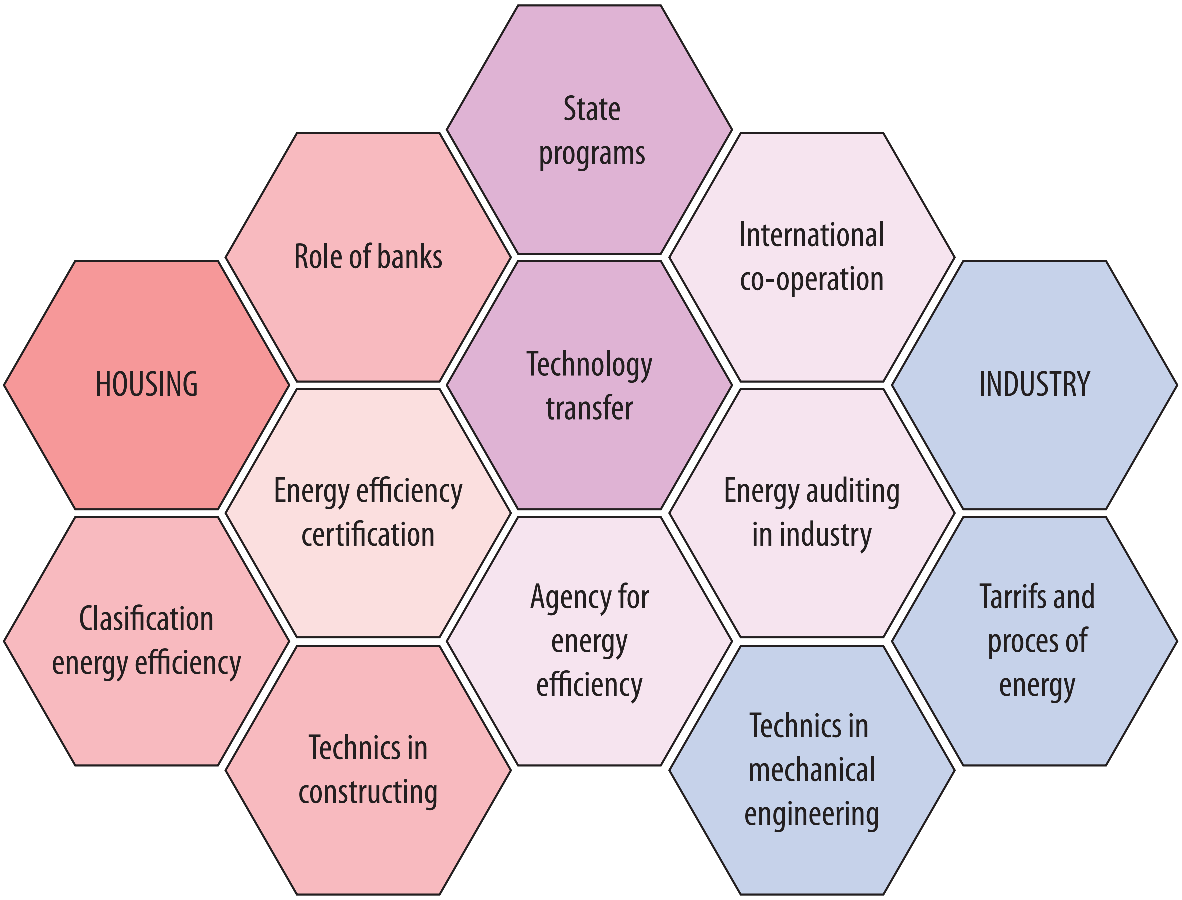


Fig. 3.6.3.3. Macro-project: Demand-Side Energy Efficiency.

consequence of outdated technology or equipment, but primarily because of weak energy management in companies. There is no use of energy audits, and simple research on a small number of industrial companies has shown that the return on investments in energy efficiency is 2 to 3 years, but that there are also measures that pay for themselves in a few months or only a few days.

In order to realize this project, it is necessary to introduce a system of marking energy efficiency of the building, as well as system of energy audit in both construction of buildings and in industry. Special importance goes on financing of individual projects. In addition to bank loans (there are first hints of these in BiH), incentives from ecological funds of the entities are important, and also funds with money of foreign origin.

3.6.4. Economic incentives

The key is the role of economic instruments in realization of alleviation measures (mitigation). Since 2002 in RS, that is, 2003 (in FBiH) there are laws regarding an environmental fund, but these have not been made operational. These laws foresee fees for emissions, as well as incentives for the application of measures of protection of the environment and increase of energy efficiency. It is certain that increase of energy efficiency is the best measure of environment protection, thus such projects should be given preference.[19]

It is also possible to establish in BiH a special fund for the climate change adaptation, from the funds which according to provisions of the Convention on Climate Changes, are obliged to be given by countries from Annex 2 of the Convention. For a certain limited number of projects, it is possible to use financing on the basis of CDM flexible economic mechanism of the Convention.

There have been announcements on establishment of funds for credit lines related to energy efficiency and usage of renewable sources of energy in the Western Balkans (a few tens of millions of Euros). However, in BiH, there is no proposal for a project related to energy efficiency or renewable energy. That is why the offer of support funds from these funds would not mean much. For this reason, it is necessary to separate special initial funds for both project promotion, and preparation of technical specifications and documentation related to the due diligence process (necessary to receive loans or grants of the Fund).

[19] In Slovenia, 85% of the funds provided by the state ecofund are used for measures to mitigate climate change.

Funding is of vital importance for the planning and implementation of adaptation plans and projects. A basic conclusion of the Stern Review was that the costs of strong and urgent action on climate change would be less than the thereby avoided costs of the impacts of climate change under business as usual (Stern, 2006). All countries, rich and poor, need to adapt to climate change, and this will be costly. Developing countries, already the hardest hit by climate change, have little capacity (both in terms of human capacity and financial resources) to adapt. Research to date indicates that climate change may have a major effect on the water resources, agriculture, forestry, coastal management, tourism, energy, land use, buildings, transportation, natural ecosystems, and human health of the SEE countries.

Regarding adaptation, possible sources of funding for the implementation of the Climate Change Framework Action Plan for Adaptation in the SEE region (SEE/CCFAP-A) include, but are not limited to, the following: UNFCCC/GEF, including Strategic Priorities for Adaptation (SPA) to which the region is eligible and the Adaptation Fund under the Kyoto Protocol, once it becomes operational. In addition, there are other funds set up recently by the UNDP, UNEP, WB, FAO, UNESCO and the EU (Instrument for Pre-Accession Assistance – IPA, Seventh EU Framework Programme – FP7), the WMO Programme for Technical Cooperation, the SEE Initiative for Disaster Reduction and Adaptation through the World Bank, and bilateral financial and technical assistance (ODA) funds (UK, Spain, Japan, Switzerland, etc.). Other opportunities, such as Multilateral Environmental Agreements (MEAs), the areas of work of which could be synergetic with adaptation, may also provide further funding for adaptation. These MEAs include the Convention on Biological Diversity, the UN Convention to Combat Desertification and the Ramsar Convention on Wetlands. Other Specific Assistance of cooperative projects include Project-type Technical Cooperation, Climate Technology Initiative (CTI), the Japanese International Cooperation Agency (JICA) Training Courses, SEE countries national funds and private foundations, as well as in-kind contribution from participating SEE countries (CCFAP, 2008).

3.6.5. Public involvement in adaptation policies and measures

Finally, it is important to note that broad public support will be necessary to undertake the broad and significant changes that will be necessary to adapt to climate change. Until now, neither the government of the entities nor that of the state has invited stakeholders to get involved into the process of promoting adaptation.

There are a large number of stakeholders who should be included into the process of adaptation to the climate changes. Three main groups are the government, business and industry, And citizens and civic associations.

3.6.6. Information and awareness raising activities regarding adaptation

Within the preparation of this Initial National Communication there were no contacts with either the Government of the state or its entities concerning development plans for BiH. Publications and brochures related to the Communication and to the UNFCCC and climate change issues more generally were not specifically prepared, but it is anticipated that these materials will be prepared in the context of the preparation of the Second National Communication.

Independently from the project of preparation of the INC, two other activities were carried out that supported increased awareness of climate change issues.

1. The UNDP Human Development Report for 2007/2008 – "Fighting climate change: human solidarity in a divided world" -- was published in the local language.
2. UNDP BiH organized a meeting on the topic of "Climate Change Challenges in BiH" on 2-3 June 2008.

Non-governmental organizations have not generally played a major role in information dissemination and awareness raising regarding adaptation to climate change. The Regional Center for Education and Information (REIC)[20] organizes summer schools each year for participants in field of sustainable development for participants from Southeastern Europe on Energy Efficiency and Renewable Energy Sources. This summer school is financially supported by the Middle-European Initiative and Ministry of Energy, Mining and Industry of FBiH, as well as some other international organizations.

[20] Foundation supported by UNESCO, University in Bologna, Italia and University in Sarajevo, BiH.

4. ESTIMATING THE POTENTIAL FOR CLIMATE CHANGE

4.1. Methodology

The methodology for the preparation of this section of the Report was developed based on the guidelines from UNFCCC and IPCC directives and in accordance with the conditions and specific features resulting from the constitutional organization of the state and the data available for individual sectors included in this analysis. The project team for this component of the communication was selected through a public tender, to which experts from different fields applied. While all sectors were analyzed, the following sectors were analyzed in depth due to their high potential for mitigation: the electrical energy sector, the construction sector, the energy utility sector, renewable energy resources.

Because unequal quantities of data and other essential background information were available for the various sectors, in line with UNFCCC guidelines, the team members were free to analyze the current situation and the potential for reducing greenhouse gas emissions in the initial stage of research by following their professional standards.

During the next stage, it was suggested that the experts use internationally recognized models recommended in accordance with the guidelines, such as LEAP and RETSCREEN software's, but again in this stage it was up to the experts to decide whether they would use these models to analyze scenarios for reducing greenhouse gas emissions in their respective sectors, some other recommended models, or other estimation and calculation methods as specified in the guidelines. Again, the decisions were made based on the experts' judgment and the available data and analysis.

After that, the experts were supposed to express the measures for reducing greenhouse gas emissions in the form of technical project proposals, ranked by importance and investment scope value. To define the projects' importance (their competitive and market value), a team of economists joined the experts from different fields to apply a simplified cost-benefit analysis method to rank the projects. It is important to mention that unlike the other sections of this communication, there is no standard method for analyzing the potential for reducing greenhouse gas emissions, and to that end the recommendations given in the guidelines were combined with the experiences of surrounding countries, particularly those with the same status in relation to the UNFCCC as Bosnia and Herzegovina. The following chapters show that each sector was analyzed according to its specific characteristics.

Two scenarios were used to assess the potential effects of reducing greenhouse gas emissions:

- The baseline scenario, which implies 'business as usual,' or the current level of activity in the given sector, with possible changes due to external factors, such as market fluctuation.
- The second scenario, greenhouse gas emission reduction scenario with measures, which assumed organized activity to stimulate measures to reduce greenhouse gas emissions, in line with the country's actual potential and realistic stimulus measures from abroad.

An annotated overview of the mitigation potential for measures in various sectors presented in this chapter is provided in Section 4.8.

4.2. The energy sector

The main local energy resources in Bosnia and Herzegovina are coal and hydropower. Bosnia and Herzegovina imports natural gas and oil. The total energy consumption in 2005 was as follows: 45.3% coal and coke, 9.6% hydro-power, 21.1% liquid fuels, 5.6% natural gas, and 20.5% wood (Study EES BiH, 2007). The basic characteristic of the energy sector of BiH is low energy efficiency throughout the fuel life cycle (from coal extraction or fuel import to the transformation of energy into money or comfortable living conditions). As a result, energy consumption is very high; in 1991, energy consumption in BiH was almost two and a half times higher per GDP unit than in any other Yugoslav republic, e.g. Croatia or Macedonia. One of the reasons for such high energy consumption in BiH at that time was that it exported electric power to some other former Yugoslav republics at low prices. TPES (Total primary energy Supply) in 2009 is 1.49 toe/capita, while World TPES is 1.82 toe/capita and OECD TPES is 4.64 toe/capita (IEA, 2009).

Current natural gas consumption is considerably lower than in 1990 due to bad conditions in the industrial sector. The unfavorable consumption mix (a relatively high percentage consumed in heating and household use) and unfavorable consumption dynamics (much higher consumption in winter) result in increased prices for natural gas. In addition, only one pipeline is used for transporting natural gas and it is imported by a single supplier, which calls into question the stability of supply.

Despite the level of fulfillment of basic energy needs being rather high in BiH, the poor still have very limited access to energy resources. Most

Installed production capacity			
Fuel	Unit number	Capacity	Capacity in %
Nuclear power	-	-	-
Coal	4	1957	49%
Natural gass	-	-	-
Hydro-power	13	2034	51%
Other renewable sources	-	-	-
Total	17	3991	100%

Table 4.2.1. Installed production capacity in Bosnia and Herzegovina

households in BiH are connected to the electric power grid; however, this is not so common when it comes to natural gas or central heating. People with comparatively low incomes consume a lot less to meet their basic energy needs. In addition, the use of wood for heating is quite prevalent in BiH, especially in comparatively poor households. According to estimates in made in 2000, households and the commercial sector in BiH consumed 50%, industry 25%, and transport 25% of electric power. Therefore, the highest percentage of electric power is consumed by households and the commercial sector. The energy consumed by households and the commercial sector is used mostly for heating (hot water, cooking), lighting, and electrical appliances and equipment (ESSFBiH, 2008).

4.2.1. Renewable energy resources

Renewable energy resources (RES) include hydropower, wind energy, geothermal energy, solar energy and biomass. Technologies for application of some of these energy sources have long been known in Bosnia and Herzegovina, and they were utilized to a certain extent, but without significant state planning and without being based on the newest technologies. There are several reasons for that, and only the basic ones are listed here:

- the price for construction of energy systems using RES is considerably higher for those using fossil fuels,
- there is no state/entity development of RES, nor is there an energy strategy that would promote RES,
- there is a low level of exploration of RES potentials in BiH,
- there is an absence of quality statistical (primarily climatic) data that would be necessary to use RES,
- there are various barriers to more serious investments in RES-based energy systems

All previously identified reasons have lead to the existence of a very small number of energy systems based on renewable energy sources in BiH today (apart from large hydropower plants), and a brief overview of the existing situation is given in the following sections.

4.2.1.1. Hydropower potential

The development of small hydropower plants (HPPs) is the most promising source of renewable energy in BiH at the moment. In addition to hydro energy potentials of the major waterways, BiH also has available hydropower potential in small streams.

The economic hydropower energy potential of major water streams in BiH is around 18000 GWh/year. The utilization level of that potential is around 40%, or 7182 GWh/year. Another source (the studies of JP EP BiH, made for BiH before 1992) says that the theoretical hydropower potential in BiH totals 99256 GWh/year, technical water power potential of 356 small and big HPP (which may be built) amounts to 23395 GWh/year, out of which 2599 GWh/year is in small HPP. The degree of utilization of small hydropower plants is 4.4 % of available power, or 5.7 % of available energy, and these degrees of hydropower potential are very low level compared with other European countries. (ADEG Projekat, 2005).

According to the Law on concessions in FBiH, cantons are in charge of giving concessions for the electricity plants up to 5 MW. (Bošnjak et.al., 2007) Therefore, concessions for the small hydro plants up to 5 MW are to be obtained by cantonal authorities and for those with capacity higher than 5 MW are handled by the entity government. Republic of Srpska is in charge of giving concessions for all electricity plants. It is estimated with a high degree of accuracy that the total technical hydropower potential of all the stream flows in BiH is approximately 6.13 GW, or 22.05 TWh of electrical energy. The potential by watershed is given in Table 4.2.2.

The potential convenient for construction of small hydropower plants in BiH amounts to 1004.63 MW or 3519.74 GWh. Out of that, FBiH has at its disposal about 2090 GWh, and RS has 1430 GWh. A significant part of hydropower potential suitable for construction of large hydropower plants is permanently lost due to urban, environmental and economic limitations. The utilizable part is estimated at 13 TWh/year.

Table 4.2.3 lists potential small hydropower plants for which there is at least a study. Studies for a certain number of plants have still not made due to lack of funds, the interest authorities being diverted to other issues, and the uncertainty of construction after their completion.

The construction of small hydropower plants in BiH is, without a doubt economically competitive with current technologies, and with the fewest challenges and limitations of all RES. Considering the tradition of construction and exploitation of HPPs (small and large ones) in BiH, the available capacity of this source, level of training of personnel of power utility and construction companies (with a tradition in constructing these facilities), it can only be stated that it is necessary to continue the trend

	Watershed - River	Maximum Capacity	Annual Energy Output
		MW_{el}	GWh
1.	Una*	392.10	1566.7
2.	Vrbas	616.89	2427.47
3.	Bosna	365.78	1593.60
4.	Drina*	1838.61	7107.66
5.	Sava*	55.55	283.05
6.	Cetina	197.00	594.40
7.	Neretva	1548.00	5048.21
8.	Trebišnjica*	1112.4	3429.50
BiH - TOTAL		6126.33	22050.59

* a part belonging to B&H

Table 4.2.1.1.1.: Technical hydropower potential by watersheds of BiH (ADEG Project, 2005)

River watershed	Capacity (kW)	Net energy output (GWh)
Total in FBiH	122.171	551.786
Total in RS	413.690	1.887.940
Total - BiH	535.861	2.439.726

Table 4.2.1.1.2.: Potential for small HPP in BiH (FBiH and RS) (ADEG Project, 2005)

of exploring potential locations for the construction of small HPPs, their construction and exploitation. On the other hand, the only thing that can be anticipated at this moment as a limitation in the construction of small HPPs, or rather in the approval procedure for the construction of such facilities, is the lack of transparency in terms of dealing with the public, and the issuing of questionable environmental licenses and the questionable fulfillment of environmental requirements during construction.

4.2.1.2. Wind power

Insufficient measurements make it impossible to estimate the real potential for wind energy in BiH. It has been indicated that there is the economic potential for developing approximately 600 MW of wind-based electricity by 2020, assuming that an appropriate incentive system to build wind power installations is introduced. In the period of 1999-2004, a preliminary selection of potential locations for installing wind power plants in BiH was conducted (ADEG Projekat). Temporarily, 16 locations were marked as having good potential. The total estimated installed capacity for these locations is 720 – 950 MW, implying annual production of 1440 – 1950 GWh. The infrastructure offers adequate conditions for connecting possible locations to the grid, as the high- and medium-voltage network in BiH is well developed.

Considering the territorial position of BiH, and land configuration as well, wind energy potential in BiH is considered in two regions:

- Southern BiH, where proximity of the Adriatic Sea and the land configuration of this area give convenient preconditions for wind energy use, and
- Sarajevo area, where mountains in the region create winds convenient for utilization in wind power plants.

A global evaluation of quality of the regions in BiH relies on existing data. According to these data, the region of Southern BiH has the strongest potential for electricity production from wind. Thus, the extended area of Podveležje, situated app. 30 km from Adriatic coast, offers excellent conditions, confirmed by intensive measurement for the last three years. A detailed study of wind-power plant micro-location choices has not been carried out yet. Analysis of the possible wind energy utilization in selected macro-locations is just a beginning step, reflecting the perspectives of these regions for wind power generation (Muštović, 2005).

At present, there is no operational wind power plant connected to the high-voltage network. Although the investigations and measurements for some locations are in the final phase, at present there are no wind power plants under construction either. There are only a certain number of small wind power plants for households, but they are not accounted for in this data because there is no reliable source for estimating their capacity. However, it is certain that this capacity is too low to influence the overall estimated wind power capacity rate significantly.

4.2.1.3. Geothermal energy

In terms of geothermal water sources, the hydro-geological structure of terrain in BiH is the result of complex geological and tectonic processes and is divided into three principal types: deep artesian wells and inter-mountain depressions of Posavina – the River Sava catchment), a group of sources in the urban area, and hydro geological massifs (Una-Sana massif, central Bosnian mountains, southeast Bosnia (EES BiH Study, 2007).

The geothermal energy potential of BiH is 33 MWth (Strategic Plan and Program of FBiH Energy Sector Development, 2008). The temperatures at known sites (50 to 85 oC) are too low for producing electric power. For the time being, only the option of exploitation in thermal facilities is being considered. The exact locations of geothermal water sources in northern Bosnia, where temperatures are believed to be higher (80 to 100oC), have not been found yet, but if they are, plans exist for partial conversion to electrical energy.

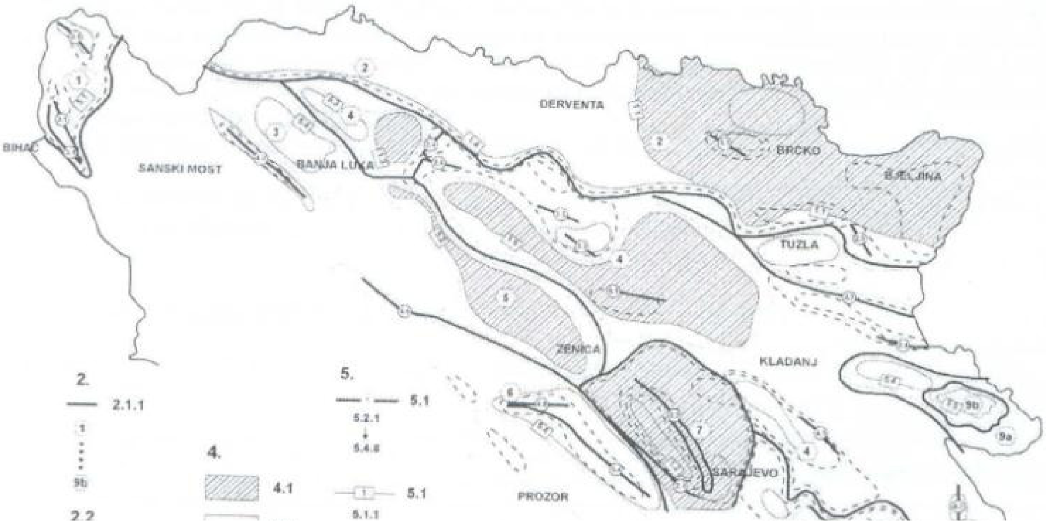


Figure 4.2.1.3.1.: Zones of hydrothermal potentials (EES BiH Study, 2002).

BiH	Site	Depth (km)	Water temp. (°C)	Facility power (MW)	Fluid flow rate (l/s)
FBiH	Ilidža	2-3	100	1	Minimum 60 (temp. 80°C)
RS	Northwestern part of RS basin	2-3	100	1	Maximum 160 (temp. 100°C)

Table 4.2.1.3.1. Sources in BiH planned for electricity generation: Characteristics (Tica, 2002).

Total potential installed capacities of geothermal wells at 29 locations		Temp. (0°C)	Yield (kg/s)	Thermal power (MWt)		Thermal energy (TJ/god.)	
				Up to 50°C	Up to 20°C	Up to 50°C	Up to 20°C
Geothermal wells	1	92 °C	20.0	3.51	3.51	55.40	94.97
Geothermal wells	28	21-57.5	0.2-162	3.64	3.64	57.38	804.7
TOTAL				7.15	57.08	112.7	899.7

Table 4.2.1.3.2.: Thermal potential of geothermal wells used directly in FBiH (Study EES BiH, 2007).

Total potential installed capacity of geothermal wells at 16 sites		Temp. (°C)	Yield (kg/s)	Thermal power (MWt)		Thermal energy (TJ/god.)	
				Up to 50°C	Up to 20°C	Up to 50°C	Up to 20°C
Low-temperature geothermal wells	1	75°C	20.0	2.09	4.80	32.98	72.55
Geothermal wells with water temperatures between 20 and 65°C	15	20.5°C -44 °C	1-230	0.0	28.51	0.0	449.46
TOTAL				2.09	33.12	32.98	522.0

Table 4.2.1.3.3.: Thermal potential of geothermal wells used directly in RS (Study EES BiH, 2007).

B&H sector	Site	Water temperature (°C)	Thermal power (MWt)	Geo-fluid flow rate (kg /s)
FB&H	29 sites	20.5-75	57.08 (up to 20°C) 7.15 (up to 50°C)	From 1 to 1000, depending on site
RS	16 sites	20-75	33.12 (up to 20°C) 2.09 (up to 50°C)	

Table 4.2.1.3.4.: Supposed sources in BiH for thermal energy production

4.2.1.4. Solar energy

Apart from the application of thermal energy obtained from solar collectors for heating and preparation of sanitary water in buildings , this form of energy is also applicable for cooling, industrial process heating, pool heating applications, etc. Each of the mentioned applications is certain in BiH in the period until 2020, and the intensity of that application is directly dependent on government incentive policies. It is realistic to expect that in the period until 2020 in BiH there will not be more significant application of solar energy for the production of electrical energy, with the exception of individual low-power PV systems (negligible for the energy balance of BiH), and the same trend is to be expected even until 2030

The amount of solar energy emitted daily at the horizontal surface in BiH amounts to 3.4-4.4 kWh/m2 annually. With solar irradiation figures of 1,240 kWh/m2/a in the north of the country and up to 1,600 kWh/m2/a in the south, conditions for using solar energy are very favorable in BiH. The theoretical potential of solar energy in BiH totals 74.65 PWh. The technical potential totals 685 PJ, that is 6.2 times greater than the total primary energy needs in the energy balance of FBiH for the year 2000. Despite this, the use of solar energy is insignificant, and the exploitation of solar energy with flat-plate collectors is also limited. At present, only very small-scale consumers in BiH use it for water heating needs (a total of 4,000 – 6,000 m2 of solar collectors). The main reasons for this limited use are prohibitively high capital costs (450-550 €/m2, depending on the type of the system and collectors), and the lack of legislation that promotes and subsidizes the use of renewable energy systems.

The level of usage of PV systems in BiH is very low, almost negligible. A rough estimate of PV usage is around 2 kW or 2.2 MWh. There is a small number of autonomous systems used in traffic control, meteorological stations and households. In view of the relatively high cost involved, the introduction of photovoltaics on the market beyond very small-scale consumers far from the utility grid is dependent on promotion programs and international projects (ADEG Projekat, 2005).

At present, there are no solar and PV plants (apart from the small PV near Trebinje) in BiH. Despite the fact that BiH belongs to the European countries that receive a significant amount of solar irradiation (around 1240 kWh/m2 in the north and reaching 1600 kWh/m2 in the south), the use of solar energy is insignificant. It is realistic to estimate that because of a continuous reduction in capital costs, the installed collector area in BiH could reach 50,000 m2 by 2020. Based on the average solar irradiation in BiH of 3.6 kWh/m2, and the average collector efficiency of 50%, this area of collectors could produce 33 GWh of heat annually.

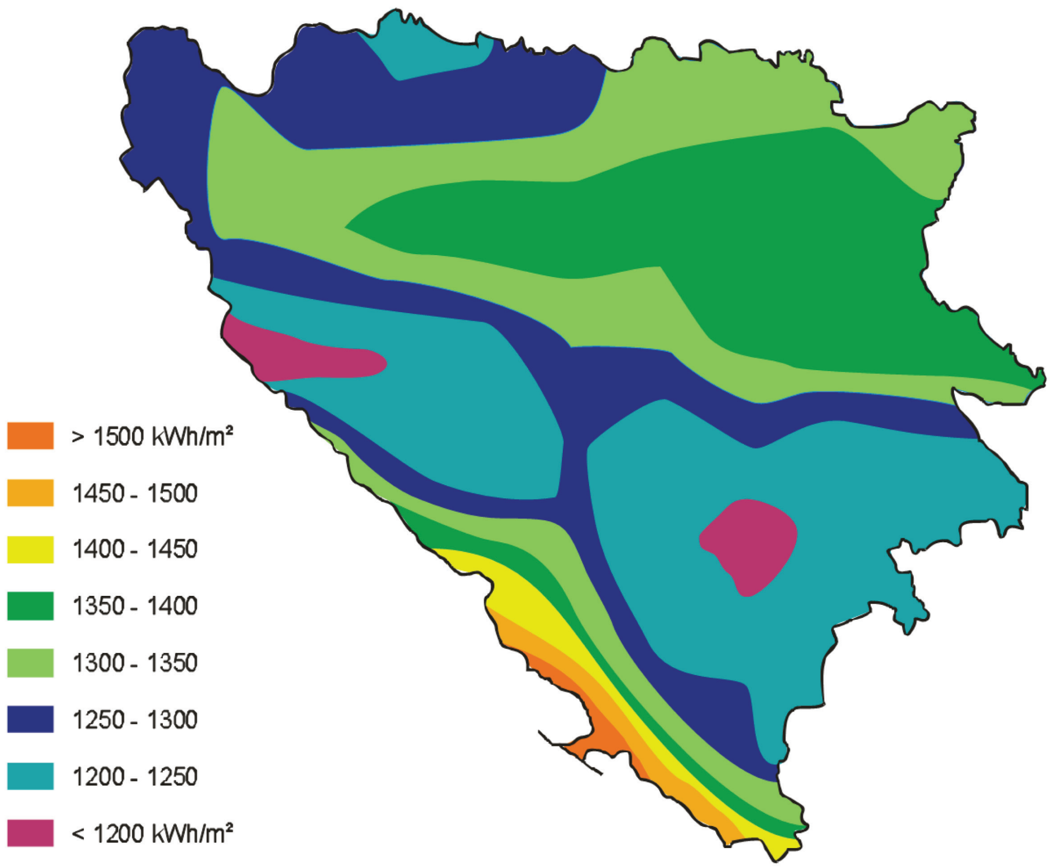


Figure 4.2.1.4.1.: Average annual sum of horizontal plane irradiation (kWh/m2) (ADEG Project, 2005)

4.2.1.5. Biomass

There is a long tradition of biomass use in BiH, but that use is characterized with a very low rate of utilization, mainly in rural and suburban areas as a primary source of energy for heating and cooking purposes in households and buildings. Apart from the traditional use of firewood and the recycling of wood waste in the wood-processing industry, there are no reliable data on the exploitation of different biomass sources in BiH, especially for wood waste. There have been plans by some local authorities for biomass-fired district heating in some places (municipalities with the large wood processing industry plants), but because of a lack of funding they have not been implemented. There are several plants for the collection of wood waste for the production of pellets and briquettes, but their production is negligible (Petrović et al., 2006).

	Biomass Available	Energy potential (PJ)	Source
Biogas from livestock [1]	20 100 000 m^3	0.508	Agriculture
Fruit tree branches [2]	211 257 t	0.739	Agriculture
Grain residues [3]	634 000 t	8.876	Agriculture
Leguminosae and oil crops resid. [4]	3 858 t	0.038	Agriculture
Residues from log processing [5]	1 142 698 m^3	7.533	Forestry
Firewood [6]	1 466 973 m^3	13.201	Forestry
Branches [7]	599 728 m^3	2.623	Forestry
Total technical potential	-	33.518	-

[1] biogas from farms of caws, pigs and chicken
[2] useful residues after cutting
[3] useful residues of grain (straw)
[4] useful residues of leguminosae and oil crops
[5] wood residues from primary and secondary wood processing industry
[6] fuel wood
[7] forest residues

Table 4.2.1.5.1. Total biomass energy potential in Bosnia and Herzegovina (ADEG,2005).

The most significant source of biomass for energy production is wood mass from forestry (firewood, forestry residues) and wood waste from the wood processing industry. However, agricultural residues also have a significant energy potential in the regions of northern, central and southern BiH. Within the ADEG Project,[21] special attention is directed to possibilities of application of different kind of biomass resources, proposal of optimal technical, technological and, in economical sense, profitable solutions for that application, spatial distribution of biomass resources, and other issues essential for beginning of use of this energy resource important to BiH as well. The first part of this project, named WP1, conducted a precise analysis of biomass potential and its density and location in BiH's regions. This potential and its source are shown in table 4.2.8.

Biomass in BiH totals approximately 9 % of total primary energy supply, mostly as firewood and wood waste (details are provided in the following chapter). Historically, biomass has been used by the rural population on a large scale for heating and cooking in all BiH's regions. It could be supposed that, according to this scenario, biomass use will stay more or less on its present level; i.e., 4,200 GWh (45 % of technical capacity) (ADEG, 2005).

BiH energy potential of biogas from livestock

It is important to emphasize that BiH has excellent natural conditions to develop livestock farming. It is important to note the following:

- Both BiH entities have a good economic rationale for using manure to produce biogas.
- Prediction: the biomass percentage in the world production will reach between 25% and 46% prior to 2100.
- There is significant potential for using liquid manure from farms obtained from registered livestock in BiH to produce biogas as a way proposed to mitigate climate change.
- Based on the current livestock estimates for the period 2004 through 2007, the following daily quantity of biogas can potentially be calculated (see Table 4.2.1.5.2.):

4.2.2. Power generation – baseline scenario

The main local energy sources in BiH are coal and hydropower. BiH imports natural gas and oil. The primary energy structure is as follows: coal 56%, hydropower 10%, liquid fuels 28% and natural gas 6%. In terms of power generation, the installed capacity ratio between thermal power plants and water power plants is 49:51, while the ratio between the amounts of electricity produced by these two types of facilities is 75:25.

[21] Advanced Decentralised Energy Generation Systems in Western Balkans, an initiative based at the University of Sarajevo under the EC 6th Framework Programme.

Type of animal	Estimate by year			
	2004	2005	2006	2007
1. Cattle (bovine)	447395	454188	466640	460360
2. Sheep	890941	902481	1005963	1030746
3. Pigs	587171	625473	686430	506759
4. Horses	27346	26690	25614	25158
5. Poultry	8975735	9804886	12563840	14302229
Total biogas produced (m^3/day per livestock unit)	791462.2	816214.2	873605.86	853175.8

Table 4.2.1.5.2. Calculated values of the potential of annual biogas production for B&H according to livestock data and amount of manure produced in the area analyzed.

BiH has ten coal basins (lignite basins at Kreka, Gacko, Stanari, Bugojno, Livno and Duvno, and brown coal basins in central Bosnia and at Banovići, Ugljevik and Kamengrad), so the current thermal energy industry is understandably focused on them, and the same can be expected in the future.

According to its origin, the coal found in B&H belongs to lignite, high in ash and sulfur and of low heat value. BiH does not have proper stoves, especially low-capacity stoves (for households) that would suit the quality of the coal used, and as a result coal combustion is inefficient and results in pollution due to incomplete combustion. Thermal plants using coal emit huge amounts of SO2, with BiH ranked third in per capita SO2 emission in Europe (1990).

The exploitation of hydropower is less than 40% of the total usable potential, which is rather low in comparison with other European countries. The utilization degree for small hydro power plants is even lower. In 1991, there were 11 small hydro power plants, which made 4.4% of the total potential small hydro power plant capacity, i.e. 5.7% of the energy available. Studies on hydropower potentials are currently being produced. The legal framework has been created to allow the construction of private plants and their connection to the electricity power grid.

The power sector is one of the cornerstones of B&H's development. Should we take into account the export capacity in this sector, a considerable lack of electrical energy in South-Eastern Europe and a substantial number of natural resources not yet discovered, the orientation of B&H towards the rehabilitation and restructuring of this sector is absolutely understandable.

With regards to the process of power generation and distribution, there are three vertically integrated monopolies in BiH:

- Public Enterprise Elektroprivreda Bosne i Hercegovine (EPBH);
- Public Enterprise Elektroprivreda Hrvatske Zajednice Herceg - Bosne (EPHZHB);
- Public Enterprise Elektroprivreda Republike Srpske (EPRS).

EPBH has 1,839 MW of installed generation capacity, of which thermal power plants total 73%, and water power plants 26%. The figure of 762 MW of the generation capacity of EPHZHB covers only the hydro power plants. Consumption at the level of distribution was 1,075 GWh. The total generation capacity of the Electric Utility of Republic of Srpska is 1,375 MW.

If calculations are made based on the cash flow, the electricity generation sector is profitable; however, if depreciation costs are added to the calculations, the loss is enormous. In fact, the profit covers only 30% of the annual depreciation expenses, which significantly hamper system maintenance and result in major losses, which are 20% higher in BiH than in EU member states (where losses are 12%).

Electricity consumption is a significant indicator of the standard of living. In 2004, average electricity consumption in the world was approximately 70 GJ per capita. Consumption in the developed countries had reached 236 GJ/per capita, while in BiH it was around 50 GJ/per capita, which is clearly considerably lower than average.

Electricity generation in BiH in 2002 totaled 10.8 TWh. Sixty percent was generated in thermal power plants, and 40% in hydropower plants. Total consumption (distributed, direct, and losses) was 9.7 TWh, leaving a net surplus of 1.1 TWh. Losses in the transmission and distribution grid totaled 1.6 TWh, which is more than 15% of the produced electric power. In 1999, the collectability rate ranged between 75% and 99%, while the loss in the low and high voltage grid was 9.8% (in EPB&H).

For small HPP, it is assumed that all small HPP (with a capacity of less than 10 MW) that have already received a concession will be built in the near future. There are about 200 concessions for small HPP in FBiH (from 2002 to present) with a possible installed capacity of 177 MW and possible annual energy production of 800 GWh (base scenario).

In the wind sector, it is assumed that all planned wind power plants will be constructed by 2020, with a total installed capacity of 616 MW and annual energy production of 1,600 GWh (base scenario).

4.2.2.1. The power sector in Federation of BiH

Two electric utility companies operate in the electric power sector in FBiH: Public Enterprise Electric Utility BiH, Sarajevo, and Public Enterprise Electric Utility HZHB , Mostar. The installed facilities, generation and consumption of energy in FBiH show that the energy system of FBiH covers around 60% of the total electric power system of BiH.

The total electricity generated in FBiH in 2006 was 8,248 GWh, consumption was 7,879 GWh, with a surplus balance of around 370 GWh.

As for the mining sector, there are ten operating mines contributing to the generation of electric power at the thermal power plants in Tuzla and Kakanj.

In terms of gas, the enterprise BH-Gas Ltd. Sarajevo operates in FBiH, along with distribution companies in Sarajevo and Visoko. The enterprise "Terminali Federacije" Ltd. Sarajevo was founded as a business entity for storing liquid fuels. In 2006, liquid fuel consumption was 771,000 tons and is increasing continuously.

In the period 2000-2006, electric power consumption in the Federation of Bosnia and Herzegovina increased at an annual rate of 4%. Peak load grew at an annual rate of 11%, which is a clear indicator that the share of power consumed by large consumers is rising (ESSFBiH, 2008). According to overview given in the same document (ESSFBiH, 2008), the energy sector is planning to build 588 MWe of wind power plants in FBiH by 2016, 1194 MWe in hydro power plants by 2015, and 3950 MWe in termal power plants of different type, size and capacity by until 2025.

4.2.1.2.The power sector in Republic of Srpska

In terms of the current situation, the total demand for energy in Republic of Srpska is met by consuming coal, liquid and gas fuels, hydropower and fuelwood. As for total energy consumption, depending on the year, coal covers the largest fraction (38-44.9%); the share of hydro-power depends of hydrological conditions and ranges from 11.3 to 15%; and, the share of natural gas is quite low and ranges between 0.2 to a maximum 8.2%.

In RS, electric power is currently mainly produced in thermal power plants or hydropower plants. There are two thermal power plants, TPP Gacko and TPP Ugljevik, both of them coal-fired plants, with a total peak power of 490.6 MW and total annual production of 2450 GWh.

Also, the total installed capacity of the operating hydropower plants is 735.8 MW, amounting to annual production of 2588 GWh. Also, there are small industrial power plants whose capacity is 15.2 MW and the annual production 72 GWh.

In order to use the existing water resources for electricity generation, the catchments of the rivers Drina, Vrbas and Trebišnjice have been researched, along with smaller-scale studies of the Una, Sana, Bosna and Neretva. Based on the research findings, the technically usable hydro-potential in the Republic of Srpska is 3152.29 MW, with the annual production estimated at 9239.48 GWh. Also Republic of Srpska have plans for construction of 281,7 MWe in small hydro power plants, as well as 885.9 MWe in large hydro power plants.

4.2.3. Power generation – greenhouse gas emission reduction scenario with measures

In selecting priority actions and measures for reducing greenhouse gas emissions, and not only in the energy sector, the principal criterion should be the cost-effectiveness of the proposed measure, which means that in principle, priority should be given to the measure with the lowest cost per unit of emission avoided. Except for the criterion of cost-effectiveness, the second thing to be considered is the level of development of the sector in which a particular measure will be applied; in other words, emission reduction projects should primarily focus on the sectors which are of strategic interest for the development of BiH, e.g. the mining industry, agriculture, etc. Beside these criteria, certain co-benefits to be considered are those resulting from investing in greenhouse gas emission reduction projects. The benefits of greenhouse gas emission reduction projects which are particularly linked to the energy sector are:

- Additional profits from trading reduced CO_2 emissions,
- Bringing foreign investments,
- Increasing the employment rate,
- Application of the best available technology (BAT),

- Transferring new technology knowledge,
- Using higher energy efficiency to enhance enterprise competitiveness
- Gaining experience of the options available to reduce emissions for the purpose of developing regulations in connection with climate change.

The measures which can be applied to reduce the amount of greenhouse gases emitted by the energy sector of BiH can be classified in several groups:

- Reducing methane emissions caused by underground mining by using a mixture of ventilation air and methane
- Increasing the energy efficiency of the existing facilities - both production and transmission facilities
- Building renewable energy sources
- Using biomass or fuels with lower CO_2 emissions
- Reducing N_2O emissions.

A commercial technology has been developed which uses a mixture of ventilation air and methane from coal mines, provided the methane concentration in ventilation air is between 0.2 and 1.2%. The mixture is oxidized in an airtight plenum chamber containing a ceramic bed. The released energy can be used for the production of thermal and/or electric power. During the process of oxidization methane is transformed into CO_2 and vaporized water.

This technology can potentially be applied in brown coal mines in the central Bosnian basin (Zenica, Kakanj, Breza). According to the available data, by using the technology described above the Zenica Brown Coal Mine could reduce its emissions up to 100,000 tons of CO_2 equivalent, and the mine in Breza up to 50,000 tons of CO_2 equivalent (Feasibility Study on Applicability of VAM Technology at Zenica Brown Coal Mine, 2009). Table 4.2.10. gives estimates of methane emission reductions for the above mines, as well as the value of CER credits and the investments needed for the projects.

Mine	Emission reduction $GgCO_2ekq/a$	CER credit[22] value in million EUR/a	Investment value in million EUR
Zenica	100	1.4	4.0
Breza	50	0.7	2.5

Table 4.2.3.1. The potential methane emission reductions for brown coal mines in central Bosnia, CER credit value and the value of the needed project investments

[22] CER credit value in December 2008 (OneCarbon www.onecarbon.com).

4.2.3.1. Potential of GHG emission reductions in thermal power plants

Two options are possible in terms of increasing the efficiency rate for the existing thermal power plants in BiH, and consequently reducing CO_2 emissions:

- Reconstruction of the existing units; and
- Construction of new units.

The efficiency rate of the existing units in thermal power plants in BiH is around 30%. There are possibilities of increasing efficiency rates, especially by rehabilitating the existing units. Since these projects are also implemented outside the CDM scheme (which means they are financially justifiable), and for the purpose of demonstrating "additionality", this measure should particularly be used for technology transfer. It is in view of this that the option of introducing or increasing the co-generation capacity of the existing units in thermal power plants should be considered. In cases like this only a small fraction of the invested funds can be compensated for with CER credits.

Emission from thermal power plants in 2005 was around 8 million tons (Energy Sector Study B&H, 2008). Table 4.2.3.1.1. gives an overview of potential CO_2 emission reductions by B&H thermal power plants if their efficiency rates increase for 1% (baseline scenario) and 3% (advanced scenario) respectively, and the financial effects of those reductions. As each thermal power plant is special, a variety of measures should be applied to increase efficiency rates. For that reason, it is not possible to estimate the investments needed until each of the thermal power plants is analysed separately and in detail. Some previously implemented CDM projects show that 15% of the funds invested in projects of this kind can be returned through CER credit sales (for 10 years in advance).

Efficiency rate increase in %	CO_2[23] Gg/a emission reduction	CER credit value[24] in million EUR/a	Investment value in million EUR/a
1	80	1.12	75
3	240	3.36	225

Table 4.2.3.1.1.: CO_2 emission reductions by thermal power plants in BiH due to efficiency rate increase and the resulting economic effects

The total installed capacity of thermal power plants in BiH is 1957 MW, although the funds needed for investment in medium-capacity, coal-fired thermal power plants (approximately $ 150 million per 100 MWe of installed power (Enrique Loredo, 2007). Constructing state of art thermal power units in BiH would

[23] In comparison with emissions from thermal power plants in 2005 (8 million tons).
[24] CER credit value in December 2008 (OneCarbon www.onecarbon.com).

reduce coal consumption without decreasing the amount of electric power produced and would help reduce the specific pollutant discharge; in terms of climate change, reduction in CO_2 emissions is of the greatest importance. Bearing in mind the current price of 1 ton of CO_2 equivalent avoided emissions according to the CDM (from around EUR 14/tCO_2, or KM 28), the annual value of CO_2 equivalent avoided emission would be around 36.5 million KM if the current old fashioned thermal power units in BiH are replaced with new ones.

4.2.3.2. Potential for GHG emission reductions from using natural gas for electricity generation

Of all measures used to reduce greenhouse gas emissions based on using natural gas, the most important is the use of natural gas in thermal power plants instead of coal. Using natural gas in coal-fired thermal power plants is technologically highly feasible. Using natural gas allows the use of combined cycle (gas + steam turbines), which increases the unit efficiency rate. Due to lower specific CO_2 discharge and a higher efficiency rate, CO_2 emission is reduced. In considering this measure, due attention has to be paid to the issue of sustainable development of BiH, given the fact that natural gas in an imported resource, while coal is obtained locally. The mining industry is very sensitive to any fluctuations in coal consumption in the energy industry. This measure should be considered in the context of balancing natural gas consumption in winter and summer. The Electric Utility BiH and BH Gas are currently working on a feasibility study of construction of a combined cycle plant at the Kakanj thermal power plant. Considering the potential efficiency rate (approximately 55%) and the difference between the specific CO_2 emissions when natural gas is used instead of coal, the power of a combined cycle plant can be twice as high (which also means twice the amount of generated electricity) as that of a coal-fired plant, while keeping the same CO_2 discharge rate.

4.2.3.3. Potential of GHG emission reduction from using renewable energy sources

Producing electricity using renewable sources (wind, biomass, hydro, solar and geothermal power) reduces GHG emissions, depending on a country's energy mix, or the so-called grid emission factor. There is no officially calculated grid emission factor for BiH. According to the data on electricity generation from the last few years, it ranges between 0.7 and 0.8 tCO_2/MWh. Based on this factor and plans for electricity generation using renewable energy sources; it is possible to calculate emission reductions. The potential of individual types of renewable energy sources is as follows:

- The total estimated wind power potential (27 locations in southern BiH) is 9000 MW, the total technical potential around 2000 MW, and the realistic target utilization rate of this energy source for 2015 400-600 MW. It is estimated that 2.4TWh of electricity can be produced at the considered locations (Energy Sector Study BiH, 2008). This would reduce coal consumption for around 2400kt, which means a reduction in CO_2 emissions for 2600Gg/year, calculated in accordance with IPCC and default emission factors.
- The most acceptable measure in terms of cost-effectiveness is co-combustion a certain percent of biomass in the existing coal-fired thermal power plants. There is research connected with the option of biomass co-incineration at the Kakanj thermal power plant indicating that biomass co-incineration is technically feasible, with the biomass totaling around 7% of the total fuel fired. CO_2 emission reductions would be proportional to the share of biomass used as fuel, which would be around 150,000 tons/year in the case of the Kakanj thermal power plant.
- The construction of small hydropower plants with a capacity of up to 10 MW deserves special attention, but the most complete analysis has been given by the three national electric utility enterprises: Electric Utility of HZHB, Electric Utility of BiH, and Electric Utility of Republic of Srpska. The total estimated average production of small hydro power plants would be 963 GWh a year. At the default grid emission factor in BiH, CO_2 emissions would be reduced by about 700,000 tCO_2 per annum, which could bring 20 KM million in annual profits from CER credits. For example, there are plans to construct several hydro power plants in Republic of Srpska, whose total peak power would be 885.9 MW and whose total annual production is estimated at 2205 GWh/year or more. If the planned hydropower plants will be constructed in Republic of Srpska which means that (the above table), CO_2 emissions would be reduced for 2425.5 GgCO_2/year. Most of the hydro-potential of BiH would utilised if the measures specified in the previous section are implemented. If it is assumed that small HPP potential is utilized at 80%, this equates to building approximately 800 small HPPs with potential installed capacity of 700 MW and potential annual energy production of 3,600 GWh.

The baseline scenario of using renewable energy sources for electricity generation assumes the construction of wind power plants and small hydropower plants by 2020 (data taken from the Renewable Energy Sources chapter). The advanced scenario envisages the construction of more wind power plants and small hydropower plants, in light of the technical capacity of these renewable energy sources in BiH (data taken for the chapter Renewable Energy Sources). Tables 4.2.3.3.1. and 4.2.3.3.2. give an overview of GHG emission reduction if renewable energy sources are exploited according to the quoted scenarios, along with the estimated value of earned CER credits and the necessary investments. The investment figures with regards to these facilties were also taken from the Renewable Energy Sources chapter.

Scenario	Installed capacity in MW	Production GWh/a	CO_2 Gg/a emission reduction	CER credit value[25] in million EUR/a	Required investment in million EUR/a
Baseline	616	1600	1120	15.68	924
Advanced	900	2300	1610	22.54	1350

Table 4.2.3.3.1. GHG emission reduction from using wind power for electricity generation in BiH

Scenario	Installed capacity in MW	Production GWh/a	CO_2 Gg/a emission reduction	CER credit value[26] in million EUR/a	Required investment in million EUR/a
Baseline	177	800	560	7.84	265
Advanced	700	3600	2520	35.28	840

Table 4.2.3.3.2. GHG emission reduction from using hydropower in small hydropower plants for electricity generation in BiH

More specific activities result in reduced emissions:

1. Preparation of an action plan to promote renewable energy sources, which will put an emphasis on the needs and benefits of using them for electricity generation, as well as on the possibility of receiving funding from international interested parties for their use
2. Application of the latest technological solutions to achieve a greater utilization degree of primary energy sources (fluidized-bed combustion, supercritical plant parameters) in the construction of new fossil fuel power plants

However, to achieve the above, it is first and foremost necessary to do the following:

- Continue the process of implementation EU directives on the use of renewable energy sources and implementation of energy efficiency measures into BiH legislation
- Start a fund which would be used to finance renewable energy source and energy efficiency projects; this fund would be capitalized from earmarked funds, such as environmental pollution fines or taxes, funds obtained from environment users, or special taxes paid for driving motor vehicles

3. The second group of measures which directly reduce pollutant discharge into the atmosphere is that of activities aimed at rationalizing energy consumption that increase energy efficiency and reduce losses in the transmission and distribution grid. Energy efficiency measures can be divided into interventions targeted at increasing energy consumption efficiency and interventions in energy-consuming systems:

- The largest amounts of energy will be saved if energy-related and industrial processes are automated
- Rehabilitation of energy-consuming systems or units, such as mechanical repairs, replacement of plant units or the whole energy-consuming system
- As electric motors are the biggest consumers of electric power, replacing old electric motors and installing newly-developed, more efficient motors (EEN) and variable speed drive (VSD) in energy-generating and industrial units will increase energy efficiency
- Rehabilitation of equipment in energy-generating and industrial plants, such as restoring performance levels reduced due to wear and tear, inadequate performance or under-manning
- Introduction of new technologies (petroleum industry) requiring lower electric power consumption
- Reduction in technical loss in electricity distribution lines

To achieve the above said, it is necessary to:

- Produce energy consumption and energy balance studies for all energy-generating and industrial plants, which will inform and teach the plant staff about the optimal procedures of operating equipment and electrical devices
- Introduce compulsory energy efficiency checks in each individual sector by relevant institutions
- Establish a network of industrial energy efficiency on the state level, with clearly defined objectives
- Demand in the stage of planning of the construction of new thermal power plants that the aspect of CO_2 emission reduction and the potential financial effects of such reduction are covered in the study documentation in order to ensure a higher degree of efficiency in comparison with the existing plants
- In planning hydropower plants, the issue of meeting CDM requirements should also be covered (up to 20 MW power).

[25] CER credit value in December 2008 (OneCarbon www.onecarbon.com)
[26] CER credit value in December 2008 (OneCarbon www.onecarbon.com)

4. Since the trends and relevant documents related to climate change and sustainable development are generally unfamiliar to the broader expert and professional community dealing with energy generation and industrial sector strategies, it is essential to organize education targeting the general public, and more specifically the relevant professional and expert community, about the Kyoto Protocol, the possibility of using various kinds of renewable energy sources, how to fund related projects, and trading in emissions (e.g., the EU ETS).

4.2.4. Production and consumption of thermal energy - baseline scenario

4.2.4.1. Gas utilization

Bosnia and Herzegovina does not have its own natural gas sources, so its total supply is based exclusively on the import of this source of energy. Natural gas is imported from one source only and via one transmission route. However, despite this fact, natural gas might play a more prominent role in the energy mix, given its importance and role as an eco-friendly source of energy, and above all, because of its environmental advantages.

According to this scenario, the total share of natural gas in B&H energy consumption would remain within the current boundaries of 5-7%.

Gas for BiH consumers is transported through the transmission system of the Russian Federation to the city of Beregovo at the border between Ukraine and Hungary, then on through the transmission system of Hungary to Kiskumdorozma (Horgos) at the border with Serbia, and finally through the gas transmission system of Serbia up to Zvornik, where it reaches the main metering and regulating station for Bosnia and Herzegovina. The BiH gas transmission system comprises two routes: the first one is the Zvornik – Sarajevo pipeline, which started operating at the beginning of 1980, and the second one is the Sarajevo – Zenica pipeline, built in 1984. The total length of the transmission system including all its branches is around 190 km, of which 132 km lies on the territory of the Federation of BiH and is the property of BH-Gas d.o.o Sarajevo, and of which approximately 60 km lies on the territory of Republic of Srpska and is the property of Sarajevogas a.d. Lukavica and of Gaspromet - Pale.

The current capacity to the metering station in Zvornik, with a supply pressure of 26 bar, is 750 mil.Sm^3/year (25.6 PJ; 0.61 Mtoe), and on the pipeline stretch between Zvornik and Sarajevo, provided an adequate pressure before MSR consumers is maintained, has a capacity of around 600 mil. Sm^3/year. Its maximum transmission capacity is 1 bil. Sm^3/year (34.075 PJ; 0.81 Mtoe), which can be reached if a compressor station is built.

Natural gas consumption in BiH is normally classified into two categories: the residential sector, which consists of households and the commercial sector (mostly within city distribution systems), and the industrial sector, which consists of huge industrial plants directly connected to the main transmission system and, on a smaller scale, by industry which is supplied with gas via low-pressure distribution systems. Natural gas is not currently used in the sector of electricity production. The constant tendency to increase natural gas consumption in BiH stopped at the beginning of the 1990s, when consumption was 600 mil. Sm^3, and the hourly transmission pipeline capacity was at its maximum. Gas consumption after 1998 dropped to 150-200 mil. Sm^3 per year, which accounted for only 30% of consumption in 1990. Since 2003, consumption has shown a tendency to rise, and in 2005 it reached the level of approximately 400 mil. Sm^3 (13.63 PJ). Although consumption increased again, the share of this source of energy in the primary consumption of energy dropped from 14% in 1990 to 5-7% in the post-war period.

Natural gas consumption share is dominant in heat energy production, even in the industrial sector, which has very low gas consumption for technological needs during the summer. The share of industrial consumption, i.e., continuous annual consumption, dropped from 85% in 1990 to 25% - 50% (only in 2000), with a rise in recent years to 60%. Average winter consumption is extremely high, so to meet its needs, transmission capacity to the BiH border of 500 mil. Sm^3, i.e. 1.5 mil. Sm^3/day has to be provided. On the other hand, summer needs are far below average annual demand and quite prone to daily/monthly variation, which means they are 50% lower than winter needs.

Viewed from this perspective, there is a potential market of natural gas in BiH, especially in the industrial sector and in urban areas, where its direct

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006
FBiH (mil.m^3)	171.20	151.74	146.08	153.25	152.54	182.50	178.34	198.83	208.00
RS (mil.m^3)	30.00	36.83	105.10	11.05	3.00	20.84	142.04	181.64	155.10
Total BiH	201.20	188.57	251.18	164.30	155.54	203.34	320.38	380.47	363.1

Table 4.2.4.1.1.: Natural gas consumption in BiH, by entities.

use by end-users leads to the best energy utilization, without additional conversion or losses. In estimating the competitiveness of natural gas as a source of energy, an overall energy strategy and environmental protection strategy will affect the gas sector in several aspects. It has been estimated that in the areas with gas networks, natural gas will completely replace liquid fuels in industry, services sector and households, coal, to some extent, and, to a small extent, wood fuel. There is currently no precise prediction of the percentage of gas use in areas with gas networks, or to which extent the use of liquid fuels, coal and wood fuel might decrease.

Natural gas demand projections in BiH have not yet been calculated within an overall energy strategy, since one has not been done yet. Demand projections have been calculated for the purpose of a range of studies whose content and focus are only projections of natural gas sector development in BiH, the most important of which are the BiH Gas Development Study, done by the Danish firm Ramboll with the support of the World Bank (Ramboll, 2001) and the BiH Energy Sector Study (2008). All current projections of development of potential natural gas market so far have given realistic indications that B&H could increase the share of natural gas in primary energy by at least 15% by 2020. Taking into account the scenario of a more moderate rise in natural gas consumption, an increase in the existing transmission capacity will be required.

4.2.4.2. District heating

The position of BiH is between the continental and Mediterranean climates, and such climate conditions in the most of the BiH territory require great consumption of thermal energy. Thermal energy for heating is obtained partially through district heating systems in towns, while other consumers (buildings and households which are not connected to the said systems) make their own heating arrangements.

The average share (ESSBiH Module 1B, 2008) of central heating in BiH is around 30%, district heating 12%, own boiler rooms 11% and self-contained central heating 6%. Around 70% of apartments are heated only by room heaters/furnaces. Households with no heating comprise only a very small percentage (around 0.7%).

On the territory of BiH, district heating systems are mostly concentrated in large towns. Before the last war, most of this population used thermal energy supplied through the district heating system. Due to long-term neglect of maintenance of these systems, and due to their age (it is estimated that heating plants and accompanying equipment are between 20 and 25 years old), these systems operate with low efficiency. After the war, there has been some reconstruction of the existing systems but, according to available data, more significant reconstruction has been done only in Sarajevo. In most of the other systems, there has only been some necessary reconstruction, so these systems have significant losses, which in some cases reach 60% of all losses. The data, published in the Municipal Network for Energy Efficiency (MUNEE) programme, funded by USAID, show that central heating companies in BiH face difficulty in billing for delivered heating energy. The high level of non-payments makes it impossible to adequately maintain the existing systems and, particularly, to invest in system upgrades. In addition, the Law on Consumer Protection stipulates that energy delivered to the consumer should be metered and not charged based on the surface (m2) of apartments. The implementation of the Law has been reduced and applies only to individual cases. There are also no plans or deadlines for the introduction of thermal energy metering at the consumers' end of the system (Smajević et al., 2008b).

Thermal energy supply companies in RS rely on their own boiler plants. They use heavy fuel oil and coal, except in Pale, where in addition to coal, a certain amount of biomass is used, and in Zvornik, where natural gas is used.

In FBiH, some thermal energy supply companies do not have their own plants to produce thermal energy but obtain it from local thermal energy units (most often, thermal power plants). Compared to other towns, heating in Sarajevo has some special aspects, because the construction of the gas network enabled development of a flexible heating system, consisting of a series of individual networks, and the use of small efficient boiler units.

Other buildings such as education institutions, health centers (hospitals and clinics), state institutions (courts, police), catering establishments and other similar institutions normally have their own plants for thermal energy production, which use fuel oil or coal as a source of energy (in Sarajevo Canton, it is normally natural gas).

Almost all companies for central supply of thermal energy use heat exclusively for space heating but not for preparation of warm potable water.

4.2.4.3. Buildings

There were a lot of difficulties in order to estimate mitigation potential in this sector, mainly due to various sources of data with different level of reliability. This communication makes estimations for the residential sector and the public sector. Industrial buildings estimates were not finalized mainly due to lack of data. BiH passed through the privatization process in a past decade and most of the industrial buildings have changed their status, so currently there are no reliable data for this sector.

Residential buildings

Various available data show an estimated number of apartments in Bosnia and Herzegovina. The first data from the 1991 Census are unofficial, and the exact number of apartments damaged during the war that are still not in use, and the number of apartments built after the war, do not exist. Data on the number of apartments up until 1991 are relatively correct (there is a slight discrepancy in figures between the 1981 and 1991 Censuses), and data on apartments built after 1991 are based on available data on the number of newly built apartments.

Given that around 447,661 apartments were damaged in war activities, some of which were reconstructed, and a certain number of new apartments were built, it is estimated that there are currently cca 1,100,000 apartments in use. Building age of apartments is high – almost 80% of apartments are more than 30 years old.

Given the fact there are no reliable data based on a population census, the data presented here were taken from the Energy Sector Study BiH (Granić, 2008): 29% of the population live in apartments in collective residential buildings (FBiH 31%, RS 29%, BD 5%), while as many as 71% live in family houses (FBiH 69%, RS 71%, BD 95%). Housing units vary in size depending on the time (tendency of size growth with increasing living standard) and place of construction (more spacious housing units in rural areas).

Administrative unit	Urban in m^2	Rural in m^2	Average in m^2
FBiH	74.6	103.4	86.3
RS	82.0	81.8	81.9
BD	-	-	81.3
BiH	77.2	97.2	86.0

Table 4.2.4.3.1.: Average housing unit size/area

Considering the facts the average housing unit area in Croatia in 1996 was 71.1 m^2 (First National Report of Croatia, 2001), that it was around 50 m^2 in B&H in 1980 and 60.45 m^2 in 1991, the information according to which the average housing unit area in B&H in 2005 was 86 m^2 should be treated with reservations.

In light of the fact there are no reliable data on housing heating schemes; the data presented in the Energy Sector Study BiH were taken as valid (Energy Sector Study BiH, 2008).

Given the population's economic standing, the data relating to the percentage of family houses heated centrally and their residents' habits, as well as the one stating the average heated area is 55.72 m^2, ought to be treated with reserve, as they were obtained as survey findings. We may consider the average area heated to be smaller, which accordingly translates as higher average energy consumption used for heating per area unit.

Heating schemes:

- 30% of the housing is centrally heated: district heating 12%, home steam boilers or furnaces 11%, self-contained central heating 6%. The types of fuel used: fuelwood 32%, natural gas 31%, fuel oil 18.5%, and coal 8.5%.
- - 70% of the housing is heated with room heaters. The types of fuel used include: fuelwood 77%, electric power 12%, and coal 9%.

Administrative unit	Average heated area in m^2	Centrally heated area in m^2	Room heating in m^2	Split heating system in m^2
FBiH	57.84	74.01	45.90	34.13
RS	50.75	76.80	37.49	21.65
BD	58.66	84.87	54.92	0.00
BiH	55.72	75.15	43.85	29.24

Table 4.2.4.3.2.: Average heated area and heating schemes

Based on the survey conducted for the purposes of the BiH Energy Sector Study, the average amount of energy used for heating is 200 kWh/m^2 of the area heated. This figure is approximate, i.e. average, as BiH spreads across different climate zones. It is also similar to the average heated area, and both values should be treated with reserve. No buildings have been inspected for their heatloss properties, so all the data have to be treated with reserve.

The main types of energy or fuel used in households for water heating are electricity (80%) and fuelwood (15%). (Energy Sector Study BiH, 2008)

The main types of energy or fuel used for cooking are electricity (50%) and fuelwood (36%). (Energy Sector Study BiH, 2008)

Only few housing units have air conditioning (8%) and it is not equally prevalent across the country. (Energy Sector Study BiH, 2008)

Generally, households are well equipped with electrical appliances; energy-saving light bulbs are used only very rarely (3%; Energy Sector Study BiH, 2008). An average of 3.25 inhabitants live in one household (3.29 in RS, 3.37 in BD, and 3.14 in FBiH).

In urban areas, an average household has 3.16 members, and in rural and semi-urban areas 3.41 members (Energy Sector Study BiH, 2008). 93% of the population lives in their own apartments, while 5.6% are tenants and 1.4% are temporary residents.

	BiH	RS	FBiH	BD
Number of housing units	1,100,000	372,907	706,348	20,745
Average energy use for heating (KWh/m^2)	200	216	199	224
Average heated surface (m^2)	55.72	50.75	57.84	58.66
Total energy consumption for heating (GWh)	12,258	4,088	8,130	272

Table 4.2.4.3.3 . Average energy consumption for heating of apartments

Public buildings

Statistical data on the number and breakdown of public building stock (services) are not available, so the information that the building stock in this sector is 5m2/resident is used as a parameter, which means that in BiH it is approximately 19,000,000 m2 (Energy Sector Study BiH, 2008).

The building age of public sector buildings (services) is high, so by the 1980s, buildings with the following purpose were built:

- services 64.5%
- education 92.3%
- commerce 74.4%
- health 82.6%
- management and administration 78.5%

Public sector buildings are heated by centralized heating systems in 85% of cases, and only 15% of them are heated by room heaters/furnaces. The application of cooling systems is small and only an insignificant number of buildings have cooling systems installed. Air-conditioning is used to a somewhat greater extent.

Having in mind the age of these buildings and the manner of their maintenance (mostly poor), it could be assumed that energy consumption for heating in this sector is big. It is around 3,800 GWh of energy for heating, while energy consumption for cooling has not been estimated due to the small percentage of cooling systems.

Industrial buildings

Because statistical data on buildings in industry were not available, this area has not been analyzed. In this sector, property transformation is a particular problem, as well as outdated technologies. After the process of property transformation and a cost-effectiveness analysis of starting production are finished, an analysis of the condition of buildings will be done, and suggestions will be given for their energy rehabilitation.

4.2.5. Production and consumption of thermal energy - GHG emissions reduction scenario with measures

4.2.5.1. Gas utilization

If all development plans of BH-GAS -- i.e.,the FBiH Government -- are implemented, natural gas will have a 15% share in energy consumption in FBiH. For now, there are no particular plans and indicators of gas projects in RS towns. It is currently not possible to say with certainty to what extent natural gas will replace liquid and solid fuels in the areas to be part of gas projects. The aim of all the listed gas projects in towns and regions is to create conditions for further expansion of the natural gas market by introducing natural gas as a new source of energy. Emphasis is put on finding possibilities to apply new technologies (combined production of electricity and thermal energy) and areas of natural gas application (cooling, warm water preparation, gas used in traffic), in order to achieve an even distribution of annual amounts.

Main measures to implement in towns and areas where a gas network is built:

- replacing liquid and solid fuels with natural gas in existing plants in all sectors of application (industry, services, households)
- building new gas-fired industrial and energy plants

4.2.5.2. District heating

In order to address existing conditions, a series of measures must be undertaken leading to an increase in energy efficiency and improvement in operations, thus increasing competitiveness of companies for production and distribution of thermal energy. The applicability and extent of these measures will vary in each of the district heating systems, but in general, they would lead to significant improvement in the functioning of the whole district heating system.

Analyzing the current conditions (ESSBiH Module 9, 2008), the following measures relating to production were identified, as well as measures relating to consumption.

There are several categories of measures from the supply side:

- **General measures**
  - district heating in distant city quarters and expansion of thermal networks,
  - increase in use of existing capacities,
  - analysis of use and optimization of exploitation regime.
- **Improvement of thermal networks infrastructure**
- Pipeline reconstruction
  - general replacement of old hot-water and warm-water pipeline network in critical areas,
  - improvement of hot-water and warm-water pipeline by replacing duct-laid pipes with pre-insulated pipes,
  - reconstruction of insulation of above-ground steampipes, hot-water pipes and warm-water pipes where necessary.

- **Transmission, distribution and supply system**
  - measures to decrease water loss,
  - increasing capacities of circulation pumps and general measures to modernize the system,
  - instalment of appropriate regulating valves and introduction of frequency regulation of pumps,
  - introduction of pipeline network balancing,
  - reconstruction of direct substations,
  - introduction of compact substations.
- **Facilities and regulation**
  - Control and regulation
    - control and management systems for district heating,
    - temparature regulation,
    - management of regulation and metering, remote control.
  - Reconstruction of facilities
    - rehabilitation and construction of boiler rooms,
    - changes on heat exchanges
    - installation of condensing boiler rooms at separate thermal networks,
    - introduction of cogeneration.

Maeasures from demand-side are:

- **Individual consumption metering**
  - introducing actual thermal energy consumption metering,
  - installation of cumulative meters of heat consume with consumers,
  - introducing appropriate billing methods.
- **Buildings**
  - improving thermal characteristincs of buildings,
  - encouraging consumers to instal thermostat regulation,
  - informing consumers about possibilities to introduce metering and upgrades.

Implementation of the listed supply-side measures in district heating systems would lead to significant improvement of efficiency and competitiveness of the existing systems. According to the results of a survey by UNDP BiH (UNDP BiH, 2009) conducted while this report was being completed, to which most central heating companies responded, it has been determined, based on partial estimates, that only through rehabilitation and modernization of existing boiler rooms could there be significant savings in fuel consumption. These savings would vary between 5% (in Prijedor) and 7% (in Banja Luka), 10% (in Brod) in heavy fuel oil-fired boiler units, 12% (in Doboj) to 20% (in Breza) in solid fuel-fired boiler units (coal). Yet, given the specific characteristics of each producer and distributor of thermal energy, and lack of adequate relevant information, it is difficult to precisely determine overall effects of implementing the said measures and the amount of funds necessary for their implementation, without completing an appropriate analysis of such characteristics and information.

Scenario of district heating system development

The most comprehensive document dealing with challenges of the development and improvement of the district heating system in BiH in the next period is the Energy Sector Study BiH, Module 9 – District heating (ESSBiH Module 9, 2008). In this study, using the programme tool of MAED, developed by IAEA (International Atomic Energy Agency), along with some specially developed table calculations in Excel, projections of district heating development in Bosnia and Herzegovina have been presented, based on three development scenarios between 2005 and 2020, as follows:

- S2 - reference scenario of energy demand,
- S3 - scenario of energy demand which includes energy-efficiency measures, and
- S1 - low scenario of energy demand (economic growth).

District heating systems are grouped into zones according to their specific characteristics. In the scenarios, urban areas in each zone were considered, as well as heat consumers in apartments and family houses and in the services sector, which includes commercial and public buildings. The general initial data were the rate of economic growth and population growth in an individual zone, and the fluctuation of share of urban areas in the total population, which, according to the scenario, is characterized by significant growth in all cases. In this report we will present data from the mentioned study for two scenarios, S2 and S3.

Table 4.2.5.2.1. shows energy balance of district heating systems according to scenario S2, and table 4.2.5.2.2. shows the balance according to scenario S3.

Both scenarios envisage introduction of district heating systems in distant city quarters and expansion of thermal networks. Improvement of thermal network infrastructure would lead to gradual fall in heat loss in ditrsibution networks, which in 2005 in BiH equalled around 9.3% of all consumed fuel (in the FBiH around 9%, in RS 10.5%), and in 2020 it should be around 6.6% (in FBiH around 6.2%, in RS 7.7%), according to scenario S2, or 6.3% (in the FBiH around 6%, in RS around 7%) according to scenario S3.

Final heat consumption slightly increased from 78.4% at BiH level in 2005 (in FBiH around 81.1%, in RS 70.5%) to 80.8%, according to scenario S2 (in FBiH around 81.8%, in RS 78%), or 80.5% according to scenario S3 (in the FBiH around 81%, in RS 79%) by 2020.

The data presented in the scenarios predict decrease in losses in transformation of heat energy in RS from 18.9% in 2005 to 14.3% according to scenario S2, or 13.9% according to scenario S3, by 2020. At BiH level, however, there will be some increase in losses from 12.2% in 2005 to 12.6%, according to scenario S2, or 13.2% according to scenario S3, by 2020.

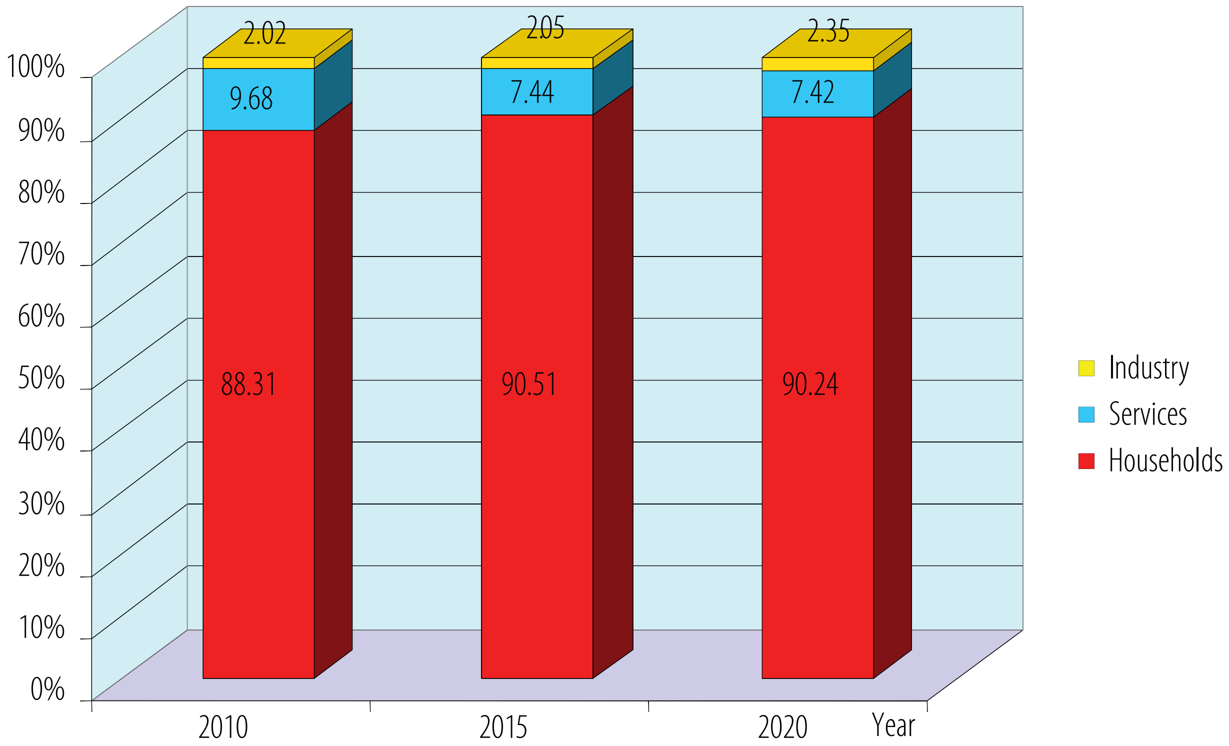
			2005	2010	2015	2020
Federation BiH	Final heat cons. from DH	PJ	3.739	4.592	5.448	6.384
	Heat loss in distrib. network	PJ	0.415	0.539	0.538	0.481
	Heat loss in transf.of en.	PJ	0.456	0.634	0.769	0.937
	Heat prod. for DH	PJ	4.611	5.765	6.755	7.802
Republic of Srpska			2005	2010	2015	2020
	Final heat cons. from DH	PJ	1.103	1.402	1.746	2.140
	Heat loss in distrib. network	PJ	0.165	0.173	0.173	0.212
	Heat loss in transf.of en.	PJ	0.296	0.278	0.307	0.393
	Heat prod. for DH	PJ	1.564	1.853	2.226	2.745
BiH			2005.	2010	2015	2020
	Final heat cons. from DH	PJ	4.842	5.994	7.194	8.524
	Heat loss in distrib. network	PJ	0.580	0.712	0.711	0.693
	Heat loss in trans.of en.	PJ	0.752	0.912	1.076	1.330
	Heat prod. for DH	PJ	6.175	7.618	8.981	10.547

Table 4.2.5.2.1.: Energy balance of district heating system according to scenario S2 (ESSBiH Module 9, 2008)

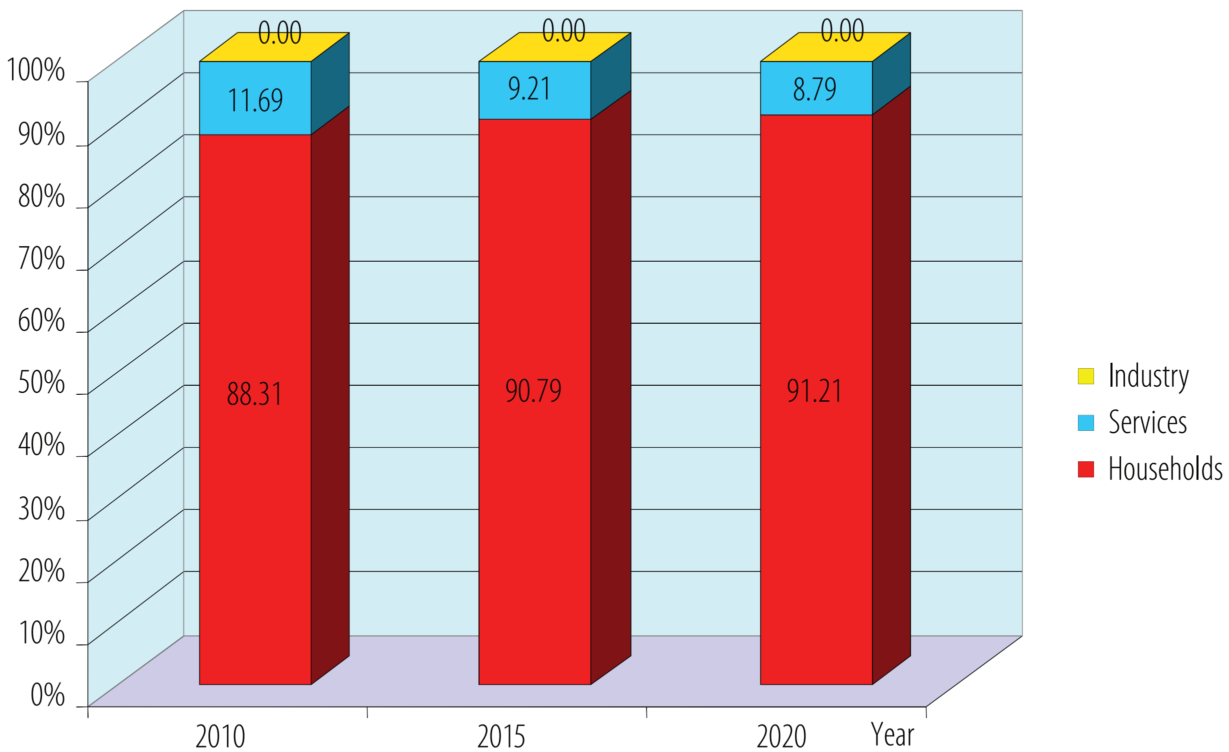
			2005	2010	2015	2020
Federation BiH	Final heat cons. from DH	PJ	3.739	4.344	4.668	4.964
	Heat loss in distrib. network	PJ	0.415	0.406	0.411	0.368
	Heat loss in transf.of en.	PJ	0.456	0.773	0.759	0.796
	Heat prod. for DH	PJ	4.611	5.524	5.835	6.155
Republic of Srpska			2005	2010	2015	2020
	Final heat cons. from DH	PJ	1.103	1.324	1.508	1.684
	Heat loss in distrib. network	PJ	0.165	0.139	0.135	0.149
	Heat loss in transf.of en.	PJ	0.296	0.244	0.288	0.297
	Heat prod. for DH	PJ	1.564	1.753	1.93	2.211
BiH			2005.	2010	2015	2020
	Final heat cons. from DH	PJ	4.842	5.668	6.176	6.648
	Heat loss in distrib. network	PJ	0.580	0.545	0.546	0.517
	Heat loss in trans.of en.	PJ	0.752	1.017	1.047	1.093
	Heat prod. for DH	PJ	6.175	7.230	7.769	8.258

Table 4.2.5.2.2. Energy balance of district heating system according to scenario S3 (ESSBiH Module 9, 2008)

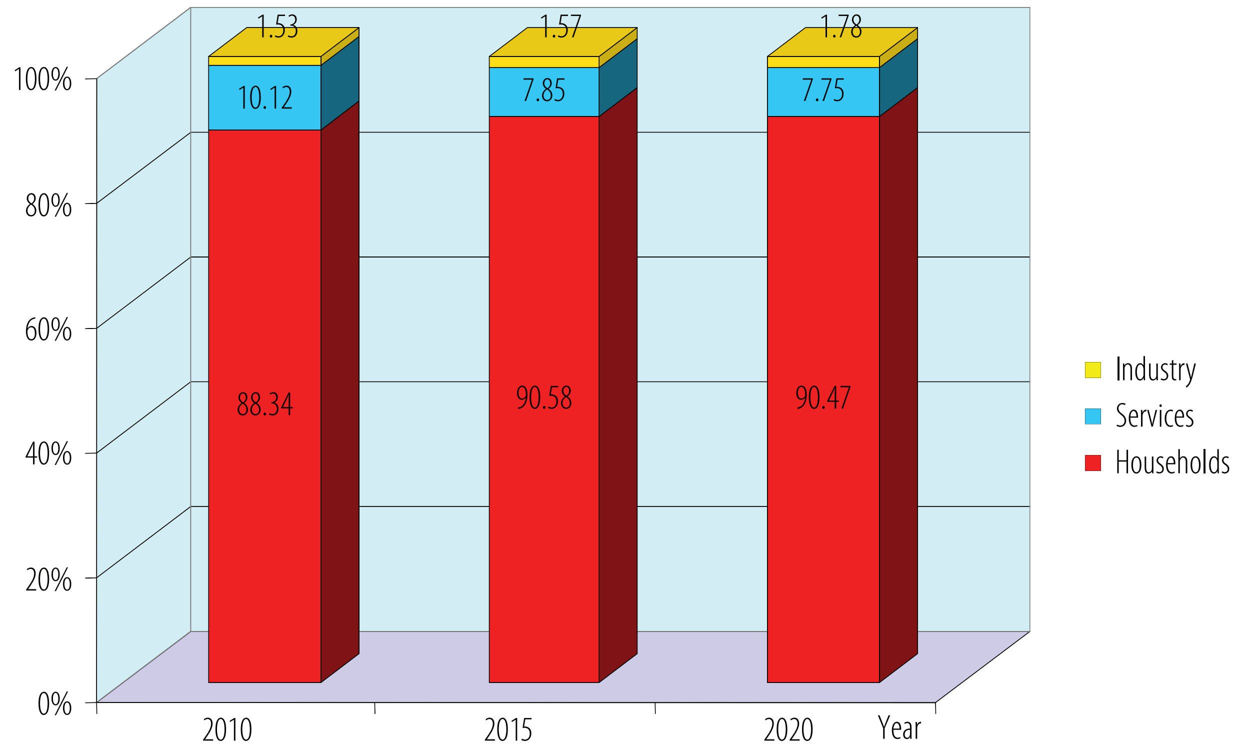
The analysis of calculation data shows that the biggest part of total expected decrease in thermal energy consumption for space heating by district heating system according to scenario S3 compared to scenario S2, at BiH level, refers to the household sector (picture 4.2.5.2.1., picture 4.2.5.2.2. and picture 4.2.5.2.3.).



Picture. 4.2.5.2.1.: Reduction in final energy consumption (S3-S2) by sectors in FBiH



Picture 4.2.5.2.2.: Reduction in final energy consumption (S3-S2) by sector in RS



Picture 4.2.5.2.3.: Reduction in final energy consumption (S3-S2) by sector in BiH

Estimation of CO_2 emissions from district heating systems

Carbon dioxide emissions in the period up to the year 2020 have been determined based on the projections of fossil fuel consumption in district heating quoted in the Energy Sector Study in BiH, Module 9 – District Heating, for S2 and S3 scenarios, including the application of appropriate emission factors, recommended by IPCC methodology.

Projections of investing in district heating development in all regions studied in BiH (ESSB&H Module 9, 2008) have been based on the scenario indicators. The assumption is that investments in district heating development will be made in the reference period, in

S2 scenario	CO_2 emissions in Gg			
	2005	2010	2015	2020
Federation of BiH	359.38	449.59	517.11	586.05
Republic of Srpska	118.42	142.16	167.86	173.72
Bosnia and Herzegovina	477.80	591.75	684.97	759.77
S3 scenario				
Federation of BiH	359.38	431.65	454.17	472.42
Republic of Srpska	118.42	130.22	143.08	132.16
Bosnia and Herzegovina	477.80	561.87	597.25	604.58
Emissions reduction in S2-S3				
Federation of BiH	0	17.94	62.94	113.63
Republic of Srpska	0	11.94	24.78	41.46
Bosnia and Herzegovina	0	29.88	87.72	155.19

Table 4.2.5.2.3.: CO2 emissions from district heating plants.

accordance with consumption growth and district heating network expansion. Investing in the housing stock – houses and flats with central heating, as well as in businesses – public and service sectors has been examined. It has basically been planned to introduce consumption measures and install corresponding equipment with all newly connected customers, and certain investments have been made for that.

Investments by the S2 scenario are specified in Table 4.2.5.2.4., and by the S3 Scenario in Table 4.2.5.2.5.

The presented investments refer only to consumption (growth in efficiency and heat consumption), while investments in production plants have not been discussed, although significant capacity increase in district heating systems has been planned in the said period. The stated investments do not include calorimeters with metering boxes or heat allocators either.

The study has not examined the possibility of using biomass as fuel in FBiH, nor geothermal energy in district heating systems in RS in the upcoming period, although there is great potential for their utilisation. This is important to emphasize because the first eco-friendly heating plant was put into operation in Gračanica (FBiH) in the course of 2008 using biomass as fuel, and the Bijeljina Municipal Assembly passed a decision on July 2008 on establishing a mixed-ownership company of Bijeljina and Geoterm, a Danish-Austrian company. This company, which is located in Bijeljina (RS) should use thermal waters as its energy source, where the exploitation of the first (out of four) boreholes should begin in October 2009. It is planned to close down the existing heating plant, which uses coal as its energy source.

		FBiH		
		2010	2015	2020
Total investments in flats	€	31,536,340	31,313,773	28,107,831
Total investments in houses	€	20,730,988	23,019,665	24,201,082
Total investments in economy	€	10,337,518	12,923,065	15,683,574
Investments in hot water pipeline	€	35,865,514	39,560,506	42,920,037
Total investments	€	98,470,360	106,817,009	110,912,524
		RS		
		2010	2015	2020
Total investments in flats	€	18,066,574	17,581,517	14,316,180
Total investments in houses	€	8,896,952	11,809,488	14,503,910
Total investments in economy	€	3,597,654	4,469,224	5,371,709
Investments in hot water pipeline	€	20,044,512	21,311,289	22,221,137
Total investments	€	50,605,692	55,171,518	56,412,936
		Bosnia and Herzegovina		
		2010	2015	2020
Total investments in flats	€	49,602,914	48,895,290	42,424,011
Total investments in houses	€	29,627,940	34,829,153	38,704,992
Total investments in economy	€	13,935,172	17,392,289	21,055,283
Investments in hot water pipeline	€	55,910,026	60,871,795	65,141,174
Total investments	€	149,076,052	161,988,527	167,325,460

Table 4.2.5.2.5.:Total investments under the S2 scenario (ESSBiH Module 9, 2008).

		FBiH		
		2010	2015	2020
Total investments in flats	€	31,536,340	31,313,772	28,107,831
Total investments in houses	€	10,287,803	12,836,891	15,303,536
Total investments in economy	€	8,718,635	10,542,524	12,322,039
Investments in hot water pipeline	€	26,443,317	17,435,497	15,653,938
Total investments	€	76,986,095	72,128,684	71,387,344
		RS		
		2010	2015	2020
Total investments in flats	€	18,066,574	17,581,518	14,316,181
Total investments in houses	€	8,896,952	11,809,488	14,503,910
Total investments in economy	€	2,991,984	3,601,753	4,171,418
Investments in hot water pipeline	€	15,173,193	10,714,106	8,993,152
Total investments	€	45,128,703	43,706,865	41,984,661
		Bosnia and Herzegovina		
		2010	2015	2020
Total investments in flats	€	49,602,914	48,895,290	42,424,012
Total investments in houses	€	19,184,755	24,646,379	29,807,446
Total investments in economy	€	11,710,619	14,144,277	16,493,457
Investments in hot water pipeline	€	41,616,510	28,149,603	24,647,090
Total investments	€	122,114,798	115,835,549	113,372,005

Table 4.2.5.2.5.:Total investments under the S3 scenario (ESSBiH Module 9, 2008).

One of the substantial obstacles to the development of the district heating system is also the current legal framework that regulates the status of the enterprises engaged in the production and distribution of heat energy. It should be pointed out that the current legal regulations in the field of district heating are inadequate and insufficient. According to the current situation, district heating companies are under the jurisdiction of municipalities in RS and cantonal administrations in FBiH (Ballard-Tremeer et al. 2006). To this effect, it is necessary to pass appropriate laws and secondary legislation in order to regulate this field at the state, entity and municipal/cantonal levels.

District heating enterprises in BiH also encounter problems with collecting payments for the heat energy delivered, and the low level of payments collected makes adequate investments in system upgrades impossible.

Presently, development plans either do not exist or are underway for a big number of district heating systems. Adequate development plans should be designed in the upcoming period for all district heating systems that do not have such plans.

4.2.5.3. Buildings

The possibilities of reducing energy consumption and of CO_2 emissions in the buildings sector are great. Basically, the measures may be classified as follows:

- Legislation – adoption of new standards and technical regulations in the field of energy efficiency (directives, standards, technical regulations, rulebooks, technical instructions)

- Optimizing the shells of the existing buildings based on cost-effectiveness
- Energy-efficient technologies for equipping the buildings

The measures can also be classified according to whether they apply to the already constructed buildings or the buildings that are yet to be constructed, so we are stating them as such.

Measures for improving energy efficiency of newly-designed buildings

All measures apply to the buildings that are yet to be constructed and are significant because the effects of their implementation are very quick and do not require big funds. These measures basically imply a change in the building design approach, above all by architects and investors. The organization and implementation of measures lies at entity level, while adequate standards and some directives have already been adopted at the state level. It is necessary to accelerate the adoption of the most important directive in this field, namely, the Directive on the Energy Performance of Buildings, Directive EN 2002/91/EC.

These measures can be classified as follows:

- application of European standards in designing, based on the Directive on the Energy Performance of Buildings – technical regulation, education, handbook
- application of bioclimatic architecture principle – education, manual
- certification of energy characteristics of buildings – regulations, handbook, education
- application of new standards for public buildings – recommendations, handbook, education

Measures for improving energy efficiency of existing buildings

All measures regarding the existing building stock can be classified into three major groups:

1. Changing the customers' behaviour

   These measures may bring significant results in the energy consumption reduction, and therefore the CO_2 emissions in the buildings sector. They include work on changing the customers' behavior, and funds are required only for their promotion.

2. Low-cost measures with short investment return periods

   The measures include small-scale works and investments with short return periods – up to three years.

3. High-cost measures with long investment return periods

   The measures foresee extensive works on buildings and big investments with long investment return periods of up to 10 years

Measures feasibility assessment

Obstacles

There are many obstacles to realization of proposed measures and they can be classified in several groups:

- lack of interest on the part of the professionals in the field, above all, architects, and partly mechanical engineering technicians in the new and modern heating systems (systematic solutions – laws, rulebooks, handbooks, instructions, recommendations, etc.),
- poor organization of the field, lack of strong trade associations or chambers, that should work on education, but also on the control of quality of engineers' performance,
- lack of interest of administrative bodies in energy issues – ranging from the state to the local levels,
- lack of trained staff at all levels of public administration, but also at schools and universities,
- lack of professional staff at ministries, who should be a driving force with advisory roles,
- investors and contractors' opposition to applying the existing standards – their lack of interest in their buildings consuming less energy (they do not pay the bills, there is no difference in selling flats, because the buyers are either uninterested or poorly informed),
- lack of knowledge, poor level of information, and lack of interest on the part of individual investors,
- poor financial position of investors who build their own houses,
- lack of professional organizations and institutes – state or private with personnel and equipment, for project implementation.

Funding options

There are several cost-effectiveness analyses and funding opportunities:

- ESCO models,
- banking system,
- state policy incentives.

More information on these options is provided in the economic analysis section.

Review of measure efficiency and cost-effectiveness periods

The efficiency of various measures in the buildings sector depends on many factors, the most important ones being the following: condition and heating system of a building, shape of a building, climatic conditions, as well as the parameters set as goals and implementation quality.

Experience gained through numerous energy efficiency projects in buildings shows that there are extensive discrepancies between the computed and actual values of energy consumption (www.gi-zrmk.si and www.jeko-in.si). In residential houses, energy consumption is bigger due to their shapes, but the effects of conservation achieved by subsequent insulation are greater. The best and quickest results can be achieved in the public sector, as well as in the buildings connected to the centralized heating systems.

The investment return periods depend on the packages of selected measures and buildings, and they should be precisely calculated according to the valid prices of energy and works, as well as in concrete examples – pilot projects. Old buildings require investment maintenance, therefore, the works on energy repair are more cost-effective, i.e. they are performed with fewer costs. Since the housing stock in BiH is over 30 years old on average and already requires maintenance and rehabilitation, energy renewal should be promoted simultaneous.

Energy repair measures for residential buildings built before 1980	Reduction percentage %	Investment return
Weather stripping windows	10-15	2 years on average
Replacing windows	Up to 20	Additional investment in better quality windows is returned in 3 years' time
Insulating ceilings	7-12 (26)	3-4 years
Insulating inclined roofs	10	The best cost-effective measure for buildings
Insulating façades	20-50	10 to 15 years (20-40% of the total façade repair price)
Improving heating systems		
Other measures: educating and motivating the consumers	5-10%	Up to one year
Total	60 or more	25 years on average
Economically feasible	30	10 years

Table 4.2.5.3.1.:Efficiency of selected measures in buildings and their rates of return (Sources: www.gi-zrmk.si , www.jeko-in.si).

Potential results of CO_2 emissions reduction in the buildings sector

Residential buildings

Based on the estimation of the situation in the buildings sector, the vision of the country's economic development, as well as the need to adopt European standards in the field of energy efficiency in the buildings sector, one may expect the development to occur according to two scenarios, also foreseen by the Energy Sector Study in BiH:

- S1 – reference energy consumption scenario (marked as S2 in the Study)
- S2 – energy consumption scenario including consumption decrease measures and expected economic growth (marked as S3 in the Study)

As regards the situation in the buildings sector, the potential energy consumption decrease is extremely big and ranges between 10 and 80%. Improvement may be achieved by improving the measures of energy efficiency of buildings, heating and cooling systems, as well as the energy efficient equipment.

Reduction in energy consumption in the buildings sector cannot at the same time reduce CO_2 emissions. Effects of the energy consumption reduction on the CO_2 emissions reduction depend, above all, on the energy source consumed.

In the sector of individual, that is, family living, the dominant energy source is wood, and the energy consumption reduction does not at the same time imply the CO_2 emissions reduction. Out of the total housing stock heated by wood burning stoves, only 9% flats were heated by coal as the energy source. The reduction is presented assuming that the annual emissions reduction of 3% has been chosen as economically feasible and possible.

Public buildings

Public buildings are mainly heated by centralized systems, that is, by heating plants, therefore, the CO_2 emissions reduction possibilities are given in that section. The segment not heated by centralized heating systems encompasses 15% and it has not been examined as there are no precise data on its energy sources.

4.2.5.4. Measures and projects in the sector of RES to mitigate GHG emissions

Taking into account the facts and considerations mentioned in chapter about RES potential, it is necessary to point out some generally measures that should be overtaken by state and entity ministries responsible for energy. If these measures would be overtaken, it would be easier to make the assessment of mitigation potential in sector of RES. It is necessary:

- to create a legislative framework for renewable and/or distributed sources of electricity that should process: network access, connection conditions, charges for network access and use, influence on the increase of distribution costs, establishment of tariffs for taking up electricity from renewable sources, etc.);
- to develop a functional system of subsidies, namely a model of support (incentive measures) for construction of systems based on renewable energy sources, as well as for energy efficiency projects, taking into account the capability of the current Environmental Fund,
- to develop a strategy of construction of energy facilities on RES in close cooperation with competent institutions for water management, agriculture and forestry, so that the systems would be sustainable from all aspects,
- to solve the problem of management of small HPPs and wind power plants – connection to distribution network of electricity utility companies– dispatching,
- to perform a systematic substitution of liquid fuels with renewable sources, especially in facilities of public institutions (schools, health institutions, buildings of government institutions...), and encourage installation of systems with renewable energy sources in construction of new buildings,
- to consider a possibility of construction of biomass-fueled remote heating system (eventually combined with solid municipal waste), in places with developed timber and wood industry, together with industrial power plants of industrial companies,
- to remove all the identified generally barriers as soon as possible for a larger application of RES, which specially applies to incentive measures for application of RES, i.e. construction of energy facilities on their basis, as well as completing the legislative framework.

Apart from the abovementioned general measures, it is needed to overtake some measures those are specific for some RES only. But, both generally and specific measures should be overtaken to reach the mitigation potential according to second scenario.

Hydropower potential / Small HPP

There are several issues which are important for improvement of the small HPP sector in B&H:

- to make or revise spatial planning of the area with concession for small HPP,
- to accelerate getting of permission of local authorities,
- to establish full functioning of Distribution Operators, in accordance with the Law and Distribution Network Code,
- to definite Distribution Operator's jurisdiction (by legal regulations, and before all through Network Code) ,
- to prepare the unified technical conditions for connecting to the distribution network and exploitation conditions of distribution power plants in the territory of BiH,
- to define clearly powers and obligations between the Distribution Operator and generators, while the regulatory agency must make a decision on the tariffs for purchase prices of energy from RES, which will take this into account, but also solve other issues, such as the price of this energy during night surpluses, etc.

Wind / WPP

Measures that should be undertaken in the WPP sector include the following:

- to develop a renewable sources support model, including wind power plants as well,
- to accelerate of procedures for issuing licenses for new network infrastructure,
- to harmonize and adapt "Network Code" for renewable sources,
- to harmonize and adapt "Market Code" for system balancing,
- to enact appropriate legislation for connections of generation capacities, and especially wind turbines to the transmission network,
- to reassess rules of priority dispatching of renewable energy sources,
- to reduce risk by technical measures such as network strengthening (lines, transformers, phase inverters), reactive energy compensation, network topology change through manipulations,
- mutual exchange of information related to wind forecast, creating possibilities for remote monitoring and management of wind power plants, use of PHPPs and HPPs with large accumulations, possibility of automatic discharge in case of system vulnerability,
- to limit capacities available for trade,
- to harmonize market design at a regional level,
- to harmonize and integrate balance markets.

Geothermal

Measures which could be undertaken in the geothermal sector include the following:

- Estimate the geothermal energy consumption in BiH in the future on the basis of the potential technologies of geothermal resource utilization in several fields, including the electricity generation.
- Examine the possibilities of fluid utilization from several reservoirs, taking into account the estimated abundance and water temperatures for the electricity generation in BiH:
- Examine the possibilities of its utilisation for thermal water with temperature over 80°C, the most promising areas for research, exploitation and intensive utilisation of geothermal energy for electricity generation by mini power plants (the Banja Luka valley, Lijevče Polje, the regions of Brčko, Derventa, Odžak, Brod, Gradiška and Dubica).
- Examine the possibilities of constructing three boreholes in the Ilidža in Sarajevo region that would provide 100 kg /s of water with temperature of 120°C. It would be a temperature sufficient for utilisation at a geothermal power plant.
- Examine the possibilities of the northern BiH and its significant geothermal potential, where average water temperatures can be expected to be around 100°C.
- Examine the possibilities of utilising the south and south-east parts, which have a considerably lower geo-potential.
- The values of the heat flows in the area of south-east are 20 to 30% below average of the continental Europe, while they are by 30 to 50% higher than the average of the continental Europe (60 mW/m2) (ESS BiH, 2007). If, on the other hand, the potential utilization system, which is given precedence, would be a "double" system, it would be possible to achieve geothermal capacity in this area that is at least twice as big as that of the direct utilisation.
- The possibilities of utilising geothermal energy for electricity generation by means of, for instance, a binary plant (Tica G., 2002) should be deemed as the possibility by a long-term economic policy and strategy of the economy and administration of the areas that would utilise geo-energy. The reserves of approximately 7x106 tons of equivalent petroleum have been estimated for the Banja Luka valley in thermal water only (First Estimate…, 1992).
- It is reasonable to expect that electricity generation from geothermal resources will not be applied until 2020.
- On the other hand, it is reasonable to expect heightened interest and bigger investments in direct production and thermal energy production for tourism and leisure purposes in the second scenario.

Solar / solar plants

It is realistic to expect that in the period until 2020 in BiH there will not be more significant application of solar energy for production of electrical energy, except of individual construction of low-power PV systems (negligible for the energy balance of BiH). There are several limitations for this, and the main ones are: non-competitiveness of such facilities, and the required area (space) for their construction.

On the other side, use of solar energy for hot water preparation and partially for space heating should be supported. Because of that, it is needed to develop a RES support model, including all kind solar plants, especially for solar collectors.

Biomass / biomass-fired plants

In order to achieve a more significant application of biomass in BiH, first of all, it is necessary to carry out the following research:

- defining target areas in BiH where detailed research of economically and ecologically sustainable use of biomass should be performed,
- quantification of different flows of non-used biomass in target areas,
- estimation of biomass costs as a fuel in the future and a comparative analysis with the costs of other fuels,
- identification of the possibility for suitable, financially competitive solutions of biomass application,
- identification of the most suitable technologies, investment methods and incentive measures for selected solutions of biomass application,
- identification of obstacles in legislation and regulations that influence the selection of technologies for biomass application in the target areas in a most efficient way,
- identification of institutional obstacles for accepting the most efficient solutions for the construction of a biomass-fueled system for production of thermal and/or electrical energy

Implementation of the above mentioned steps would clearly show the real economical and ecological potential and solutions for the application of biomass-fueled facilities in the target areas in BiH, and it would help the competent authorities to plan the construction of such facilities. The identified activities greatly depend on the agriculture and forestry development strategy and the ministry of energy should plan and implement them together with the competent ministries for these areas. (Petrović i dr., 2005)

Strategies and national plans in the biomass energy sector:

It is recommended that the Energy Ministries in both government entities should put together strategies and national plans within the biomass energy sector into Energy Policy document. This component of the project would look into the formulation of national biomass energy strategies within the framework of the energy policy paper. The component would also assist in capacity building and institutional strengthening of the Energy Ministries, and Ministries for Forestry, Agriculture and Water Management, NGOs, and Community Based Organizations.

Providing heating and/or electricity services through ESCOs

To date, there has not been a programme to provide heating and/or electricity services through ESCOs. Some producers of biomass combustion boilers in BiH are intending to set up services within these companies as Energy Service Companies (they would mostly supply potential consumers with heating energy at present, but also with electricity in the near future). The main objective of these projects would be to provide people in suburban and rural areas with access to central heating services. They will establish a model for providing these communities with heating energy from central heating systems using the concept of Energy Service Companies (ESCOs).

One output for the project will be to produce 'Guidelines specifying the necessary financial, institutional and managerial inputs needed for an ESCO operating in rural communities in B&H, using biomass based-boilers for heating energy production as a source of heating supply'.

Mitigation potential in the sector of RES according to the scenarios

Small HPP

Baseline scenario

It could be supposed that all small HPP (with a power less than 10 MW) that have already got a concession will be built in the near future. There are about 200 concessions for small HPP in FBiH (from 2002 till now) with possible installed capacity of 177 MW and possible annual energy production of 800 GWh. By the end of 2007, 13 small HPP had been built with total installed power of 11,96 MW and annual electricity production of 60,10 GWh. Average investment in these HPP has been approximately EUR 1,550/kW (Fejzibegović, 2007). In Republika Srpska, the Government of Republika Srpska has, since 2005, awarded 107 concessions for construction of small hydro power plants with the total installed power of 280 MW and assessed annual production of 1,500 GWh of electrical energy.

Greenhouse gas emission reduction scenario with measures

If the measures mentioned in the previous section were realized, most hydropower potential could be realized. If 80% of hydropower potential for small HPPs were realized, approximately 800 small HPPs with the potential installed capacity of 700 MW and possible annual energy production of 3.600 GWh would be constructed.

Wind

Baseline scenario

It could be assumed that all planned WPP will be built till 2020, and that the total installed capacity of these WPPs would be 616 MW with annual energy production of 1,600 GWh.

Greenhouse gas emission reduction scenario with measures

If measures mentioned in the previous section were to be realized, most technical (currently known) potential could be realized. This potential would entail WPPs with the total installed capacity of 900 MW and annual energy production of 2,300 GWh.

Geothermal

Baseline scenario

This scenario that implies adaptation to climate changes without investments:

- There have been no examples of applying electricity generation from geothermal energy in BiH so far.
- By means of reasonable examination of the previous research for the first scenario, it can be concluded that there are no realistic possibilities of achieving the application of geothermal resources without investments for either the 2010 or 2015 scenario.
- In that regard, usage of geothermal energy in the first mitigation scenario is limited to the sectors where it was previously applied (health care, agriculture), possibly for heating or tourism purposes.
- It is not expected that geothermal energy will be applied for electricity generation in the baseline scenario
- Geothermal energy in the mitigation period is the least competitive of all renewable resources in the first scenario
- Reasons for this include the following insufficiently explored geothermal locations and potential, and the prices and availability of technologies for applying geothermal energy in electricity generation

Greenhouse gas emission reduction scenario with measures

This scenario of employing organized activities related to the measures stimulating the greenhouse gas emissions reduction:

- The estimation of geothermal energy utilization in BiH in the future is such that the technology of utilizing geothermal resources will be possible in several fields, in heating, for balneological and tourism purposes, as well as for electricity generation.

- The available geothermal energy potential can be exploited with present-day technology and existing economic conditions, provided that the quantities are located in the discovered sites, which should be stimulated

- Available results in technical papers are promising, but all the aforementioned estimations should be confirmed by research boreholes. They should be used in the necessary research to define the quality and features of the sites for the purpose of defining those quantities as proved reserves.

- Probable (additional) reserves could be estimated on the basis of the knowledge of geological conditions. It is impossible to talk about geothermal resource utilization for electricity generation without the presented geothermal parameters that can be obtained only by deep drilling, because, one can expect the approximate temperature of 100°C at the depths of 2000 to 2500 meters, which would be the temperature sufficient for electricity generation.

- The calculated quantity of geothermal energy in the northern RS reservoirs indicates that the preliminary design of constructing the electricity generation plant is justified (Tica G., Banja Luka, 2002).

- Should the research in the period up to 2020 show that geothermal sources are available, and should the technologies for applying the geothermal energy in electricity generation become more competitive in the period from 2020 to 2030, application of geothermal energy for this purpose in BiH should be considered.

Solar

Baseline scenario

It could be supposed that, according to this scenario, solar energy will not be used to a significant extent. It means, installed capacity of solar equipment (plants) and their annual energy production will stay negligible.

Greenhouse gas emission reduction scenario with measures

If a sufficient support model to use solar energy were developed, especially for solar collectors, it could be possible to expect more solar collectors installations. At the moment, it is hard to say something more about the installed capacity of solar collectors and their annual energy production.

Biomass

Baseline scenario

It could be supposed that, according to this scenario, biomass use will stay more or less on today level of 4,200 GWh (45 % of technical capacity).

Greenhouse gas emission reduction scenario with measures

If the measures mentioned in the previous section were realized, most technical (currently known) potential could be realized. If 80% of the technical capacity were assumed, annual energy production from biomass would reach 7,500 GWh.

Biogas

Baseline scenario

According to this scenario which implies "business as usual" here are some key issues related to biogas:

- The scenario according to which mitigation is performed without investments or costs.

- It is intended to orient the technologies towards renewable energy sources (RES), intensified application of RES (EES Study, 2007), the share of all types of renewable energy sources is foreseen.

- It implies a relatively low level of state and entity activity in the energy sector.

- Energy consumption for this energy source is not foreseen in this scenario (EES Study, 2007).

- It is based on slow introduction of new technologies.

- Lack of support to energy efficiency and renewable energy sources

- One should take into account the fact that only 60% of the total generation will be covered by the GHG emission reduction-related activities as that is the share involved in organized production owing to the structure of livestock numbers.

- Out of the total 20,100,000 m^3 (representing 0.506 PJ), 60 % is 12,060,000 m^3 (0.303 PJ). Taking into account the methane share contained in biogas, the total methane quantity obtained from the given biogas quantity amounts to 7.236.000 m^3 CH_4.

- Utilization of biogas in electricity generation becomes more intensive and more cost-effective thanks to the improvement of devices used for that purpose. Several types of generators for electricity generation, having various power values ranging from 80 to 350 kW, may be found in technical papers.

- According to the previous experience, the lower threshold for cost-effective utilization of biogas in electricity generation is at the engine power of 100 kW (1m^3 of biogas, depending on the device efficiency, generates 1.6 to 1.9 kW of electricity).

Greenhouse gas emission reduction scenario with measures

This scenario includes measures as well as certain investments, and according to that here are some key issues:

- It includes a relatively high level of activity of the state in both entities in the energy sector
- Resources and quantities of biogas that can potentially be generated should be estimated in detail, because livestock production is the main source of methane emissions in agriculture
- The generated biogas can be used for thermal and electrical energy generation
- Biogas will be used more extensively after 2020
- This potential can be used in households and small boiler rooms
- It is assumed that 30% of the available potential in agriculture will be used by 2010, and 70% by 2020
- Biogas will be used more extensively after 2020
- Biomass utilisation in modern cogeneration plants
- It is estimated that significant effects of changes will occur after 2010
- This scenario contains the measures for greenhouse gas reduction and altered energy requirements

Mitigation potential:

- The possible potential for thermal energy generation at standard farms is as follows:
  - Cattle farm: 7.03 kW per standard farm with 20 heads of cattle
  - Pig farm: 4.6 kW per standard farm with 100 pigs
  - Poultry farm: 14.7 kW and 35.26 kW per standard farm with 5,000 or 12,000 poultry
- The possible potential for electricity generation at standard farms is as follows:
  - Cattle farm: 48 kWh/day / standard farms of 20 heads with cattle
  - Pig farm: 33.6 kWh/day / standard farm with 100 pigs
  - Poultry farm: 108 kWh/day and 254.4 kWh/day / standard farm with 5,000 or 12,000 poultry

Biogas generated at farms from manure and agricultural leftovers can be used for several purposes:

- Heating the digestors,
- Covering the heating needs of the farm itself,
- Heating the rooms,
- Drying hay, cereals and vegetables.

Surplus biogas depends on several factors such as plant capacity, type of the raw material subjected to anaerobic fermentation, time of the year, climatic conditions, etc. Owing to the examination of these options

- It is desirable to develop energy generation and consumption plans at each farm.
- In village farms having a small number of cattle heads, biogas may be generated at simple plants and used for covering a significant part of the household energy requirements.
- It is desirable to create prerequisites and conduct research on mini-plants as regards the manner of using biogas.

4.3. Industrial Processes

4.3.1. Inorganic Technologies - Baseline Scenario

4.3.1.1. Field Overview

Mineral Industry
Cement Production

There are two cement factories in BiH at Kakanj and Lukavac. Both factories are located in the Federation of Bosnia and Herzegovina (FB&H), thus the following data present level of BiH as well (www.fzs.ba; Kakanj Cement Factory, 2006; Lukavac Cement Factory, 2007).

Year	Production (t)
2000	628,214.00
2003	890,179.00
2005	1,025,540.00
2007	1,283,357.00

Table 4.3.1.1.1.: BiH cement production by years.

Metal Production

Aluminum Production

Aluminum production is one of the most important B&H industries from the aspect of the state and region development and sustainability. Due to greenhouse gases emissions, aluminum production causes the emissions of CO_2, CH_4, PFC (CF4), SF_6, as well as ozone and aerosol precursors (NOx, NMVOC, SO2 i CO). However, aluminum in BiH is produced by the anode melting process, where NOx emissions are minor (www.fzs.ba; Aluminij d.d. (JSC) Mostar, 2007).

Year	Production (t)
2000	94,751.00
2003	112,503.00
2005	131,232.00
2007	147,193.00

Table 4.3.1.1.2. B&H aluminum production by years

Ferroalloys

At this point, there is no sufficient data that could be used to calculate the potential of mitigating climate change in the production of iron and its alloys.

4.3.1.2. Data on Emissions and Energy Consumption

CO_2 Emissions

CO_2 emitted during cement production processes is the main source of global carbon dioxide emissions of all non-energy related industrial processes. It is believed that 2.4% of the total global CO_2 emissions including process and energy related emissions are caused by cement production. CO_2 emissions have been calculated using statistical data and production data received from plant owners, as well as using the IPCC emission factors.

The emission factor used to estimate CO_2 emissions from a cement factory is 0.4985 (http://www.ipcc-nggip.iges.or.jp).

Energy Consumption

Cement Production

Year	Consumption (m^3)	Fuel
2005	712,124.00	Natural gas

Year	Consumption (t)	Liquid fuel – heavy fuel oil
2005	4,793.55	

Year	Consumption (t)	Solid fuel – coal
2005	89,251.18	

Table 4.3.1.2.2.: Consumption of fuels in cement production in 2005(Source: Kakanj Cement Factory, 2006; Lukavac Cement Factory, 2007)

The total CO_2 emissions from cement production are the sum of the emissions from the technological process itself (in the calcination process) and of the emissions caused by fossil fuel combustion.

Aluminum Production

Only 2006 data were available.

Energy source (t)	Quantity
Electricity	1,865,331.7 MWh
Fuel oil	11,252 m^3
Propane, butane	120 t

Table 4.3..5 Fuel consumption in aluminum production in 2006. (Source: Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, http://www.ipcc-nggip.iges.or.jp; Aluminij d.d. Mostar, Plan aktivnosti, 2007).

CO2 emissions (t)	2000	2003	2005	2007
Cement production (technology)	313,500.00	444,200.00	511,700.00	640,400.00
Cement production (energy)	NAV	NAV	128,511.05	NAV
Aluminum production	142,100.00	168,800.00	196,800.00	220,800.00
Total CO_2 equivalents	455,600.00	613,000.00	708,500.00	861,200.00

Table 4.3.1.2.1.: CO2 emissions from industrial processes in BiH (Source: Kakanj Cement Factory, 2006, Lukavac Cement Factory, 2007).

4.3.2. Organic Technologies - Baseline Scenario

Bosnia and Herzegovina has the relatively good technical prerequisites for introducing favorable technologies when it comes to the impact on climate change. Apart from the available staff and substantial capacities at the known enterprises, there is a series of small enterprises that could orient their production towards new technologies.

Although there is a Statistical Institute at the state (BiH) level, it has not yet compiled even the minimum amount of data required for estimating an emissions inventory.

4.3.2.1. The Most Significant Organic Technology Fields in B&H

Based on the data published by the RS and FBiH Statistical Institutes, the existing industrial production has been analyzed for the purpose of the selection of the most interesting businesses.

Production growth indexes have been analyzed and it can be concluded that the fields of food technology, production and procession of leather, production of wood pulp, oil and petroleum refineries are evidently growing.

This report will not address biotechnological products in the pharmaceutical field (therapeutic proteins, monoclonal antibodies, vaccines, antibiotics, signalling molecules, diagnostic agents, enzyme inhibitors), not produced in B&H, or human probiotics, additives (emulsifiers, antioxidants, colours, flavours, stabilizers), or amino acids.

4.3.2.2. Overview of Products by Fields

The table 4.3.7 shows the total consumption of energy sources by fields and energy source consumption in tons of products for individual fields. Assessments made on the basis of official statistical data of the FBiH and RS Statistical Institutes Institute show that consumption of energy per unit of product is the highest in the textile industry (3,924MWh/t), whereas it is the lowest in the food and drinks industry (0,268 MWh/t).

Field of industry	Quantity	Electricity consumption	Brown coal and briquettes, in tons	Fire-wood, m^3
Food and drink industry	3,161,124	0.268	0.320	0.001
Cigarette production and tobacco processing	5,426	0.823		
Textile production	1,035	3.924	0.202	0.148
Leather processing	4,184	2.404	0.397	0.006

Table 4.3.2.2.1.: Estimated consumption of electricity, brown coal and firewood per product ton (Statistical yearbook of Federation of BiH and Republic of Srpska, 2007)

4.3.2.3. Energy Consumption in Meat Industry

The possibility of replacing liquid and gas fuels is important for the analysis in order for the alternative, renewable energy sources to be involved, including the replacement by biogas, the fuel with agricultural origin.

As regards the meat industry, almost 80-85% of energy of the total consumption is accounted for by thermal energy, which is generated most often by the combustion of fuel in boilers in plants. Thermal energy in the form of steam is used for cleaning and sterilization. The remaining 15-20% of energy is used for starting machinery, cooling and lighting. Air emissions from these industries are not of great significance, because the boilers in these BiH facilities are smaller than 350 KW, and they are not subject to monitoring. This is why the emission limit values do not apply to them.

The quantity of waste from slaughtering large cattle often exceeds 50% of the live animal's weight. Unfortunately, BiH enterprises do not employ the methods of measuring the quantity of waste generated.

4.3.2.4. Overview of the Situation in BiH Breweries

The most significant environmental issues related to the beer production include the following:

- Extensive energy consumption,
- Extensive water consumption,
- Increased values of harmful and dangerous substances in waste water,
- Large volume of generated waste water,
- Emissions into air starting from the receipt and transport of raw materials, boiler room operation, boiling maize and malt, washing and disinfecting bottles, etc.,
- Large quantities of organic and inorganic waste.

Beer production consumes various types of energy. This suggests the permanent control of individual consumption. Energy consumption is often expressed in hL (hectolitres) of the beer sold, and it includes the following types of energy:

- Thermal energy,
- Electricity,
- Cooling energy.

The studied breweries include all the breweries in the territory of Bosnia and Herzegovina, namely, the Banja Luka, Sarajevo, Tuzla, Grude and Bihać breweries.

The total quantity of all the specified types of waste is 69.42 kg/hl of beer produced. It is important to emphasize that this quantity does not include the Sarajevo Brewery waste quantities.

The total electricity consumption in all breweries in 2007 was 14,100,356 kWh/year; that is, 81.84 kWh/hl of beverage produced. Natural gas consumption in breweries totals 1,862,424 m^3/year. The natural gas consumption per product unit is 3.40 m^3 per 1 hL of the product. The total fuel consumption (heavy fuel oil, fuel oil, liquefied petroleum gas) in the three breweries from which data were obtained is 2,317,712 kg/year. The fuel consumption per product unit (kg per 1 hL of produced beverage) is 19.2 (Source: Integrated Control and Prevention of Pollution in Food Industry project, 2007).

4.3.2.5. Overview of situation in fruit and vegetable processing factories

The water consumption per ton of finished product is considerable, as a large quantity of wastewater is produced at the same time. A large quantity of energy is required for the production of steam for the necessary thermal processing. The consumption of heavy heating oil, heating oil and wood is therefore considerable.

The waste produced in these fruit and vegetable processing industries is organic; i.e., there are fruit and vegetable residues after their washing, processing and preparations for further production processes.

The average annual waste quantities in BiH for this industry are as follows: big companies (20 - 100 tonnes/day) annually produce more than 200 tonnes of waste, while small companies (up to 20 tonnes/day) annually produce 20 - 200 tonnes. The data on the exact quantities are not currently available. (Source: Integrated Pollution Prevention and Control in Food and Drink Industries project, 2007).

4.3.2.6. Petroleum refinery

Crude Oil refinery in Brod

Oil refinery in Brod daily processes 1,500 tons of oil and that will be the case until it has been verified that the facility is in working order; later the processing capacities will grow to the maximum daily production of 3.600 tons.

Oil refinery in Modriča

Oil refinery in Modriča produces 130,000 tons of engine oil per year.

4.3.2.7. Pulp and paper production

Wood processing capacity is approximately 38% compared to the pre-war production levels, while paper and pulp production amounts to only 10% of pre-war production. The largest and currently the only factory for the production of paper and pulp, Natron-Hayat, is located in Maglaj, in FBiH. The capacity of this factory is lower than its pre-war capacity.

4.3.3. Inorganic technologies - greenhouse gas emission reduction scenario with measures

4.3.3.1. Reduction of GHG emissions from cement industry

Co-incineration

One of the solutions for reducing greenhouse gas emissions is to partially replace fossil fuels with alternative fuels that are obtained primarily from waste. The use of waste as an alternative fuel in cement industry is a very attractive measure in terms of greenhouse gas emission reduction.

The use of waste saves fuel; i.e., it preserves primary sources of energy, and at the same time it reduces the amount of waste disposed of at disposal sites (Ekonerg, 2006).

Baseline scenario:

- Municipal waste is disposed of at the landfill – Over time, dumping waste in disposal sites causes the release of landfill gas containing 55 – 60% of methane (CH_4). One tonne of dumped waste emits 0.037 tonnes of CH_4 (http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch6ref1.pdf).
- Coal is used as an energy source in the cement production process.

CO_2 emissions from cement production will match the sum of the emissions from the technological process of producing cement and the emissions from fuel combustion.

Emission reduction scenario: If 20% of coal is replaced with municipal waste as an energy source, the reduction of CO_2 emission will equal the sum of the difference in the amount of the coal replaced with the waste and the amount of the methane (CH_4) avoided that would have emerged over years of dumping waste.

Assumptions:

- 3,000,000-KM investment in a waste acceptance and feed facility in 2011; (Ekonerg, 2006)
- Price of coal is 65 KM/t (Energetika, www.energetika.ba)
- Price of dumping waste in landfill sites is 35 KM/t (www.vijece.mostar.ba)
- 270 kg of waste per capita is generated per year (FB&H Environmental Protection Strategy, 2007, BiH)
- In 2012, reductions in emissions will total to 27,519.07 tonnes of CO_2e.

Reduction in clinker-to-cement ratio

Since CO_2 emission is mostly ascribed to clinker production, one of the measures for reducing CO_2 emission is the reduction in the clinker-to-cement ratio.

The average clinker ratio in cement types produced in BiH is approximately 75%. Out of the total CO_2 emission from cement production, around 60% pertains to the process of clinker production, and the emissions resulting from fuel combustion in rotary kilns and for other needs in the cement production processes make up the remaining 40% (Ekonerg, 2006).

4.3.3.2. GHG emission reduction potential

Potential for GHG emission reductions

Fossil waste can be used as an alternative fuel in the production of clinker, as well as all types of organic waste. The use of waste as the alternative fuel requires permanent monitoring of its composition. Only certain types of waste in their original form can serve as an adequate replacement for fossil fuels. Other types of waste must be adequately processed so that the combustible part of the waste is prepared for incineration.

The use of waste as an alternative fuel in cement industry is a very attractive measure in terms of reducing greenhouse gas emissions, preserving the primary energy sources, and reducing the amount of waste disposed of at landfill sites, but it has certain constraining factors (Ekonerg, 2006):

- quality of clinker produced;
- emissions from facility;
- type of fuel;
- energy value of fuel;
- availability of fuel – continuous and stable quantity and quality of fuel;
- price of fuel;

- lack of infrastructure for collecting, sorting and preparing waste;
- deficient legislation;
- negative public opinion;
- competitiveness on the market.

Reducing the clinker-to-cement ratio, while increasing the ratio of additives in cement, will depend on the following constraining factors:

- availability of raw material and necessary additives;
- composition of basic minerals;
- quality of clinker produced;
- price of additives;
- market demands.

Owing to the constraining factors and risks, this measure is not yet sufficiently attractive and acceptable to producers.

4.3.4. Organic technologies – greenhouse gas emission reduction scenario with measures

4.3.4.1. Available renewable energy source potential

At this moment, the Bosnia and Herzegovina potential in renewable energy sources cannot be precisely determined. A larger percentage of renewable energy sources can be found In certain parts of Bosnia and Herzegovina, while in some parts there are almost no potentials to be used as renewable energy sources. As far as Bosnia and Herzegovina is concerned, certain parts of the state possess different potentials for the production of waste biomass.

According to some indicators, the largest available potential of renewable energy sources is found in the areas where major food-processing industries have been developed, industries listed as companies with a major potential for using biomass as a renewable energy source.

Based on the data available, the biomass used for the production of thermal energy is, per thermal unit, about four times cheaper than natural gas. The same goes for biogas, for the production of which all forms of plant and animal waste can be used and which can also be obtained in the form of landfill gas or following wastewater and sewage treatment.

Initiating the production of energy from renewable sources is the best solution for preserving the environment and reducing the dependence on the import of energy sources, and it also creates the conditions for opening new job vacancies.

The most important manufacturers of waste should also be users of waste from either agricultural production or wood-processing industry.

Based on compiled institutional and individual opinions and analyses conducted in the course of drawing up this paper, the following may be stated:

- lack of steady financial resources constitutes a key obstacle in the development of the national GHG emission inventory;
- lack of adequate secondary legislation concerning compiling basic data, data quality and update control, revising the national report on GHG emissions, as well as limited administrative capacities, constitute a major obstacle;

The greatest potential of renewable energy sources lies in using biomass in the electricity production sector, household sector, and service and industry sectors.

One of the important measures for mitigating climate change and for considerably reducing emissions may be employed by systematic management of waste originating from industries, which fall within the scope of this paper. The amount to be paid for costs would be inevitable and would vary depending on the type and capacity of the industry in question.

One of the important measures that replace fossil fuels is the thermal processing of waste with energy utilisation, whether it be thermal processing of solid waste or use of landfill gas methane for energy purposes.

The types of waste generated from industries that fall within the scope of this report are used for the production of biogas. Those are as follows: municipal wastewater, industrial wastewater, animal excrement (faeces, urine) – waste from farms, human excrement, and plant biomass as a waste product of agricultural production. The basic prerequisites that must exist for the economical use of a waste substance as the raw material for the production of biogas are a sufficient quantity throughout the year, suitable composition (particularly in terms of microdegradable ingredients content), absence of toxic or inhibitory substances for the process of biogas production and concentration of an organic substance in the substrate for improving the economy of the process. The above requisites are met by three groups of waste products that can therefore serve as suitable raw materials for the production of biogas.

Greenhouse gases are not produced in the given industries and this report thus will not deal with GHG emission calculations. However, considerable quantities of waste produced in the given industries indirectly emit GHGs. The large quantity and great efficiency of waste (solid and liquid waste from industry) as a renewable energy source constitutes one of the most important factors determining the potential role of biomass in the organic industry. Thus, these quantities of waste will be the basis for assessing the reduction of emissions.

The possibilities for using solid and liquid waste from organic technologies will be considered in this paper. Waste will be used as the biomass for the production of energy and that can be achieved by means of one-off activities in a number of fields.

4.3.4.2. Possibilities for using waste

Large quantities of waste are generated in food industries, especially in abattoirs, mills, dairy plants and oil refineries. The possibilities for waste utilisation are regeneration (fodder, fertiliser), dehydratation and recycling (biogas production).

The most important examples of waste incineration and waste to energy conversion can be applied in the leather industry (Prevent Visoko), and the incineration of waste husks could be applied in the factory for sunflower and soya processing located in Bimal Brčko.

Organic residues such as sewage sludge from food industry, biowastes and composts are increasingly used in land rehabilitation because they can improve the physical, chemical and biochemical properties of soil, and reduce the need for inorganic fertilization. Furthermore, their use contributes to an integrated approach to waste management by promoting recycling of agricultural soils (Waste Management & Research Journal, 2009)

4.3.4.3 Fruit and vegetable industry

The quantity of waste in the fruit and vegetable processing industry is reduced by preventing raw materials from coming into contact with water.

Additional methods for reducing the quantity of waste are implemented by means of the following operations:

- drying,
- freezing,
- concentrating,
- filtering,
- centrifuging,
- thermal treatments.

In the frozen food cold chain, there are eight measures that could save energy and reduce emissions.

- An increase in cold storage air temperature
- Reduction of the air-refrigerant temperature difference
- Seasonal adjustment of evaporating temperature
- Avoidance of air temperature fluctuations
- Separation of blast freezers and cold storage
- Avoidance of over-cooling in blast freezers
- Use of variable speed drive fans
- Use of a flexible and efficient defrosting system

4.3.4.4 Leather industry

Sludge generated by the processing of leather is the cause of unpleasant smells and is disposed of according to certain procedures and standards.

Quantities of waste leather and meat are large, and it is therefore suggested to develop a project in order to use this industrial waste as a fuel.

One proposal involves incineration and the production of biogas that could be used in the the Prevent leather works plant in Visoko. In this way, one more bio-energy source would be secured.

4.3.4.5. Edible oil industry

The processes of transferring heat and substance when gasifying biomass are possible in the edible oil industry. Three types of biomass could be used as the fuel in experimental researches and these are as follows: maize cobs, soya husks and sunflower stalks. The problem in using biomass is its low bulk density that equals its mass per unit volume when in bulk, and in agricultural residues it ranges between 100 and 200 kg/m^3, while in domestic lignites it ranges between 500 and 600 kg/m^3, which require larger fireboxes and storage hoppers.

In addition, variations in terms of size and shape constitute the main problem when designing the firebox and feed hopper. Bearing in mind the high reactivity (high volatile matter content), biomass is very suitable for liquefaction, pyrolysis, and gasification processes through which liquid and gaseous fuels can be obtained (Erić, 2006).

4.3.4.6. Dairy industry[27]

The ideal treatment of dairy industrial waste streams would cover the following:

- separation,
- balancing the stream,
- two-step biological treatment.

Problems with waste treatment include the following:

- high concentration of fats,
- proteins,
- varying concentration of pollutants,
- cleaning agents.

Alternative methods for recycling waste from food industries

- Application at farms
- Fermentation
- Pickling
- Composting
- Extrusion

4.4. Transport

4.4.1. Baseline scenario

4.4.1.1. Road transport

According to the 2007 data, BiH has 22,734 km of roads of all categories, which is 4.87% more than in 1991 when it had about 21,677 km. The most important road routes in Bosnia and Herzegovina are as follows:

1. Bos.brod/Županja-Tuzla/Zenica-Sarajevo-Mostar-Ploče
2. BiHać-Banja luka- Doboj – Tuzla-Bijeljina-Bos.Rača-Zvornik
3. Banja Luka-Travnik-Zenica-Sarajevo-Goražde-Višegrad

[27] Source: www.tempus16140.rs.sr/seminars/module7/uticaj-perade-hrane-na-okolinu

The total length of all road routes in the BiH territory by entity amounts to approximately 12,952 km in FBiH, 9,575 km in RS, and 207 km in BD.

The total number of registered motor vehicles in 2007 amounted to 778,474, which is 80.51% more than in 1991. In 2007, FBiH had 489,666 registered vehicles, RS had 262,708, and BD had about 26,100. Out of the total number of registered motor vehicles, 86.87% were passenger motor vehicles, 0.22% were buses, 7.92% were goods vehicles, 1.42% were motorcycles, 0.94 % were tractors, and about 2.6% were other vehicles. A very important piece of information is the fact that in 2007 the average age of registered motor vehicles was 17.3 years, and out of the total number of registered passenger vehicles, 54.24 % were over 15 years old. According to the data available, the total number of transported passengers per kilometer in road transport amounted to 1,042,466 in 1997, which was 9.4% more than the year before. With respect to cargo flows in the BiH road transportation in the reference period, they amounted to 323,151 ton/km, which is 49% more than the year before (BiH Ministry of Communications and Transport, 2005).

Baseline scenario: By analyzing the total situation in the BiH road network, which is mostly only serviceable and which barely enables using the gears stipulated for specific road categories, more and more traffic jams are to be expected, as well as the reduction in the total flow of goods and people, increase in the number of traffic accidents. If the road building trend in BiH continues at the same pace of 1.5% per year, by the year 2030 BiH could have about 29,500 km of built roads, out of which about 300 km would be motorways.

An overview of motor vehicles in Bosnia and Herzegovina shows that every second motor vehicle is over 10 or 15 years old, and it is uneconomical to make any kind of technical improvement that could in turn have a considerable effect on environmental, ergonomic, economic, and even energy-related progress. Goods vehicles and buses alike are mostly over 10 years old, which affects public safety, effectiveness and efficiency, the reduction in share in realizing income, as well as the possibilities for employment in international transport logistics.

According to estimates, road transport in Bosnia and Herzegovina, compared to the railway transport, accounts for 90% of the total annual consumption of energy sources (diesel and premium) in the sector, which, per the 2005 data, amounted to approximately 770,000 tonnes of fuel per year. Bearing in mind the average annual 7% growth in the number of motor vehicles, it is to be expected that the annual consumption growth will amount to at least 3.5%, which indicates that the total consumption of premium petrol and diesel could reach the amount of about 1309,000 tonnes in the year 2030. It is therefore believed that there are great possibilities for more rational and more economical consumption in this field of transport. When one takes motor vehicles less than 10 years old into account, certain calculations show that energy losses and fuel consumption are on average 10 - 20% higher, while vehicles over 15 years old, which account for over 54% of vehicles in this region, spend 20 - 40% more fuel per 100 km, which particularly indicates huge environmental, energy and economic losses, but also huge possible savings, both now and in the future.

4.4.1.2. Air transport

In Bosnia and Herzegovina there are 27 officially registered airports, while only 4 of these (Sarajevo, Banja Luka, Mostar and Tuzla) are listed as airports with IATA code (IATA Airport Code). The average number of passengers transported through Sarajevo Airport in the period between 1996 and 1999 amounted to 280,000 per year. In 2001, the number of transported passengers amounted to about 334,000, and in 2005 it was as many as about 450,000 passengers, which is 62% more in comparison with 1999. Sarajevo Airport alone served about 400,000 passengers during 2005, and one could say that it is also one of the best equipped airports in the region, which is why it won the ACI Best Airport Award for 2004 for airports with under 1000,000 passengers per year. (BiH Ministry of Communications and Transport, 2005).

Baseline scenario: The airports in Banja Luka, Mostar and Tuzla, unlike Sarajevo Airport, are relatively badly equipped in terms of technical capacities and personnel. The total traffic at these airports does not constitute even 20% of the total traffic of Sarajevo Airport, which should be stressed in the following period.

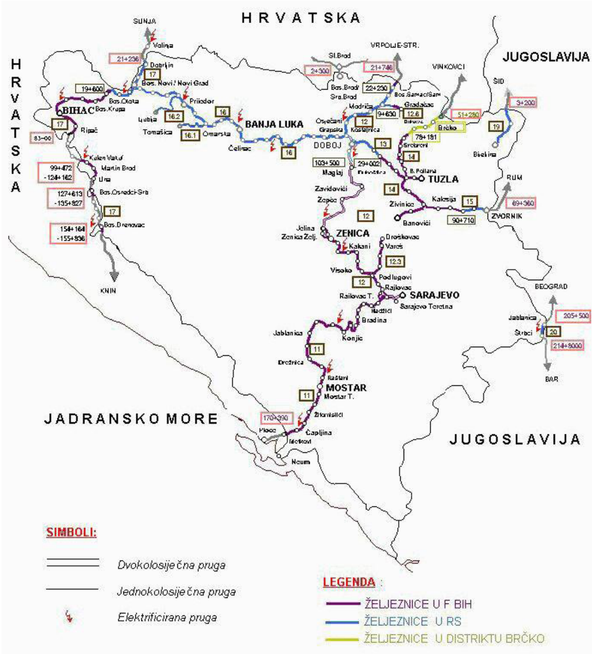
If the authorities do not take some significant measures for their proactive participation, their total traffic, with an annual increase of 1% will amount to only 48,000 passengers in the next 20 years. The increase in passenger transport of Sarajevo Airport is relatively good in the present circumstances and it enables an annual increase of 8% in the next period, meaning that passenger transport could grow from 400,000 to about 1,040,000 passengers in the year 2030. Concerning airplanes/aircrafts, only Sarajevo Airport, equipped with and possessing 2 quality airplanes, model name: ATR 72/212, could be singled out, while all the others function on an amateurish and local basis.

4.4.1.3. Railway transport

According to the 2007 data, the total length of railway lines in BiH amounts to 1,031 km, out of which 776 km are electrified. Until the beginning of the nineties, BiH was a country with marked railway transportation and transit system, which partly went through the port of Ploče towards the north of the country, and the other part went from the west through Banja Luka and Doboj to Sarajevo, Tuzla and Belgrade. The length of the BiH railway network by entity amounts to about 583 km in the FBiH, 417 km in the RS, and about 31 km in the Brčko District territory. The length of electrified railway lines in the FBiH amounts to 259 km, and to 359 km in the RS.

In 2007, passenger rail transportation/km amounted to 53,000,000 passenger kilometers, which is 5,9 % more than the year before or 200% more than in 2001.

The rail transport of cargo flows amounted to 693,352,000 t/km in 2007, which is 1.7% more than the year before, or 162.5% more than in 2001, when cargo transport by railway amounted to about 264 million t/km.



Picture 4.4.1.3.1.: The railway network in BiH

No.	Type	BiH	FBiH	RS
1	Electric locomotives 441	49	24	25
2	Diesel locomotives	24	4	20
3	Electric multiple units	3	3	-
4	Two-axis carriages	53	43	10
5	Four-axis carriages	144	94	50
6	Goods wagons	764	364	400

Table 4.4.1.3.1.: Overview of operational locomotives and carriages in BiH (end of 2006) (BiH Public Railway Corporation document, www.bhzjk.com).

Baseline scenario: The entire railway infrastructure and supra-structure can be said to be partially operational and it cannot satisfy the modern demands of multi-modal and integral transport. The growth in passenger transport in both entities is roughly the same and indicates that it could, with a 5.9% annual growth, increase by 120% or to 116 million passenger kilometers in the next 20 years; i.e., by the year 2030. At the same time, goods transport could, in the same period, increase by 34%; i.e., to 928 million t/km. As regards the construction of new railway tracks in both B&H entities, as well as Brčko District, by comparison with the previous period, it is impossible to estimate these possibilities while the possibilities for the renovation and modernization of the existing network are certain.

4.4.1.4. Sea and river transport

Bosnia and Herzegovina has a very short coastline off Neum and does not have a regulated adequate access to international waters, and therefore does not have regulated sea ports. The international port that is the most important for the BiH economy is the port of Ploče in Croatia, which is closest to Sarajevo and which has developed precisely because of the Bosnia hinterland. This port's capacity is 5 million tons/year. River transport is somewhat better developed, but with large unrealized potential. The main navigable waterways are the rivers Sava (333 km), Drina (15 km), Bosna (5 km), Vrbas (3 km), Una (15 km), and some natural and artificial lakes. The important ports on the Sava are Brčko, Bosanski Šamac and Bosanski Brod ports. The Brčko port quay is 150 m long, and its average width is 15 m. The navigability of the river Sava within Brčko District is 44 km, vessels with up to 2.5 meters draught can navigate it 260 days of the year, and during the low water level period that is possible only for shallow draught vessels. River goods transport accounts for about 1% of the total goods transport in all transport fields of BiH, the fact conditioned also by the technical capacities of the fleet as every activity involves towing rather than pushing. (BiH Ministry of Communications and Transport, 2005).

Baseline scenario: Bearing in mind the current possibilities of water transport, it may be concluded that, for the B&H needs, it will grow by about 12% at the port of Ploče, from the current approximate 3000,000 tonnes to about 10 million tonnes a year in 2030, while the annual traffic of 0.7 million tonnes on the river Sava will, with a 2% growth, amount to 0.98 million tonnes a year in 2030.

4.4.1.5. Consumption of energy sources

According to the data available, the B&H consumption of derivatives between 2000 and 2005 ranged between about 800,000 and 1.3 million tonnes a year. The table enclosed shows that the 2005 consumption of motor oil, compared to the 2000 consumption, grew by about 5%.

4.4.2. Greenhouse gas emission reduction scenario with measures

4.4.2.1. Road transport

Mitigation scenario: Given the growing demands for both domestic and international goods and passenger transport to occur solely on the Corridor Vc motorway towards the Corridor X motorway and other main and regional roads, activities focused on their construction should be intensified in the upcoming period at 3% a year. That way BiH would have around 300 km of motorway in the next 10 years (i.e., by the year 2020), as well a significantly renewed transport infrastructure, which would lead to lower

x 1000 tonnes	2000	2001	2002	2003	2004	2005
Motor gasoline	327.7	315.9	271.5	264.0	280.2	269.8
Jet fuel	9.7	8.0	8.2	7.3	5.0	5.3
Diesel petrol	423.3	414.3	407.2	451.5	512.4	513.4
Extra light heating oil	157.3	170.3	146.5	112.9	119.1	110.5
Heating oil	215.5	191.0	166.8	128.0	147.1	118.8
Bitumen	49.8	47.2	56.1	66.1	67.8	76.7
Lubricants	10.8	10.4	13.4	14.4	14.6	17.1
Other	2.0	1.0	0.9	1.2	10.2	20.4
TOTAL	1212.6	1173.7	1089.2	1068.8	1177.7	1160.7

Table 4.4.1.5.1.: Total annual consumption of petroleum derivatives between 2000 and 2005 (BiH Foreign Trade Chamber, Energy Sector Study in BiH, 2000, BiHTMAP, Volume II, 2001, p. 3-23).

fuel consumption, faster flow of vehicles, goods, and passengers, and the increase in the general economic development by about 6% a year.

Stricter measures need to be introduced for passenger motor vehicles when conducting regular vehicle inspections and preventive maintenance inspections, particularly in terms of emission parameters that deviate from MPQ (prohibited from operating). That way 5% of motor vehicles a year would have to be barred from traffic, which would result in a considerable renewal of the passenger vehicle pool in the next 20 years, as well as a 30% reduction in greenhouse gas emissions This would encourage a large number of passengers to use public transportation services, and their number would increase by about 40,000 passengers a year, i.e. by the year 2030, it would grow from today's 1,000,000 passengers to 1,800,000 passengers.

By adequately regulating fuel combustion process in only 15% of motor vehicles a year (700,000 tons x 15% x 20 years) it is possible to save about 2,100,000 tons of fuel by 2030.

4.4.2.2. Air transport

Mitigation scenario: Better economic ties of BiH with developed countries could, to a significant extent, contribute to a better utilisation of air transport and could raise it to a much higher level. By means of purchasing or renting a large number of planes, and by means of establishing a more favorable business environment for entrepreneurs, passenger air transport could be increased to about 12% a year, which would mean about 1,360,000 passengers in 2030.

4.4.2.3. Railroad transport

Mitigation scenario: If in the upcoming period necessary resources are invested and the railway infrastructure and supra-structure are renewed (investment estimation 400 million Euros), passenger transport in both entities will increase by about 12% a year, i.e. by 2030 it will grow from the present 53 million to 180 million passenger kilometers. In turn, goods transport would rise from 1.7% to about 7% a year and in 2030 it would amount to about 1,663 million t/km.

4.4.2.4. Sea and river transport

Mitigation scenario: The very low utilisation level of water transport as a whole can considerably enhance the development of heavy industry and relieve primarily road transport if investments are made in the water transport infrastructure and supra-structure, which is interesting since 1 kW can push 4 tonnes of cargo, while in other transportation fields, such as road transportation, 1 kW can push 100 kg, and in railway transportation 1 kW can move 400 kg.

4.5. Agriculture

4.5.1. Baseline scenario

4.5.1.1. Agricultural sector overview

Land resources

Out of the total Bosnia and Herzegovina territory, amounting to 5,112,879 ha, FBiH takes up 2,607,579 ha, while RS takes up 2,505,300 ha. Farmland covers approximately 2,600,000 ha (around 52%) of that territory, and the remaining 2,400,000 ha are woodlands (around 48%).

Fragmentation of farmland in BiH constitutes an additional problem, 54% of property is under 2 ha in size, 13.5% is between 2 and 3 ha, 16% of property is between 3 and 5 ha, 10% of property is between 5 and 8 ha, about 3% of property is between 8 and 10 ha in size, and only 2.9% or property is over 10 ha in size (NEAP BiH, 2002).

The sowing structure of cultivated plants and their share in the total sowing structure constitute an important segment of the BiH plant production. According to statistics, in the RS, harvest areas amounted to 443,300 ha in 1990, to 285,731 ha in 1996, and to 356,548 ha in 1997. In the period between 2000 and 2006, about 67.17% of total area in crops was sowed with cereals, and 26.66% with fodder crops. It is clear that the sowing structure is not favourable as it is not satisfactory in terms of the size of areas in crops and in terms of the yield per unit area, which are very small and low, respectively (RSSI, RS, 2007).

	2000	2001	2002	2003	2004	2005	2006
Farmland	985	975	968	998	999	1002	1007
Arable land	825	816	810	831	820	832	834
Ploughed land and vegetable gardens	580	575	572	586	590	593	596
Orchards	49	50	50	51	51	50	50
Vineyards	0.2	0.2	0.2	0.3	0.4	0.4	0.4
Meadows	196	191	188	194	179	189	188
Pastures	156	155	155	164	177	167	166

Table 4.5.1.11.1.: Farmland by land utilisation category - RS (thousand hectares).

	2000	2001	2002	2003	2004	2005	2006
Areas in crops	396	381	356	335	350	346	348
Cereals	268	260	239	218	236	227	225
Industrial crops	4.8	3.7	4.4	5.6	4.7	6.9	8.2
Vegetable crops	41.0	40.9	38.3	37.0	38.5	38.0	37.3
Fodder crops	82	76	74	74	71	74	77

Table 4.5.1.1.2.: Areas in crops by land utilisation in RS (thousand hectares)

The situation in the Federation of BiH is not much different as the total sowing area is considerably smaller and it amounted to about 206,000 ha in 2001, and 197,000 ha in 2006. Arable area by use is given in the following table (FSI, 2007).

The sowing structure is very unfavorable. The production of cereals in areas of 1-3 ha cannot be economically justified and a commercial livestock production cannot be built on it.

Another issue that brings us to the analysis of the technological level of agricultural production in BiH are average yields of the most common crops (over 80% of arable land in BiH),

The comparison of yields with the same yields in the neighboring countries gives a clear picture of average yields of main agricultural crops, and it clearly shows that the agricultural production in BiH is completely behind--between 1.1 and 4.4 times less productive.

Thus, in addition to the unfavorable structure of agricultural crops, average yields in BiH are very low, which fully qualifies this production as extensive, unproductive and therefore barely sustainable. However, the natural conditions for agricultural production are favourable, and for some crops they are even optimal in comparison with some of the neighboring countries.

The analysis of production of main types of livestock in BiH clearly reflects the habits of autarchic village farms orientated towards satisfying their own needs and keeping their own livestock numbers at the biological minimum on one hand and the tardiness of the state and its institutions, i.e. agricultural experts, to launch development process on the other.

Based on the data from the RS Statistical Institute, in 1999, over 17% of total land in the RS – BiH were pastures. If we add 10% of natural meadows to this, we arrive at the fact that almost one third of the total land can be used for livestock production.

There are great possibilities for a quality livestock production on the territory of BiH, but the number of heads of cattle must be increased, the structure must be changed and the stock composition must be improved.

Given the natural resources available, the question of increasing the total number of all types of livestock arises.

The great decrease in the number of livestock during the war and post-war periods and the deficit in the nutritional needs of the population in terms of the most important animal products clearly indicate the need to enhance this branch of agricultural production, inter alia in terms of rational use of land resources as well.

Year	Ploughed land/ vegetable gardens/flower gardens	Area in crops					Other on arable land	Fallow farmland	Uncultivated arable land, gardens
		Total	Cereals	Ind. crops	Vegetables	Fodder crops			
2001	412	206	92	2	47	65	1	12	193
2002	410	207	92	2	47	66	2	11	190
2003	416	203	90	2	48	63	2	11	200
2004	416	198	83	2	49	64	2	14	202
2005	411	197	85	2	46	64	2	13	199
2006	409	197	83	2	45	67	2	14	196

Table 4.5.1.1.3.: Arable land by utilisation in FBiH (thousand hectares).

Livestock number	1991; 1997			2004 – 2007			
Type of livestock	1991	1997	loss	2004	2005	2006	2007
Cattle	355,521	200,973	154,548	212,497	220,065	233,351	235,513
Sheep	694,213	316,712	377,501	384,319	395,517	460,607	481,256
Pigs	459,333	291,789	167,544	492,983	533,928	594,727	416,156
Horses	38,578	26,494	12,084	16,190	16,108	15,915	15,536
Poultry	4,689,316	2,087,183	2,602,133	4,646,735	5,612,886	7,178,840	8,191,229

Table 4.5.1.1.4.: Overview and comparison of numbers and types of livestock, 1991, 1997 (estimation www.plud.ba) and 2004-2007 for RS (RSZ, RS, 2008)

The table shows that in RS only pig breeding exceeded the pre-war and 1991 production levels, but it was falling in 2007.

Table 4.5.1.1.5. shows the situation with the livestock numbers in the Federation of BiH. The data refer to the total numbers of livestock by type, without dividing them into further categories, for the period between 2001 and 2007.

Apart from the lowland regions where all required conditions for breeding highly productive breeds of cattle can be provided, the transition zones between the lowlands and highlands (between 500 and 700 m above sea level), where there are no conditions for keeping cattle in barns but for their grazing, are definitively of great importance for the development of this production.

In order to attain this objective, it is necessary to improve the level of livestock breeding technology (livestock selection, keeping, feeding, etc.), which is currently at an extremely low level.

The technological problems in livestock feeding in BiH are as follows:

- meadows and pastures of bad botanical composition, extreme weed presence;
- yield from such areas is very low;
- late bringing in of green vegetation for storing hay and silage;
- bad quality of bulky food (high lignin and pulp content, low protein, vitamin and mineral substance content);
- improper food preparation and storage (as a consequence high contents of moulds and micro toxins occur);
- traditional conserving of bulky animal feeding stuffs (storing bad quality hay);
- very small number of farms store silage and hay; absence of planning of production of animal feeding stuffs according to animal needs; (daily needs, summer and winter nutrition periods);
- small farms with 2 or 3 head of cattle;

Livestock number	2001 - 2003			2004 – 2007			
Type of livestock	2001	2002	2003	2004	2005	2006	2007
Cattle	218,406	223,684	229,071	234,898	234,123	233,289	224,847
Sheep	323,945	375,082	456,704	506,622	506,964	545,356	549,490
Pigs	80,493	80,707	88,949	94,188	91,515	91,703	90,603
Horses	15,191	13,032	11,901	11,156	10682	9,699	9,622
Poultry	4,213,000	4,514,000	5,178,000	4,329,000	4,192,000	5,385,000	6,111,000

Table 4.5.1.1.5.: Overview, numbers and types of livestock for the period 2001-2007 in FBiH (FSI 2007).

- lack or unavailability of machinery for storing food;
- farmers are uninformed and do not adopt new information easily;
- bad stock composition of cattle;
- bad building structures and hygienic conditions for keeping livestock;
- an insufficient number of quality control laboratories (vitamins, micro toxins, hormones, etc.);
- an insufficient number of trained staff to control food quality.

4.5.1.2. Agricultural greenhouse gas emission sources

Methane emission

Details about the methane emission are discussed in the chapter on renewable energy resources because agricultural production, particularly livestock breeding, causes its generation, thereby also representing the most significant potential. The revised 1996 methodology of the Intergovernmental Panel on Climate Change (IPCC, 1996), prescribed by the authorities of the UN Framework Convention on Climate Change, was used while calculating methane emissions in the process of enteric fermentation and manure management.

While calculating emissions, the simplest level 1 was used for the calculation which requires only data on the number of a certain type of livestock. In the course of the calculation, the emission factors were recommended in the aforementioned IPCC methodology, and these were the factors for enteric fermentation for South-East Europe, that is, the emission factors for manure management for a cold climate region. According to the said methodology, the region analyzed was classified as a cold climate region, with an average annual temperature of 15oC. Also, warm and wet weather conditions are favorable for increased methane emissions, and such weather conditions are relatively frequent in the summer period in the region analyzed.

Global annual methane emissions generated as a result of enteric fermentation range between 0,060 and 0,100 Gg, and in countries with high livestock numbers between 0,001 and 0,005 Gg.

This calculation was made using the following equation: Emission factor (kg/head/year) x livestock population number (head /106 kgGg)= methane CH_4 emission (Gg/year).

Methane stays in the atmosphere for a relatively long period of time (about 8.4 years), which contributes to its global spread. It belongs to the group of greenhouse gases contributing to the global warming of the atmosphere, thus causing global climate change. Methane-induced global warming potential is 21 times greater than CO_2-induced potential, and it is therefore necessary to undertake, in accordance with international agreements, all necessary actions to ensure stabilization and and emission reduction in the atmosphere, The greatest manure production comes from cattle production, that is, about 60% of the total production, viewed from the perspective of the B&H livestock composition and the quantity of manure per head unit.

Significant quantities of methane are particularly released when manure is stored or treated in a liquid form in basins or tanks. If manure is used in a solid form and is spread onto fields, decomposition then occurs under aerobic conditions not producing methane. Proper management and use of new technologies can reduce this problem to a large extent, while negative effects can be directed towards useful ones.

Nitrogen oxides emission from agricultural production

Apart from methane, agricultural production causes the biggest emission of N_2O, i.e. nitrogen oxides, which belong to the group of gases causing the greenhouse effect. By applying mineral and organic fertilizers, agricultural production directly generates these oxides, as well as directly from livestock production, and indirectly from agricultural activity.

It should be emphasized that due to the high variability of nitrogen in soil and the loss of its highly available forms by the intensive use of soil, the compensation for the deficit in this nutrient by applying mineral nitrogen fertilizers is set as a priority. At the time of the highest consumption of mineral fertilizers (1980-1990), nitrogen was a priority element with a share of about 55%, while the share of P and K and other fertilizers accounted for 45%.

The characteristic of fertilizers, with the mineral nitrogen content in the ammonium form, is that after application they are directly available to plants. However, due to a high capacity of many soils to bind cations, the largest percentage of this nitrogen form from ammonium fertilizers is bound in the part of soil where it was applied. Under the influence of soil microorganisms, the absorbed ammonium nitrogen is gradually converted to the mobile NOx form, which is available to plants in a larger volume. (Govedarica, Jarak, 1995).

The application of nitrate fertilizers results in highest soil nitrogen losses, and therefore nitrogen oxides emissions as well.

Amide fertilizers contain nitrogen in the organic form (NH2 and CN2), which are after an application in the soil rapidly transformed into mineral forms plants directly take up.

By the improper use of mineral fertilizers, the manner and time of application largely lead to the loss of nutrients by their leaching into the groundwater, as well as by the volatilization of readily available forms, particularly from light and dry soils.

During manure storage, a part of nitrogen is converted to N_2O, and emissions relate to the manure before its application onto fields.

Item	year	Cattle	Pigs	Sheep	Horses	Poultry	Σ/year
Realistic annual livestock numbers Head/year	2004	447395	587171	890941	27346	8975735	10928588
	2005	454188	625473	902481	26690	9804886	11813718
	2006	466640	686430	1005963	25614	12563840	14748487
	2007	460360	506759	1030746	25158	14302229	16325252
1. Emission factor for methane enteric fermentation (kg/head/year)		55	1,5	5	18	0	
CH_4 emission (Gg/year) by 1.	2004	24,6	0,88	4,45	0,49	0	30,42
	2005	24,98	0,93	4,5	0,48	0	30,89
	2006	25,66	1,02	5,02	0,48	0	32,18
	2007	25.31	0.76	5.15	0,45	0	31,67
CO_2 originated (Gg/year) by 1.	2004	516,6	18,48	93,45	10,29	0	638,82
	2005	524,58	19,53	94,5	10,08	0	648,69
	2006	538,86	21,42	105,42	10,08	0	675,78
	2007	531,51	15,06	108,15	9,45	0	665,07
2. Emission factor for manure, for a cold climate region		4	4	0,10	1,09	0,012	
CH_4 emission (Gg/year) by 2.	2004	1,78	2,3	0,09	0,02	0,11	4,3
	2005	1,82	2,5	0,09	0,03	0,12	4,56
	2006	1,87	2,7	0,1	0,03	0,15	4,85
	2007	1,84	2.027	0.103	0,03	0,17	4,2
CO_2 originated (Gg/year) by 2.	2004	37,38	48,3	1,89	0,42	2,31	90,3
	2005	38,22	52,5	1,89	0,63	2,52	95,76
	2006	39,27	56,7	2,16	0,63	3,15	101,9
	2007	38,64	42,567	2,16	0,63	3,57	87,6
Total CO_2 originated 1+2 (Gg/year)	2004	784,98	1014,3	39,69	8,82	48,51	1896,3
	2005	802,62	1102,5	39,69	13,23	59,9	2010,96
	2006	824,67	1190,7	45,36	13,23	66,15	2140,11
	2007	811,44	894,6	45,36	13,23	74,9	1839,6

Table 4.5.1.2.1.: Methane emission and equivalent CO2 emission

4.5.2. Greenhouse gas emission reduction scenario with measures

Greenhouse effect mitigation measures have been discussed and proposed in accordance with the information and capacity available, given the modest experience and information published in these fields. A program of mitigation measures should be based primarily on the present production situation, as well as on the prospects and strategies in this field, which are only partially implemented. The implementation of the mitigation measures requires a complex approach, because an individual approach is not appropriate for all circumstances concerning the reduction of greenhouse gases.

An important decision is that N_2O and NH4 emissions should not be viewed separately, in isolation, because the reduction in one gas does not affect the reduction of the other, and the reduction effects therefore do not live up to the expectations. The mitigation program should include the aforementioned emissions, which will be addressed by applying the following measures:

- the use of biomass in biogas production, i.e. for energy purposes (discussed in the chapter on renewable energy resources),
- measures to reduce methane emissions by introducing a new livestock breeding and feeding practice;
- measures to reduce nitrogen oxides emissions through programmes aimed at improving the application of mineral and organic fertilizers and introducing organic production.

4.5.2.1. Measures to reduce methane emissions by introducing new livestock breeding and feeding practices

Reduction in Livestock Numbers

Given the situation pertaining to the livestock numbers and the nutritional requirements of the BiH population, the mitigation of methane emissions by reducing the already-depleted livestock numbers is neither a good, nor a recommendable solution. Vast areas of grassland can feed a lot more livestock, but the current situation and uncertainty in this production does not guarantee the security of production.

Manure storage, preparation and application methods

Methane and other gases generated during manure fermentation may be used for various purposes at the farm itself. Gas for lighting, burning and power, the so-called biogas, is produced in all anaerobic conditions of manure combustion. This is achieved in completely closed concrete pits with the absence of air. CH_4, H2,CO_2, etc. are then produced. Methane has a high value because it is used for combustion and to power machines. 3-6 cubic meters of gas, 60% of which is methane, are produced from 100 kg of fresh manure. Organic matter decomposition amounts to 15-30%, and sludgy manure at pH 7,5, which is easily dispersed by slurry tankers, is generated. The germination of weed seeds is also destroyed in it (ANIWASTE, 2005).

The benefits of constructing closed pits for manure storage are as follows:

- bigger amounts of produced manure;
- manure with higher nitrogen levels;
- biogas production;
- weed seed destruction;
- less manpower and more practical manure spread.

Proper manure preparation and storage represents one of the basic methods of reducing methane emissions.. Manure is chiefly stored in a primitive fashion, on the ground, and is used for the needs of the farm itself. There are a small number of cattle farms, as well as those that have concrete manure sites, lagoons, that showcase good methods of manure storage.

Change in ruminant nutrition, selection and reproduction

Improvement in ruminant nutrition is one of the possible ways of reducing methane emission and it relates to the following:

- reduction in the intake of feed with higher lignin content, such as straw and maize stover, which is chiefly used for bedding or nutrition of low-productive animals. If used for nutrition, they may be chemically and mechanically treated in order to be digested more easily;
- adding certain additives to forage which affect growth and the activities of rumen microorganisms (urea and molasses),
- the modification of the rumen flora in terms of a better cellulose digestion and reduced methane emissions, a method not as yet applied here, though used abroad;
- work on the selection and improvement of animal reproductive capacity, which would reduce the number of animals for reproduction.

4.5.2.2. Projection of nitrogen suboxide emission reduction

The largest N_2O emission is generated from agriculture, directly from soil by the application of mineral and organic fertilizers. In order to estimate the emission of this gas in the post-war period, we need appropriate official data. There are no relevant official data on the total application of mineral fertilizers in BiH, and calculations relative to this issue are currently being made by offices of statistics.

The only available piece of data on the amount of mineral fertilizers in the RS and the FBiH is the one pertaining to the value of mineral fertilizers imports, which is not a relevant and a sufficient indicator of mineral fertilizers consumption (information obtained from direct meetings with the Office of Statistics staff addressing this issue). An estimate of mineral fertilizers application can roughly be made through the need for nutrient elements by certain crops and areas sown to those crops, which would in this case too deviate from the real value, probably up to 30%. The 1990 pre-war datum used to calculate the reference emission values may serve the purpose, but only for rough estimates.

The fact about the reduction in areas sown for crop production for the entire BiH territory by 35-40% as compared to the pre-war period is evident and official, and the use of mineral fertilizers has therefore decreased proportionally in that sense. This is the only piece of data that we can safely interpret here and draw a conclusion based on it. Therefore, the reduction in production has affected the reduction in greenhouse gas emissions, while the reasons for such a situation are not conditioned by an improved environmental awareness, or by new technological solutions, but are the consequences of the war, transition and import of certain agricultural products, and a poor policy in the sector.

According to the IPCC methodology-based calculations made by experts for this communication for the year 1990, the largest percentage of the N_2O emission is generated by emission from soil which is caused by the application of mineral and organic fertilizers. The management of manure before field application accounts for the remaining N_2O emission.

- According to the calculations made using the IPCC methodology, agricultural production accounts for about 90% of the total 1990 N_2O emission in BiH.
- The N_2O value was calculated at 8,95 Gg, of which the emission from soil accounts for 7,67 Gg, and organic fertilizer management accounts for 1.28 Gg.
- Taking into account the fact that the N_2O emission calculation for 1990 was made on the basis of 800,000 ha of arable areas, which is far more than the present values and the application of 685 kg of mineral fertilizer per ha, we can safely conclude that the N_2O emission is significantly lower.
- If we consider the area surface factor alone, the emission specifically for the year 2004 will be reduced by 38% as compared to the reference year 1990 if we disregard the factor of mineral fertilizer quantity per hectare, because there are no official data.
- According to these projections, the N_2O emission from soil is reduced by approximately 2,91 Gg, and it amounts to 4,75. This concerns the nitrogen emission from soil.
- The projection of the N_2O emission from manure is also reduced given the situation pertaining to the livestock numbers, which is reduced by half compared to the reference year.

4.5.2.3. Nitrogen suboxide emission mitigation measures

Proper application of mineral and organic fertilizers

In order to reduce the emission of nitrogen oxides generated by the application of mineral and organic fertilizers, we should first of all pay attention to the needs and quantities of fertilizers applied..Particular attention should be given to the proper calculation of the application of nitrogen fertilizers and possibilities to reduce its losses from soil, which affects the emission of nitrogen oxides.

Mineral fertilizers, particularly nitrogen fertilizers, may endanger the environment if applied unprofessionally, and it is therefore necessary, when fertilizing, to strictly take account of both the properties of soil and plant needs and time and method of application. Some countries apply introducing nitrification inhibitors into mineral fertilizers, which reduce emissions.

Recommending agricultural production without the use of mineral fertilizers, with a proper and sufficient dose of an organic fertilizer, would have positive effects on environment, and would also reduce production costs. However, in order to ensure the production of agricultural products at the present level or further raise it, organic fertilizer production should be significantly larger and safe, which is impossible to achieve in these conditions of livestock production.

Organic production

Organic production is certainly safest from environmental and product quality point of view, and it is therefore necessary to introduce it to certain fields of production and professionally support it. Before using this production, one should examine its economic justifiability and become well acquainted with the principles of production.

The application of organic production principles would ensure larger, or the sole application of organic fertilizers, which would produce somewhat lower yields, but the economic effects would be positive, production costs would be reduced, though sufficient quantities of biogenic elements would have to be provided for stable yields.

Organic production means lower energy consumption, and thereby emissions of nitrogen oxides and carbon dioxide that are lower than the usual, greater accumulation of organic matter in soil, exclusion of protective agents and chemicals from production. According to the IPCC data, organic production consumes about 10-15% less energy than conventional production.

4.6. Forestry

4.6.1. Forestry sector and its characteristics

Forests represent one of the major natural resources in Bosnia and Herzegovina due to their natural and diverse structure as well as their extensive natural regeneration. The main species found in BiH forests are mostly fir, spruce, Scotch and European pine, beech, different varieties of oak, and a less significant number of noble broadleaves along with fruit trees.

The professional development and management of the forestry sector has been dedicated to traditional systems and has recently (especially after a turbulent post-war period where forests have been neglected and misused) faced higher demands in terms of contributing more to the protection and enhancement of all forest functions, ranging from economical viability to social responsibility and environmental and ecological sustainability.

Forests and forest land in BiH encompass an area of approximately 2,709.800 ha (according to data from 1990), which is around 53% of the territory of the country. 2,186.300 ha or 81% is under state ownership, while private ownership consists of 523.500 ha or 19%. Most of these properties are very small in size (around 2ha) and vastly scattered throughout the country, with outstanding issues in ownership due to population migration.

The following table shows forest area structure according to forest categories and by entity.

Forest type	Area in hectares		
	FBiH	RS	Total
High forests with natural regeneration	523832,1	459090,0	982922,1
High degraded forests	13434,5	23225,0	36659,5
Forest cultures	67717,5	60833,0	128550,5
Coppice forests	253297,0	174119,0	427416,0
Areas suitable for reforestation	186141,1	207719,0	393860,1
Areas unsuitable for reforestation and management	116840,7	55739,0	172579,7
Total undisputed forest land	1161244,9	980725,	2141969,9
Mined areas/disputed land acquisition	118659,0	17211,0	135870,0
Total	1279903,8	997936,0	2277839,8

Table 4.6.1.1.: Total forest and forest land area cover in Bosnia and Herzegovina (Source: 38.EFNS, Sarajevo, 2006).

The third administrative unit in BiH is district Brčko, where there are approximately 11,000 ha of forests, of that 8,500 ha being privately owned and merely 2,500 ha within the public management system. According to Constitutional provisions, the ownership of forests lies in authority of FBiH, RS and BD, where ministries of forestry are responsible for administrative management of these areas through the public forest management enterprises. In conformity with data shown above, almost 400,000 ha (186,141 ha for FBiH and 207,719 ha for RS) have been assumed as being bare lands with a productive function and in those terms could be potentially included in reforestation programs.

The customary management system of natural regeneration that has been practiced in BiH throughout the centuries has contributed to realizing significant forest diversity in this sense.

Nevertheless, some preceding studies (mostly based on the satellite surveys within the EU CORINE program) have shown that actual forest cover size might be lower by 10-15% than previously projected.

Due to activities such as illegal logging, ore mining, construction, forest fires and others, forested areas have been shrinking rapidly; furthermore, a significant part of the forest cover has been declared as mined (numbers indicate some 10%) and has evident damages due to war activities. In addition there are extensive unresolved property disputes and illegal land acquisition which await resolution due to complex legal mechanisms and administration.

In the recent years, significant progress has been made in the area of forest certification, where three of the forest management public enterprises have undergone scrutiny of international auditing against the Forest Stewardship Council (FSC) certification, while several others are presently preparing to undergo the same procedure and promote sustainable forest management within their practices. Currently around 50% of state managed forests in BiH have been certified according to FSC Standards.

Forestry legal and institutional framework has been structured through two entities. In FBiH there are cantonal forest management companies, whereas in RS, the forestry management operations are led by a single public enterprise. This decentralization of forest management authority, legal framework (two separate laws on forests) and administration has led to further difficulties in establishing appropriate mechanisms for controlling forest operations, especially illegal logging and land acquisition in bordering areas.

4.6.2. Potentials for mitigation measures

There are several potential areas that could mitigation greenhouse gas emissions in the forestry sector, and thus financing mechanisms for generating emission reductions in the land-based sectors are required.

Prior to that it is important to state that updates of forestry databases are acutely needed, as accurate data for the forestry sector are still not available; and conducting new national inventories is of great significance in order to lay foundations for the best approach to issues related to climate change mitigation.

Some mitigation measures which would surely increase the sink capacity of the forests include practical ways of applying certain silviculture methods (increasing carbon sequestration in tree biomass), as well as enlarging the forest area by reforestation of bare lands, therefore increasing overall annual biomass increment. Some activities that could be integrated into everyday forest management planning include permanent control of forest health conditions and monitoring, increase of thinning activities and planting pioneer wood species on the degraded forest lands. On the other hand, one very important aspect includes increasing fire protection measures, restoring the productive forest cover, increasing protection measures and generally expanding the forest and mountain areas under protection in order to address the threat to biodiversity and to promote ecosystem management (BiH has vast portion of threatened species, yet only less than 1% of its land is currently set aside as protected).

Some main categories of mitigation measures (to be developed in the form of project proposals) are the following:

Maintaining/increasing stand-level carbon density (t carbon per ha) through stand improvement, de-mining forest areas, regular thinning, uneven-aged stand management and overall increase in forest productivity

The forest surface to be included in thinning activities should be increased. Thinning activities in some forest areas are presently not at a high level because of high economical inputs into this activity and low outputs in terms of lack of markets for non-economical wood. Increasing this activity would highly improve thinned wood quality, stability and productivity, enhance biodiversity and would in the long run boost the carbon stocked in the existing forests.

Proper management systems and sanitary practices would also minimize losses of dead organic matter in soil carbon by reducing soil erosion, and by avoiding other high-emission activities.

Degradation of soil and forest lands can be reduced through improved protection of forests, implementation of sustainable forest management policies and practices, or by diversification into other economic returns from non-timber forest products and forest uses not involving harvesting (such as tourism, recreation, berries/mushrooms collection, etc).

De-mining forest areas could be another area with significant potential to increase carbon sinks. Mined areas (presumed size is 10% of forests) currently do not have appropriate silviculture methods applied and are very prone to pest outbreaks, fires and decay, which cause high levels of emissions. This is an important segment where economical incentives are needed.

Maintaining or increasing the forest area through afforestation/reforestation and rehabilitation of bare lands

Data from 1990s show that BiH has an area of 272,052 ha (current unofficial data show this number to be around 400,000 ha) that has been categorized as bare lands with a productive capacity. Beech forests grew on 24% of these lands; forests of fir, spruce and beech grew on 15% of this land; 20% of area was covered by Sessile/Durmast oak and the remaining 41% was grown with other variety oaks (DPRS BiH, 1986). This evidently demonstrates that with certain financial investments and correct identification and research on these areas new forests can be grown with species that have proven growth in particular areas or with different ones which might adapt better to climate changes. Nonetheless, there are also potentials for establishment of plantations, be it in the form of conifer or broadleaved cultures.

In order to mitigate potential climate change effects, significant areas of these bare lands could be included in reforestation programs in order to increase the forest carbon sinks or expand the forest cover.

Increasing carbon sinks through forest conservation, increasing fire protection measures and permanent control of forest health

Outbreaks of pests and diseases pose a potential threat to forest ecosystems in BiH. Acceleration of the impacts of pests and diseases on forest ecosystems has been observed during the last several decades due to increasing anthropogenic pressures, war activities and inappropriate post-war silviculture measures. The population dynamics of potential insect pests are highly dependent on temperature, and pest outbreaks result in considerable economic losses and accumulation of combustible material (dead biomass) in the forest, especially in the conifer forests encompassing fir and spruce. Therefore it is important to enhance the system of reliability and completeness of data on biotic disturbances and improve monitoring, which would ensure appropriate sanitary measures (periodic thinning and removal of infected trees) and general control over areas.

Nevertheless, another important threat to forest ecosystems is caused by forest fires. It is approximated that 3000 ha of forests is ruined by fires annually in BiH. Increased risk of forest fires due to increased temperatures is expected in some parts of BiH, which calls for fire protection capacity to be expanded. Intensifying forest fire prevention activity is important to minimize economic losses, reduce the accidental release of CO_2 into the atmosphere, maintain forest cover on soils, and allow existing CO_2 sinks to remain effective.

Fire risks are known to be increased by the amount of dead biomass left after logging, or bedding in the forests, therefore sanitary practices are to be improved. Fire risks are also going to increase in areas with high population density. Projects should be designed in order to aim at more fire protection measures and awareness raising.

Increasing off-site carbon stocks in wood products and increasing the use of biomass-derived energy to substitute fossil fuels.

Wood is the principal heating fuel for majority of B&H rural households. A study of potentials of using small di¸23dfstrict heating systems should be conducted in order to improve energy efficiency of rural households. Procurement and utilization of forest biomass for energy should be researched in order to provide consistent results on how these technologies could perform in new environments.

There is also a potential for forest industries to supply wood waste, produce wood chips and pellets to nearby industrial and residential customers. Therefore, projects should be designed in a sense to assess the feasibility of heating plants to be fired with wood chips made from locally available logging residues, sawdust and bark from mills, or harvested timber.

Promote forest certification in order to enhance SFM, reduce forest misuse, involve local communities and stakeholders and raise awareness on importance on climate change mitigation

Promoting forest certification in order to enhance sustainable forest management in BiH can be a means of reducing forest misuse and involving local communities and stakeholders. In the long term, it may also be a way of increasing the forest carbon stock generating mitigation benefits through producing an annual yield of timber and maintaining soil and water quality and biodiversity as well as enhancing socio-economic functions of forests. Several forest management companies have recognized the benefits of forest certification through independent third party verification, but quite a number of them need an additional incentive. As forestry represents an important source of climate change mitigation potential, and as it has opportunities to qualify for carbon credits and other financial assistance related to reforestation, forest certification might represent one of advantages in terms of these projects. The proof of sustainable forest management can improve the practices of forest management companies of BiH to appropriately balance economic, social and environmental factors of management in order to meet the needs of today's society without jeopardizing benefits of future generations.

4.6.3. Analysis of potential mitigation measures in forestry in accordance to the scenarios

4.6.3.1. Baseline scenario

Changes in forestry cover in BiH were estimated under the baseline scenario as given in the following table (Table 2). From the data gathered it is clear that the areas under forests have decreased between the periods 1990 and 2005. This was due to the previous war activities, where forests were illegally harvested for fuel wood and other subsistence needs or additional income. This decrease has attributed to land conversion to other activities, but due to an absence of specific data on land-use categories and their change over time, it can be only assumed that these areas have contributed to an increase in degraded lands, especially lands suitable for afforestation (as shown in the table). This also contributes to high uncertainty of information and data. The approach used has embarked upon using COMAP method, but since there is lack of data in the forestry sector (especially since inventory data are not yet completely compiled) in BiH, the analysis has only roughly incorporated its requirements.

Change in Forest Cover: Between 1990 and 2000, Bosnia and Herzegovina lost an average of 2,500 hectares of forest per year (FAO, 2005). In total, between 1990 and 2005, Bosnia and Herzegovina lost 1.1% of its forest cover, or around 25,000 hectares (FAO, 2005). This amount has been applied in ratios to the projection for year 2015 and 2030.

The projected decreases calculated are based on the ratio for the year 1990 to 2005, even though this loss might not be absolutely relevant, due to specific state of affairs the country was under within this period (war). Since the decrease between 1990 and 2005 was 25000 ha, this amount was applied to two next annual factors.

The projected decreases presume loss of forest cover for another 25000 hectares in next fifteen years under the baseline scenario, with high uncertainty of data.

Land use category	1990	2005	2020	2035
Forests	2. 210. 000	2. 185 000	2 160 000	2 135 000
Other wooded land (including land suitable for reforestation)	500 000	549 000	647 000	-

Table 4.6.3.1.1.: Projected land use (forestry) pattern under the Baseline Scenario.

4.6.3.2. Mitigation scenario

The intention of mitigation is to increase the area under forest and to reduce the degraded area or activate the areas which are suitable for reforestation (according to the DPRS BiH data from 1986, these areas encompass 392.259 ha). Afforestation is conducted annually in BiH and funds are in place for it, but it could be enlarged to a great extent based on the forestry inventory data which would be able to give further details on identifying project areas. The private sector should also be engaged in order to encourage afforestation of private properties (private ownership of land suitable for afforestation out of the total encompasses 120,200 ha).The collaboration of the public sector and the private sector could contribute to an increase in the area under forest cover, but specific plans for this should be made taking into consideration the complex administrative procedure for private forest owners.

The recommended annual increases under the mitigation scenario are 11,000 ha per period of five years, the reason being the fact that between years 1981-1985 there was a plan to fulfill establishment of conifer plantations on the area of 11,000 Ha. According to this, the projected area under the mitigation scenario would increase forest cover by 33,000 hectares over the next 15 years and respectively by the same amount until 2035. With carefully planned increase in the forest cover, it is projected that area suitable for afforestation and not currently afforested would decrease.

Land use category	1990	2005	2020	2035
Forests (ha)	2. 210. 991	2. 185 000	2 218 000	2 251 000
Other wooded land (ha)	500 000	549 000	483 000	4 017 000

Table 4.6.3.2.1.: Projected area of forests under the Mitigation Scenario.

If this mitigation scenario would be accepted as a project proposal, its potential would be significant in storing carbon. The technical and economic application of the project would be appropriate as there are lands suitable for afforestation and based on government funds and additional sources the project could be implemented. The technical capacities exist within the forestry sector. An additional benefit of the project would be increase in employment (especially of the rural population) and potential of application of the projects for CDM. By careful assessment and consideration of forestry scientific community and the policy makers this project could be integrated into entity forestry plans.

4.7. Waste Management

4.7.1. Review of Waste Sector

The "BiH Solid Waste Management Strategy" (SWMS) from the year 2000 reviews solid waste management conditions in BiH and defines policy and strategy in this sector. Although SWMS does not directly mention reduction of GHG emissions, defined strategy suggesting construction of the regional sanitary landfills according to EU standards (Landfill Directive 99/31/EC) and outlining possibilities of waste incineration with energy recovery and recycling in long term period, directly involve measures for reduction of GHG emissions. Implementation of SWMS commenced with WB/IDA credit for Project "Solid Waste Management Project" (Ex. Environmental Infrastructure Protection Project) in 2002.

As a result of adopted SWMS, there have been a lot of activities aimed at upgrading waste legislation in BiH. Generally, waste legislation in both entities assigns general waste management principles, among which the "polluter pays" principle and the principle of waste management hierarchy are most relevant from the standpoint of GHG mitigation. Implementation of the principle of waste management hierarchy, as sequences of prior practices in waste management, directly influence on reduction of GHG emissions. In fact, this principle represents a baseline for definition of different options in GHG mitigation respecting SWMS.

The influence of waste management on climate change considering GHG mitigation and taking into account the SWMS for BiH, waste management hierarchy, costs and applicability in specific circumstances have been analyzed through following waste management options:

- Municipal Solid Waste Production Avoiding and Waste Quantities Reduction,
- Reduction of Disposed Biodegradable Municipal Solid Waste,
- Increasing of Separately Collected and Recycled Municipal Solid Waste,
- Increasing of Population covered by Municipal Solid Waste Collection Service,
- Landfill Gas Combustion and Electricity Generation,
- Municipal Solid Waste Incineration with Energy Recovery.

All the aforementioned waste management measures are in compliance with current policy (legislation) and are contained in the SWMS, which envisages their application in three periods: short-term (2001-2005), mid-term (2005-2010) and long-term (2010-2020). However, the quantitative objectives for the said measures are for the most part not stated precisely. For instance, an increase in population covered by waste collection service is projected to be 98% of large municipality areas and up to 70% of small municipality areas by the end of the long-term period, while the size of population to be covered by the waste collection service remains unclear. The projections concerning the end of the mid-term period are 95% of large municipalities, and 60% of small municipalities to be covered by waste collection services. The achieved recycling rate of 10% of household waste by weight by 2020 is also projected, while quantitative data on individual types of material (i.e. waste) are not stated. Also, there is no definition of the recycling objectives for commercial waste, which is in its nature similar to household waste and accounts for 50% of the total municipal waste-municipal solid waste (according to estimated average waste production values for 1999). The SWMS envisages that at least 20% of (the weight of) waste is to be processed in waste energy recovery facilities by 2020. It is envisaged that by 2011 every municipality is to introduce waste recycling initiatives through the collection of material, separated at the source, that can be recycled (mainly paper, biodegradable waste, highly valuable plastic and metal). It is therefore planned for every WAD (Waste Allocation District) to establish a centralized facility for the processing of recyclable material, including composting and a material recovery facility (AEA, 2000).

An analysis of the current situation in this sector has shown that the objectives concerning the construction of regional sanitary landfills defined in the SWSM are unrealistic. The plan is to have 16 regional landfills by December 2009, but until now (March 2009), only two landfills have been constructed (in Sarajevo and Zenica), while project documentation has been produced for a „Ramići"- Banja Luka regional landfill (which is being constructed) and a regional landfill in Bijeljina. The landfills must be constructed in line with the European standards (Landfill Directive). Therefore, the application of the stated measures with certain rescheduling compared to the defined strategy is required in order to define different GHG mitigation scenarios.

Taking into account the aforementioned flaws of the current SWMS, it is necessary to adopt, in the shortest possible time, new waste management strategies at the entity level, which would more clearly define the quantitative objectives in terms of recycling and reduction in biodegradable waste amounts disposed of at landfills, and define realistic dynamics for the construction of regional sanitary landfills.

4.7.2. Emission Reduction Potential (Mitigation potential)

4.7.2.1. Projection of waste quantity

In order to calculate possible reduction of GHG emissions utilising different waste management options it have been necessary to estimate quantity and morphological structure of municipal waste. Since that exact data on the quantity and morphological structure of

	Annual amount of MSW generated in 1999 year (Gg MSW)	Annual amount of MSW generated in 2010 year (Gg MSW)	Annual amount of MSW generated in 2020 year (Gg MSW)	Annual amount of MSW generated in 2030 year (Gg MSW)
MSW in RS	724,269	1002,558	1347,354	1810,731
HHW in RS	362,134	501,278	673,676	905,364
MSW in FBiH	1138,0	1575,258	2117,015	2845,091
HHW in FBiH	569,0	787,629	1058,508	1422,546
Summary MSW	1862,269	2577,812	3469,369	4655,822
Summary HHW	931,134	1288,907	1732,183	2327,911

Table 4.7.2.1.1.: Estimated Annual amounts of municipal solid waste (MSW) and household waste (HHW) generated at entity and country level for 2010, 2020 and 2030 year according to data and methodology presented in the SWMS.

MSW generated on country level as well as on entity level does not exist, the following data have been used for estimation:

- Best available estimations and models proposed in SWMS - for estimation of waste quantity (AEA, 2000)
- Population statistic- for estimation of waste quantity (RS-RZS,2008; FZS, 2008)

Table 1 shows estimated total MSW and HHW amounts, in accordance with the methodology recommended in the SWMS. A linear annual rate of waste production growth is projected at 3%, according to the 1999 data, which includes the growth of population and amounts of produced waste per capita – growth rate of 1,8%.

It was assumed that a total MSW amount generated in the RS in 1999 was 724,269 t (population of 1,448,537 x 0,5 t/a year/per capita), and a total HHW amount was 362,134 t (population of 1,448,537 x 0,25 t/a year/per capita), according to the estimated average values of waste production presented in the SWMS and the available statistics (AEA,2000; RS-RZS, 2008). By analogy, the MSW amount in the FBiH in 1999 was 1,138,000 t (population of 2,276,000 x 0,5 t/a year/per capita), and a total HHW amount was 569,000 t (population of 1448537 x 0,25 t/a year/per capita),(AEA,2000; FZS,2008). The amounts of waste generated in Brčko District were included through the data for RS and FBiH, taking account of the SWMS and the 1999 statistics).

4.7.2.2. GHG mitigation scenarios for the waste sector

The baseline scenario anticipates waste management development and a projection of the situation according to the current documents and plans, which are, as a rule, based on the SWMS. The basis of such waste management is the disposal of waste remaining after the implementation of economically justifiable and environmentally acceptable measures aimed at avoiding the production, separate collection and recycling of waste, at regional sanitary landfills. The reference scenario anticipates the continual growth of municipal waste amounts (Table 1), which will gradually decrease over time due to the effects of the measures aimed at avoiding the production and recycling of waste.

Two regional sanitary landfills for MSW disposal (of the planned 10 – according to the SWMS) are anticipated in FBiH for 2010: "Smiljevac"- Sarajevo and "Mošćanica" - Zenica, where 10% and 8% of the total MSW collected in the FBiH would be disposed of, respectively. For RS, one regional sanitary landfill for MSW disposal (of a planned 6 – according to the SWMS), "Ramići"- Banja Luka, is anticipated, where 16.7% of the total MSW collected in RS would be disposed of. At the sanitary landfill in Sarajevo, the collected landfill gas is used for electricity generation, while at the Zenica landfill a flare system for the combustion of landfill gas has been constructed. The combustion of landfill gas by flare is also envisaged at the future sanitary landfill in Banja Luka. It is envisaged that all 16 regional sanitary landfills will be constructed by the end of 2020.

It is assumed that the envisaged measures aimed at separate collection and waste recycling rate will be implemented at a pace anticipated in the SWMS; i.e., the recycling rate of 10% of the total generated HHW by the end of 2020. It was anticipated that the HHW recycling rate would be 5% for 2010, while for 2030 the HHW recycling rate would be 20% in both BiH entities. Owing to the unclearly defined quantitative objectives with respect to the reduction of biodegradable waste amounts on one hand, and the clearly defined EU requirements with respect to the reduction of biodegradable waste amounts disposed of at landfills on the other, it was assumed that 50% of recycled waste would be biodegradable waste. It was also necessary to assume the rate of coverage by waste collection services as compared to the total population in order to get an estimate of the amounts of waste disposed of at official landfills, which the calculation of the GHG emission reduction potential relates to. Using the SWMS estimates, it was assumed that 80% ((95+60)/2) of the population would be covered by waste collection services in 2010, and the same percentage of generated MWS would be disposed of at landfills, and by analogy, this percentage for 2020 would be 84% ((98+70)/2). For 2030, it was assumed that the entire population would be covered by waste collection services. The remaining waste is assumed to be locally composted in rural areas and disposed of at illegal landfills. All aforementioned assumptions are used in both scenarios.

The current limits of financial and other resources pose a serious obstacle to introducing any other important waste management option, except for the construction of regional sanitary landfills, in the forthcoming period by 2020. Although the SWMS foresees measures for the thermal processing of waste (incineration), that is, the incineration of 20% of MSW with energy recovery by 2020, it is realistic to assume that this will not happen according to this baseline scenario. For that reason, a rescheduling compared to the deadlines set by the SWMS is anticipated, as is the case with the construction of regional sanitary landfills, and incineration of 20% of MSW with energy recovery is anticipated by 2030.

	2010	2020	2030.
MSW collected (Gg)	802,046	1131,777	1810,731
Waste recycled (Gg)[28]	25,064	67,368	181,073
Waste incinerated (Gg)	0,000	0,000	362,146
Net MSW disposed on landfill (Gg)	776,982	1064,410	1267,512

Table 4.7.2.2.1: Impact of waste recycling and incineration initiatives on the amount of municipal waste disposed of at landfills in RS.

[28] It is assumed that 50% of recycled waste is biodegradable waste reduction.

	2010	2020	2030
MSW collected (Gg)	1260,206	1778,293	2845,091
Waste recycled (Gg)[29]	39,381	105,851	284,509
Waste incinerated (Gg)	0,000	0,000	569,018
Net MSW disposed on landfill (Gg)	1220,825	1672,442	1991,564

Table 4.7.2.2.2.: Impact of waste recycling and incineration initiatives on the amount of municipal waste disposed of at sanitary landfills in FBiH.

The mitigation scenario anticipates the introduction of measures for the combustion of methane by flame flare system, as well as measures aimed at using landfill gas (methane) to generate electricity, along with the already defined measures in the baseline scenario. Apart from directly reducing the amounts of methane released by flaring, the measure for using methane to generate electricity also reduces the equivalent amount of CO_2, which would be released by the use of fossil fuels in the course of the generation of the given amount of electricity. Given the defined dynamics of the construction of sanitary landfills in RS and FBiH, a gradual increase is anticipated in the amount of methane combusted by flares and in the generation of electricity in suitable facilities, such as internal combustion engines and gas turbines (Tables 3a and 3b). It was anticipated that an average of 37 kg of methane is consumed for the generation of 55 kWh of electricity (BREF, 2006), and that a reduction of 0.7 t of CO_2 per 1MWh of electricity is achieved owing to avoiding the use of fossil fuels.

Applying the measure of methane combustion by flare results in an emission reduction of 67,83 Gg CO_2-eq in 2010, 88 Gg CO_2-eq in 2020 and 332 Gg CO_2-eq in 2030 in the RS. Applying the measure of using methane to generate electricity results in a total emission reduction of 292,77 Gg CO_2-eq in 2020 and 348,46 Gg CO_2-eq in 2030 in the RS, and while at the same time generating electricity amounting to 19 740 MWh in 2020 and 23 501 MWh in 2030.

	2010	2020	2030
Methane Generation from Net MSW disposed of in landfills (Gg CH4)	35,90	49,18	58,56
Percentage of methane combusted by flame flares system (% CH4)[30]	9	27	27
Emission reduction by combustion by flame flares system (Gg CH4)	3,23	13,28	15,81
Percentage of methane used for electricity generation (% CH4)	0	27	27
Emission reduction utilasing methane for electricity generation (Gg CH4)		13,28	15,81
Avoided emission from fossil fuels due to electricity generation (Gg CO2-eq)		13,82	16,45
Net reduction of emission (Gg CH4)	3,23	26,56	31.62

Table 4.7.2.2.3.: Reduction in methane emission according to the measure concerning methane combustion by flare and the measure of electricity generated from methane, in accordance with the mitigation scenario for the RS.

[29] It is assumed that 50% of recycled waste is biodegradable waste reduction.
[30] This assumes an EU-average landfill gas collection efficiency of 54% (Smith et. al..,2001).

	2010	2020	2030.
Methane Generation from Net MSW disposed of in landfills (Gg CH4)	56.40	77.27	92.01
Percentage of methane combusted by flame flares system (% CH4)	4.32	27	27
Emission reduction by combustion by flame flares system (Gg CH4)	2.43	20.86	24.84
Percentage of methane used for electricity generation (% CH4)	5.4	27	27
Emission reduction utilasing methane for electricity generation (Gg CH4)	3.05	20.86	24.84
Avoided emission from fossil fuels due to electricity generation (Gg CO2e)	3.17	21.71	25.85
Net reduction of emission (Gg CH4)	5.48	41.72	49.68

Table 4.7.2.2.4.: Introduction of measure concerning methane combustion by flare and measures concerning electricity generated from methane in accordance with the mitigation scenario for FBiH.

Applying the measure of methane combustion by flare results in an emission reduction of 51,03 Gg CO_2-eq in 2010, 438,06 Gg CO_2e in 2020 and 521,64 Gg CO_2e in 2030 in FBiH. Applying the measure of using methane to generate electricity results in a total emission reduction of 67,22 Gg CO_2e in 2010, 459,78 Gg CO_2e in 2020 and 547,49 Gg CO_2e in 2030 in FBiH, while at the same time generating electricity amounting to 4534 MWh in 2010, 31008 MWh in 2020, and 36924 MWh in 2030.

The projection of GHG emissions from this sector includes balancing emissions of methane due to decomposition of the MSW disposed of in existing SWDS, since there is no anaerobic treatment of wastewater or treatment plants. This balancing involves different waste management options and consequent net reduction of MSW disposed of in SWDS, and therefore a net reduction in methane emissions. Projections of methane emissions generated by waste management have been based on the default IPCC methodology method 1 (IPCC,1996), which does not consider the progress over time of methane release. Regarding the lack of exact data on the morphological structure of MSW and the quantity of MSW disposed of in different SWDS categories (according to IPCC methodology categorization), as well as lack of national data and factors regarding calculations of methane released from SWDS, default factors have been used.

According to EU15-average costs and total potential reduction of methane options in the waste sector, investment into landfill gas flaring measures is EUR 5/tCO_2e, while investment into electricity generation measure is EUR 31 /tCO_2e (Bates and Haworth, 2001). Taking into account the aforementioned estimated CO_2 reduction potential per year in the entities of RS and FBiH, the cost of appropriate investments may be calculated according to the projected scenarios.

4.8. Summary of Mitigation Measures by Sector

	Activity	Description	GHG emission reduction effects	Finances required for the activity	Comments
ENERGY SECTOR – power production					
1.	Action plan for promotion of RES (Power production)		Indirect effects on GHG emission reduction	400,000 KM	This plan should be focused on the mechanisms of promotion and in direct relation to the Energy strategies which will be realized in shortcoming period
2.	Energy audits for power production and industrial facilities (Power production)	Produce audits and studies for each facility separately to estimate the energy saving potential for each facility.	The fact is that thermal power plants in BH produce about 10,000 GWh/year and at the same time use 700 GWh/year for their own needs. Following the steps recommended by the studies would result in estimated energy savings of cca 100 GWh/year, with corresponding emisson reductions of 103 Gg CO_2/year.	3,000,000 KM	
3.	Energy efficiency monitoring at each facility (Power production)	Establish a body at the public utility or entity level with adequate equipment for measuring electricity consumption.		5,000,000 KM	
4	Reducing methane emissions caused by underground mining by using a mixture of ventilation air and methane in brown coal mines in the central Bosnian basin (Zenica, Kakanj, Breza).	Technology that uses a mixture of ventilation air and methane from coal mines, provided the methane concentration in ventilation air is between 0.2 and 1.2%.	150 Gg CO_2eq/year	13 million KM	
5	Efficiency increase of the existing power plants	Efficiency rate of the existing units is around 30%	80 GgCO_2/year I a case of efficiency increase for 1%	150 million KM	
			240 GgCO_2/year in a case of efficiency increase for 3 %	450 million KM	
6	Use of natural gas in combined cycles for power and heat production		Not possible to estimate at the moment		

	Activity	Description	GHG emission reduction effects	Finances required for the activity	Comments
7	Wind mils	The realistic target utilization rate of this energy source for 2015 400-600 MW.	2600Gg/year	Not possible to estimate	
8	Co/firing biomass and coal	It is feasible to do that with 7% of biomass percentage, without serous reconstructions of furnaces for pulverized combustion	150,000 tCO_2/year for TE Kakanj alone.	Not possible to estimate	
9	Small hydro up to 10 MW	177 MW baseline	560 $GgCO_2$ /year	1.848 million KM	
		900 MW advanced	2520 $GgCO_2$/year	2.700 million KM	
10	Application of the latest techno-logical solutions to achieve a greater utilization degree of primary energy sources (fluidized-bed combustion, supercritical plant parameters) in the construction of new fossil-fuel power plants		Not possible to estimate		
HEAT PRODUCTION					
1	Expansion of the natural gas market by introducing natural gas as a new source of energy	Replacing liquid and solid fuels with natural gas in existing heating plants in all sectors (industry, services, households) or building new gas-fired industrial and energy plants	Not possible to estimate at the moment		
2	Geothermal energy use	For heat production (district heating) or electricity production (binary cycles)	Introducing a geothermal-fired district system in Bijeljina, a project valued at 110 million KM, would help reduce the combustion of approximately 3300 kt of coal per year (only the town heating plant), and therefore reduce the CO_2 emissions by 3.5 $GgCO_2$/year.		
3	Biomass				If we supposed to use 80 % of the technical capacity, we could have the annual energy production of 7.500 GWh.
4	Biogas utilization	Biogas production on cattle rising farms and use for heat and electricity production	Out of the total 20,100,000 m^3 (representing 0.506 PJ), 60 % is 12,060,000 m^3 (0.303 PJ). Taking into account the share of methane in biogas, methane reductions would total 7.236.000 m^3 CH_4 /year	Not possible to estimate	

	Activity	Description	GHG emission reduction effects	Finances required for the activity	Comments
BUILDING SECTOR					
1	New regulation and Implementation	Harmonization with EU standards, i.e. new technical by-law (standards was adopted). Thus energy consumption will be reduce.	Not possible to estimate at the moment		
2	Optimization of the existing buildings envelope	• Insulation of walls • Insulation of roofs and ceilings • Replacement joinery (windows and doors)	Not possible to estimate at the moment		There are no official documents about the status and number of the buildings
3	Transformation of attic and equal roofs because cretion new living space and reduction of energy consumption	• Transformation of attic in living space • Upgrade of equal roofs	Not possible to estimate at the moment		There are no official documents about the status and number of the buildings
4	Overheating building protection	Installation of different sun protection: 1. Blind - indoor or outdoor 2. Eaves	Not possible to estimate at the moment		There are no official documents about the status and number of the buildings
5	Renewal of heating systems	1. Installation of calorimeters and thermostatic valves 2. Partial renewal old systems 3. Complete renewal systems	Not possible to estimate at the moment		There are no official documents about the status and number of such systems
6	Energy renewal of public buildings: partial or complete (easy promotion and realization)	Pilot projects wich begin with public buildings: Municipality, health care, education, culture. . .	Not possible to estimate at the moment		There are no official documents about the status and number of the buildings
7	Promotion of low-energy and passive buildings (house)	Pilot projects to realization low-energy and passive houses, like as sustainable colonies 1. Public buildings 2. Houses	Indirect effects		
8	Promotion RES in building sector	Realization of pilot-projects: 1. Using solar collectors and PV systems 2. Using biomass for district and household heating			
9	Promotion of using household equipment and appliances of class A	1. Using of equipment and appliances class A 2. Using „saving" light (bulb)	Direct effects		There are not official documents or studies, treating this problem
10	Education of users, motivation and promotion	Promotion of saving energy in residential and public sector, like as commercial houses	Indirect effects		

	Activity	Description	GHG emission reduction effects	Finances required for the activity	Comments
DISTICT HEATING (Supply-side measures)					
Federation BiH					
1.	General measures	1. District heating in distant city quarters and expansion of thermal networks 2. Increase in use of existing capacities 3. Analysis of use and optimization of exploitation regime	Not possible to estimate at the moment		Beceuse of specific characteristics of each producer and distributor of thermal energy, and lack of adequate relevant information, it is difficult to precisely determine overall effects of implementing represented measures.
2.	Improvement of thermal networks infrastructure	Pipeline reconstruction • General replacement of old hot-water and warm-water pipeline network in critical areas • Improvement of hot-water and warm-water pipeline by replacing duct-laid pipes with pre-insulated pipes • Reconstruction of insulation of above-ground steampipes, hot-water pipes and warm-water pipes where necessary Transmission, distribution and supply system • Measures to decrease water loss • Increasing capacities of circulation pumps and general measures to modernize the system • Installation of appropriate regulating valves and introduction of frequency regulation of pumps • Introduction of pipeline network balancing • Reconstruction of direct substations • Introduction of compact substations	Not possible to estimate at the moment		Beceuse of specific characteristics of each producer and distributor of thermal energy, and lack of adequate relevant information, it is difficult to precisely determine overall effects of implementing represented measures.
3.	Facilities and regulation	Control and regulation • Control and management systems for district heating • Temparature regulation • Management of regulation and metering, remote control Reconstruction of facilities • Rehabilitation and construction of boiler rooms • Changes on heat exchanges • Installation of condensing boiler rooms at separate thermal networks • Introduction of cogeneration	Not possible to estimate at the moment		Beceuse of specific characteristics of each producer and distributor of thermal energy, and lack of adequate relevant information, it is difficult to precisely determine overall effects of implementing represented measures.
Republic of Srpska					
1.	General measures	• District heating in distant city quarters and expansion of thermal networks • Increase in use of existing capacities • Analysis of use and optimization of exploitation regime	Not possible to estimate at the moment		Beceuse of specific characteristics of each producer and distributor of thermal energy, and lack of adequate relevant information, it is difficult to precisely determine overall effects of implementing represented measures.

	Activity	Description	GHG emission reduction effects	Finances required for the activity	Comments
2.	Improvement of thermal networks infrastructure	Pipeline reconstruction • General replacement of old hot-water and warm-water pipeline network in critical areas • Improvement of hot-water and warm-water pipeline by replacing duct-laid pipes with pre-insulated pipes • Reconstruction of insulation of above-ground steampipes, hot-water pipes and warm-water pipes where necessary Transmission, distribution and supply system • Measures to decrease water loss • Increasing capacities of circulation pumps and general measures to modernize the system • Instalment of appropriate regulating valves and introduction of frequency regulation of pumps • Introduction of pipeline network balancing • Reconstruction of direct substations • Introduction of compact substations	Not possible to estimate at the moment		Beceuse of specific characteristics of each producer and distributor of thermal energy, and lack of adequate relevant information, it is difficult to precisely determine overall effects of implementing represented measures.
3.	Facilities and regulation	• Control and regulation • Control and management systems for district heating • Temparature regulation • Management of regulation and metering, remote control • Reconstruction of facilities • Rehabilitation and construction of boiler rooms • Changes on heat exchanges • Installation of condensing boiler rooms at separate thermal networks • Introduction of cogeneration	Not possible to estimate at the moment		Beceuse of specific characteristics of each producer and distributor of thermal energy, and lack of adequate relevant information, it is difficult to precisely determine overall effects of implementing represented measures.
WASTE SECTOR					
Federation BiH					
	Installing flame flares system on regional landfills	2010	2020	2030	EUR 5 /tCO_2e
		51.03 $GgCO_2eq.$	438.06 $GgCO_2eq.$	521.64 $GgCO_2eq.$	
	Electricity generation from methane	67.22 $GgCO_2eq$	459.78 $GgCO_2eq.$	547.49 $GgCO_2eq.$	EUR 31 /tCO_2e
Republic of Srpska					
1	Installing flame flares system on regional landfills	2010	2020	2030	EUR 5 /tCO_2e
		67.83 $GgCO_2eq.$	278.88 $GgCO_2eq.$	332 $GgCO_2eq.$	
2	Electricity generation from methane	.	292,77 $GgCO_2eq.$	348,46 $GgCO_2eq.$	EUR 31 /tCO_2e

WASTE SECTOR					
Federation BiH					
1	Installation of a flare gas capture system at regional landfills	2010	2020	2030	EUR 5 /tCO_2e
		51.03 $GgCO_2eq$.	438.06 $GgCO_2eq$.	521.64 $GgCO_2eq$.	
2	Electricity generation from methane	67.22 $GgCO_2eq$	459.78 $GgCO_2eq$.	547.49 $GgCO_2eq$.	EUR 31 /tCO_2e
Republic of Srpska					
1	Installation of a flare gas capture system at regional landfills	2010	2020	2030	EUR 5 /tCO_2e
		67.83 $GgCO_2eq$.	278.88 $GgCO_2eq$.	332 $GgCO_2eq$.	
2	Electricity generation from methane	.	292.77 $GgCO_2eq$.	348.46 $GgCO_2eq$.	EUR 31 /tCO_2e

	Activity	Description	GHG emission reduction effects	Finances required for the activity	Comments
INDUSTRY					
1	Co-incineration of municipal waste in rotary cement kilns	If 20% of coal is replaced with municipal waste as an energy source, the reduction of CO_2 emission will equal the sum of the difference in the amount of the coal replaced with the waste and the amount of the methane (CH_4) avoided that would have emerged over years of dumping waste.	If project implementation starts in 2011, reductions in emissions will total to 27,519.07 tonnes of CO_2e in 2012	3,000,000 KM investment in a waste collection and feed facility in 2011	
2	Biogas production from the organic waste or waste waters (sludge)		Not possible to estimate	Not possible to estimate	
3	Incineration or gasification of leather and food industry waste	Heat and electricity production	Not possible to estimate	Not possible to estimate	
TRANSPORTATION					
1	Road transport - building of corridor Vc motorway towards the Corridor X motorway and other main and regional roads	renewed transport infrastructure, which would lead to lower fuel consumption, faster flow of vehicles, goods, and passengers, and the increase in the general economic development by about 6% a year.	Not possible to estimate	Not possible to estimate	
2	Road transport - Measures need to be introduced for passenger motor vehicles when conducting regular vehicle inspections	5% of motor vehicles would be removed from the roads annually, which would result in considerable renewal of the passenger vehicle pool in the next 20 years.	30% reduction in greenhouse gas emissions from current levels. By adequately regulating the fuel combustion process in only 15% of motor vehicles a year (700,000 tonnes x 15% x 20 years), it is possible to save about 2,100,000 tonnes of fuel by 2030.	Not possible to estimate at the moment	

	Activity	Description	GHG emission reduction effects	Finances required for the activity	Comments
3	Investments in the railway infrastructure and supra-structure.	Passenger transport in both entities will increase by about 12% a year; i.e. by 2030 it will grow from the present 53 million to 180 million passenger kilometers. In turn, goods transport would rise from 1.7% to about 7% a year and in 2030 it would amount to about 1,663 million t/km.	Not possible to estimate	800 million KM	
AGRICULTURE					
1	Reduction of methane emissions by introducing a new livestock breeding and feeding practice	Manure storage preparation and application, and changes in ruminant nutrition, selection and reproduction.	Not possible to estimate indirect effects		
2	Proper application of mineral fertilizers		The emission specifically for the year 2004 will be reduced by 38% as compared to the reference year 1990 if the factor of mineral fertilizer quantity per hectare is disregarded due to lack of official data.		
3	Use of organic fertilizers	N_2O value was calculated at 8,95 Gg, of which the emission from soil accounts for 7,67 Gg, and organic fertilizer management accounts for 1.28 Gg.	Not possible to estimate		
FORESTRY					
1.	Maintaining or increasing the forest area through afforestation/reforestation and rehabilitation of bare lands	Recommended annual increases in forest cover under the mitigation scenario are 11,000 ha per period of five years	Rough estimate of 10Gg annual sequestration	4.5 million KM per year (This is a rough estimate -- detailed calculations based on several factors need to be conducted)	
2.	Maintaining/increasing stand-level carbon density (t carbon per ha) through stand improvement, de-mining forest areas	Mined areas (presumed size is 10% of forests) currently do not have appropriate silviculture methods applied and are very prone to pest outbreaks, fires and decay, which cause high levels of emissions.	NA	Finances should be calculated in co-operation with the Mine Action Centre (or relevant authority responsible for de-mining)	
3.	Increasing carbon sinks through forest conservation, increasing fire protection measures and permanent control of forest health	Projects should be designed in order to aim at more fire protection measures and awareness raising, as well as to enhance the system of reliability and completeness of data on biotic disturbances and improve monitoring, and general control over areas.	NA	Financial aspects should be estimated after assessment of the capacities of the forest management enterprises in these segments and subsequent to review of the existing research	

	Activity	Description	GHG emission reduction effects	Finances required for the activity	Comments
4.	Increasing off-site carbon stocks in wood products and increasing the use of biomass-derived energy to substitute fossil fuels.	Projects aimed at assessing the feasibility of heating plants to be fired with wood chips made from locally available logging residues, sawdust and bark from mills, or harvested timber	NA	NA	
5.	Enhance sustainable forest management, reduce forest misuse through involvement of local communities and stakeholders and raising awareness on importance of climate change mitigation through forestry	Development of projects related to raising awareness on the significance of forestry and climate change	NA	NA	

5. OTHER RELEVANT ACTIVITIES

This chapter provides an overview of technology transfer needs in BiH for climate change mitigation and adaptation. It then analyzes the situation in the area of research, monitoring and forecasting of the climate and systematic observations and describes a plan for improvement in the area of meteorological and water-power system of observation within the Global Climate Observing System and analytical and forecast system within the World Meteorological Monitoring and World Climate Program. A conformity assessment of national programs and appropriate international standards is provided in terms of programs and methods of the World Meteorological Organization and in accordance with international standards. This chapter also discusses gaps, needs, and priorities in the area of education and awareness raising, including proposed activities to implement Article 6 of the Convention on Education, Training and Raising Public Awareness. Finally, the chapter summarizes information sharing activities and the proposed establishment of a climate change website.

5.1. Assessment of technological needs for mitigation and adaptation

5.1.1. Approach within the UNFCCC

For economic in transition countries, the most important projects are related to adaptation in terms of vulnerability, even though they may have very little capacity to identify needs and prepare specific

Country Size (Population)	Number of Projects	Average Project Size ($ktCO_2e/yr$)	Technology Transfer Claims as Percent of	
			Number of Projects	Annual Emmision Reductions
Population less than 1 milion	8	336	38%	4%
Population 1 million to 5 million	38	74	58%	73%
Population 5 million to 10 million	62	76	61%	65%
Population 10 million to 25 million	155	124	59%	68%
Population 25 million to 50 million	116	275	51%	72%
Population 50 million to 100 million	261	78	87%	85%
Population 100 million to 250 million	266	135	36%	60%
Population 250 million to 1 billion				
Population over 1 billion	1387	186	25%	62%
Total	2293	164	39%	64%

Table 5.1.1.1.: Number of technology transfer projects by country size (Analysis of TT in CDM, 2007).

projects. The realization of projects reducing global emissions of GHG is not, from the point of view of climate change, significant for non-Annex 1 countries, but if those projects are in the line of sustainable development of the state, they then bring knowledge, equipment, employment. These are projects that are partly or completely in line with sustainable development or are completely financed from international sources, such as the Clean Development Mechanism (CDM). Table. 5.1.1.1. gives an overview of number of technology transfer (TT) projects by the population of the host countries (Analysis of TT in CDM, 2007). According to this, BiH could expect around 39 projects given its population of 3.7 million. Of course, the Convention mechanisms are not the only means of technology transfer; they are only the initial ones.

5.1.2. Assessment of technological needs for mitigation and adaptation

Countries in Southeastern Europe belong to a category of the European countries that are significantly threatened by climate change and that have few resources for addressing the accompanying problems and – with a few exceptions – relatively under-developed in terms of international cooperation in this area. Dealing with climate change is not a problem of the ministries in charge of environment only, but of the whole government and of society as a whole. Each socioeconomic development plan is based on natural conditions, and new plans must be based on changing natural conditions – it is necessary to adapt to a new target, and a moving one at that. The problem is very serious. Climate change risks in Southeastern Europe are greater than average, whereas management capacity (within the European framework) is below average. Actually, even in the event that these countries will be well organized in their efforts to address climate change, there will still be impacts that are unavoidable.

Taking into account that non-Annex 1 countries are not the main cause of climate change, but they suffer the greatest consequences, it is very important that they analyze development scenarios and define their policies on sustainable development in accordance with adaptation and mitigation measures. Analysis of the SRES development scenarios shows clearly that each scenario gives the opportunity for developing states to catch up with developed states in terms of development. Those chances depend on the development strategy of individual countries and fitting, or not fitting, those strategies into global development scenarios. The question then arises: how can BiH create its own development scenario in circumstances of globalization? Can BiH have a scenario according to which it will increase usage of coal if the world develops with decrease of share of coal in primary energy? Alternatively, will BiH have to adapt to a global development scenario that it cannot influence?

5.1.2.1. The state of technology transfer in BiH

Countries, particularly those with economies in transition, need new technologies not only for adaptation to climate change, but also for sustainable development in general. It is particularly good if those technologies fulfill both tasks. Technology transfer is a complex process and, most frequently, there is an insufficient level of capacity for this transfer in developing countries. The result is more expensive technology (the supplier internalizes the cost of their increased risk, or in the best case the time for negotiations is greater), but also the reduced efficiency of technology (due to insufficient knowledge of employees handling the technology, poorer organization of work, lower quality and the price of the product).

Bosnia and Herzegovina, as a country undergoing economic transition and reconstruction, has mostly completed the process of ownership transformation as well as organizational restructuring under existing company ownership. Technology transfer has occurred in only in a limited number of cases: those where big companies have majority owners that are large multinationals. These instances were supported by measures designed to decrease environmental impact. No special steps have been made in either energy efficiency or in renewable energy. BiH companies need technology transfer. Implementation of mitigation measures is a really good opportunity for this process. This is a chance that, with international expertise and financial assistance, technology transfer begins.

There are many forms of technology transfer – from visits to an international fair to transfer of know-how as a whole, including training of employees and later joint work on further development. A simple method of understanding purposes is given in Fig. 5.1.2.1.1. The first level is related to capabilities of the state: capacity building, identification of needs by sector, collection of information on technologies, and, finally, foreign assistance to build country capacities.

At the second level, the state must have development work programs with identified needs for technologies, a business environment that accepts technologies, developed transfer mechanisms, and a system of domestic incentives for investors.

Most frequently, the performance of technologies do not need to be proven: they are known and verified. Problems instead include many barriers from ignorance and distrust to inadequate legal regulations. That is why it is necessary – at the third level – to demonstrate technologies, with all their technical, economic, ecological, market, legal and social aspects, in BiH. This is particularly when technologies require a new model of behavior (for example, usage of heat pumps – everyone knows the principle of how they work, but without a proper demonstration, their use in BiH cannot be expected). After beginning implementation

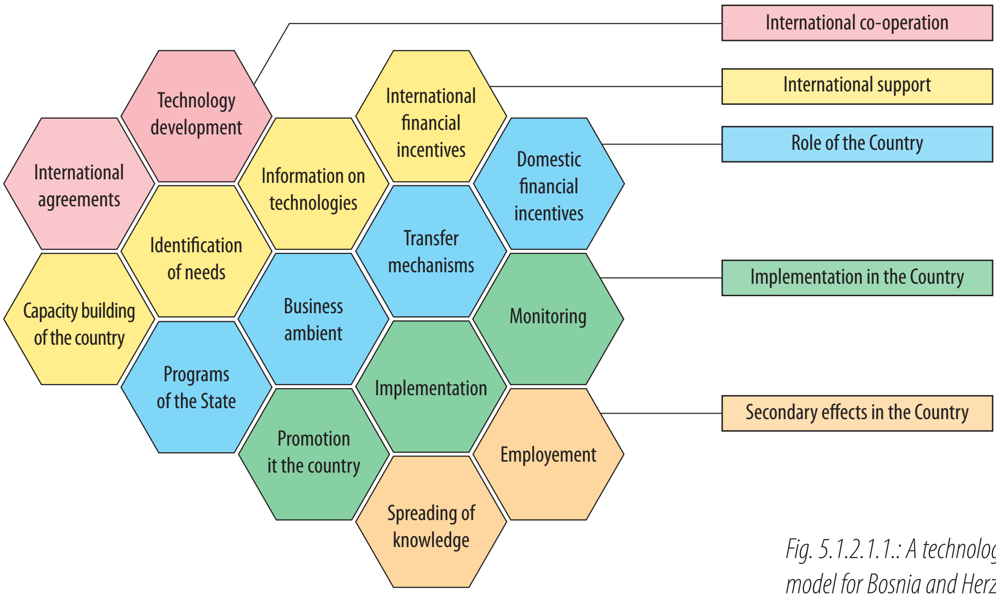


Fig. 5.1.2.1.1.: A technology transfer model for Bosnia and Herzegovina.

Sector	Measures
Energy	Establishment of incentives for the use of renewable energy sources: • Development of incentives for the production and use of renewable sources of energy (voluntary mechanisms); • Establishment of a Designated National Authority (DNA) and system of usage of CDM flexible mechanism of foreign support for implementation of projects in FBiH; • Development of incentives for the production and use of renewable sources of energy with international support (via the CDM and through DNA); • Give incentives for the introduction of renewable energy sources with the aim of decreasing dependency on imported fuel and energy; • Introduce an energy supply strategy for FBiH and work on its implementation.
Transport	Decrease in air pollution due to urban transport: • Development of mechanisms for introduction of environmental fees for releasing of gases from motor vehicles (paid together with registering of vehicles); • Provision of incentives for reducing the use of leaded motor fuels until they are completely banned from use; • Promotion of the sale of more energy-efficient new vehicles; • Promotion of public transport, including railway transport; • Development and refinement of policies for determining pay tolls.
Economy	Decrease in energy intensity: • Establishment of an energy efficiency work program for the economy and citizens in cooperation with the Federal and cantonal chambers of commerce; • Establishment of energy advice centers; • Establishment of a system for statistical monitoring of parameters, which define energy intensity as per industrial branches; • Introduction of a system for labeling the energy efficiency of technical products; • Popularization of Energy Service Companies (ESCOs); • Introduce a system of stimulating/giving incentives to increase energy efficiency in households and the economy, as well as stimulating replacement of imported fossil fuels by domestic fuels from renewable sources (carrot and stick system); • Introduction of an energy management institute for budget institutions (at all levels); • Introduction of a system of energy audits in the economy (voluntary mechanism); • Introduction of an environmental management system in certain industrial branches (EMAS I);
Civil Engineering	Introduction of regulations for energy efficiency in building construction, as well as a system to promote energy efficiency in buildings.

Table 5.1.2.1.1.: Possible technology transfer measures by sector
(Source: Environmental Protection Strategy, FBiH, draft, 2007)

of a technology, it is very important to establish monitoring to follow results and particularly difficulties, as well as to remove any difficulties from new projects.

Bosnia and Herzegovina does not have a well-developed infrastructure for needs identification, collection of information on available technologies, special incentive systems. When it comes to state-level institutions, certain tasks can be done by the Foreign Investment Promotion Agency (FIPA). There are no incentives for importing technologies to BiH. The only potential incentive mechanism is to use the legal designation of foreign investments as equity investments, which are then exempt from payment of customs duties and VAT; i.e., technology (knowledge and equipment) could be exempt from the payment of customs duties and taxes if it were classified as foreign investment equity.[31] Limitations due to lack of incentives should be taken into account when creating technology transfer models.

Technology needs identified in the preparation of the FBiH Environmental Protection Strategy is listed in Table 5.1.2.1.1.).

5.1.2.2. Technology transfer in the BiH forestry sector[32]

Mitigation of climate change and adaptation to potential changes could be encompassed by technology transfer within the forestry sector of BiH. Selection of appropriate technology transfer strategies could create multiple socio-economic and environmental benefits in the long run and accentuate sustainable development in BiH. Taking into consideration the limitations in existing financial and institutional mechanisms regarding the technology transfer in the forestry sector of BiH, there is a need for new policies, mechanisms, and their institutional implementation. In terms of climate change and forestry, there are a wide variety of existing measures available, such as improvement in silviculture practices (and of sustainable management practices more generally), promotion of genetically superior planting material, enhancement of protected area management systems, substitution of fossil fuels with bio-energy, efficient processing and use of forest products, and monitoring of vegetation status, particularly under reforestation practices of bare lands.

Mitigation technologies in forestry are minimal and mainly aimed at biodiversity aspects. They will need to encompass specific features of the forestry practice itself, such as the rotation periods, susceptibility to natural calamity, differences in characteristics of the geographic setting and climatic conditions.

[31] Information obtained at FIPA on February 9, 2009.

[32] Source: South East European climate change framework, Action plan for adaptation, RCC, Sarajevo, November 2008.

In BiH, most technology transfer in the forestry sector is undertaken by the state forestry departments, cantonal/entity forest management enterprises, and non-governmental organizations, and this activity is primarily related to conservation and the use of non-wood forest products. These aspects are further emphasized by the companies in BiH that are committed to Forest Stewardship Council certification principles and criteria, which regularly monitor these activities and aim to increase the areas under compliance.

The concept of the CDM as a technology transfer mechanism should be considered more expansively within the forestry sector in BiH. Currently, there is insufficient information on this process within the sector and the potential benefits it might bring, while there are limited technical capacities which are exacerbated by the lack of a Designated National Authority and a lack of methods for monitoring. Progress on these issues could be stimulated by additional funding, legal instruments and overall awareness-raising tactics.

Due to the current lack of policies, capacities and institutional structures related to forestry and climate change, the state forestry administration and its related structures are unable to undertake mitigation projects and related activities. Apart from the current decentralization of forest management companies, a step that will complicate data monitoring and evaluation, there are several issues which need to be addressed such as property rights, which coincide with the fragmentation of the private forest holdings and their scattered location, which in the bigger picture causes negative effects on the monitoring and verification processes that are needed to address appropriate responses to climate change effects.

Bosnia and Herzegovina could engage (with appropriate foundation elements of institutional structures, human capacities and financial means) in the technology transfer within the forestry sector on its own initiative or with collaboration with an Annex-I country. BiH institutions should first concentrate on ensuring a higher level of forest conservation and enlarging protected areas, as well as promoting research and raising awareness on several issues related to deforestation and forest health and introducing more incentives for the adoption of sustainable forest management practices by forest management companies and their logging cooperatives, even though some of them are already complying with international standards based on their own initiative. Annex I countries could assist in these activities, especially in activities related to technology transfer and funding for privately-owned wood-processing companies as well as the establishment of industrial plantations and the transfer of experiences with monitoring and verification programs.

Previous sections of this communication have pointed out how climate change may affect forests and certain species and their habitats. This threat calls for a specialized institution to be established in order to carefully assess these impacts and create strategies for adaptation in the field of forest ecosystems and parties dependent on them.

Currently, governmental structures in BiH lack an adequate approach to incentives and institutional mechanisms to perceive forests as carbon sinks and manage them in that manner. Technology transfer is not supported by environmental policies, especially in terms of the private sector. Capacity building should include the establishment of new institutions (such as the Designated National Authority, or DNA, for CDM projects) and strengthen all institutions that can facilitate the adoption of mechanisms in regards to technology transfer, increase private sector participation, include and promote forestry mitigation projects, and ensure their funding. Additionally, the establishment of national or entity-based sectoral action plans from the perspective of adaptation and the establishment of training to assist capacity development of administrative officials in charge of those issues would improve the operating techniques of these institutions.

5.1.2.3. Technology Transfer in the Energy Sector

One of the great problems in BiH is a lack of appropriate legal norms that would regulate issues related to energy efficiency and renewable energy resources. For example, while heat consumption in the next 50 to 100 years depends on construction quality, current building codes in Bosnia and Herzegovina were developed in the former Yugoslavia in 1987, and they require only a relatively low level of insulation in buildings. Bosnia and Herzegovina is one of the countries that is in the process of coming closer to the European Union, and in accordance with this, it should implement appropriate directives into its legislation.

In analyzing the current situation for BiH and its entities, the following general measures for increasing the use of renewable energy sources and energy efficiency in buildings (Granić et al, 2008b) were identified:

- Establishing the legal framework that is to the greatest extent possible harmonized with the relevant EU directives in the area of renewable energy sources and energy efficiency;
- Strengthening the institutional framework – establishing a department for renewable energy sources and energy efficiency at relevant ministries, electricity supply companies and other organizations; establishing of energy efficiency and renewable energy agencies at the entity and regional levels;
- Establishing financial mechanisms for financing energy efficiency projects and renewable energy sources through the entity-level Funds for Environmental Protection;
- Initiation of information, education, and outreach activities in the area of energy efficiency and renewable energy;
- Giving incentives for education and training for energy auditors for the buildings sector;
- Implementation of energy audits with recommendations for increasing energy efficiency in family houses, residential and non-residential buildings for public use;
- Implementation of detailed feasibility studies as per individual areas:
  - Improvement of heat insulation of buildings,
  - Improvement of heating, ventilation and acclimatization systems as well as remote heating system,
  - Usage of solar energy,
  - Usage of biomass,
  - Usage of geothermal potential,
  - Usage of cogeneration.

Considering the current state of the economy, which has been greatly affected by the war, BiH needs financial and expert assistance for more intensive implementation of energy efficiency and renewable energy measures. Expert assistance does not only imply the transfer of appropriate technologies (for example, the introduction of domestic production of solar systems, low temperature boilers, etc.) but also usage of experience and knowledge, which have advanced to a great extent in implementation of the aforementioned measures.

5.1.3. The Clean Development Mechanism as a Source of Support for Technology Transfer

Usage of renewable energy sources and implementation of energy efficiency measures will lead to increased energy independence and improvements in environmental quality, but also to increased competitiveness of the economy in BiH. With a well-designed program, these measures will result in the development of the economy that builds on the tradition in BiH of producing equipment for thermo-technical systems. In the last few years, several companies in BiH have aimed their activities at the area of production of equipment and systems for the use of renewable energy.

Within the incentive mechanisms of the UNFCCC, regardless of the fact that the state has still not established a DNA Office, preparation activities for CDM projects are underway. Their structure is given in Table 5.1.3. There are at least three projects being developed, as well as three more projects that have been announced. Projects are related to N_2O (coke industry), CH_4 (mines), SF_6 (thermo-electric power plant) and CO_2 (small hydropower plants).

5.2. Overview of national plans and programs for systematic observing and improvement of climate research and forecast capacities

5.2.1. Overview of national plans and programs for systematic monitoring and improvement of climate research and climate forecast capacities

One of significant assumptions in successfully fighting against climate change is the need to strengthen capacities, which imply institutional and personal training and skills development, as well as the improvement of meteorological monitoring.

In Republic of Srpska, there are currently 26 meteorological stations, out of which two are Class 1 weather stations (Banja Luka and Bijeljina). The proposal for weather monitoring in RS on the basis of the "Republic Strategy of Air Protection with Management Action Plan" is as follows:

- Modernization of the existing or opening of new Class 1 weather stations for the following locations: Banja Luka, Kozarska Dubica, Doboj, Bijeljina, Sokolac, Čemerno and Trebinje;
- Installation and opening of climate stations in the following locatins: Banja Luka (at the university campus), Laktaši, on Manjača, Tijesno (Karanovac), Čelinac, Brod, Derventa, Modriča, Prnjavor, Vlasenica, Javor (mountain), Tjentište, Nevesinje, Ljubinje, Jahorina and Kneževo.

In FBiH, there are currently 13 professional weather stations, out of which Bjelašnica, Mostar and Sarajevo-Bjelave are Class 1 stations. It is necessary to continue with further modernization and improvement of work, as well as opening of new stations, first in Goražde, Travnik, Ljubuški and Široki Brijeg, as well as expansion of network of climate and precipitation stations.

It is also necessary to establish a professional weather station in Brčko District.

By implementing the aforementioned activities, in addition to weather monitoring, the climate base would be significantly improved; that is, many lines of data would be extended that exist from before 1992. We should only mentioned that until 1992, on the territory of BiH there were around 120 climate and more than 500 precipitation stations. It should be particularly pointed out here that there is a need to further modernize the network by the introduction of Automatic Weather Stations and their connection into a system of automatic monitoring together with hydrological stations, particularly with the purpose of automatic monitoring and software control of the situation at river basins, as well as for planning water consumption for the needs of electricity supply, water supply, agriculture, other activities, and the population.

5.3. Education, training and awareness rising

Global warming is one of the most serious environmental problems. That is why, from a long-term point of view, one of the most important activities of each party to the UNFCCC is developing of a national system for the promotion and development of education, awareness-raising, and training on climate change. This is not only a commitment created by each of the states within the UNFCCC; this system will allow each state to participate in their own planned activities in a more professional and active way.

By the adoption of entity Laws on Environmental Protection (2002/2003), BiH created conditions in which it could begin organized activities in the area of education and awareness-raising, which were to have been gradually implemented through institutional strengthening, inter-sectoral cooperation, and a supportive regulatory framework. On the whole, it may be concluded that until now all these activities have not been well organized, and that the results have been modest. Unfortunately, it seems that people in Bosnia and Herzegovina are not very concerned about the consequences of global climate change. Precisely for that reason, better environmental education, particularly awareness-raising may help in the realization of long-term national strategy and climate change policy. It is very important to organize coordinated and cooperative implementation between different stakeholders, especially between state institutions and NGOs.

5.3.1. Gaps in education

The education system in Bosnia and Herzegovina, namely in both entities, has not paid special attention to the environment and especially not to climate change, even though this issue is clearly marked in the Constitution. One of the biggest gaps is the lack of a national strategy for environmental education in BiH. Without this strategy, it has not been possible to specify and integrate climate change issues into curriculum at all education levels. In all segments of education, starting from preschool education to postgraduate studies, segments of wide areas related to the environment and its protection are studied in a fragmented way. The field of environment, its protection and sustainable development is studied at faculties within undergraduate and postgraduate study programs only at some Faculties of Technology and lately at Faculties of Economics within the Environmental Management.

Awareness of causes and potential consequences of climate change in BiH is low. There are several causes, such as the late inclusion of BiH into the activities of the UNFCCC (2000). This fact, combined with the consequences of the war, the complex state structure, the slow and complicated economic restructuring, low living standards, etc., explains to a certain extent why activities in the area of climate change awareness-raising have been implemented sporadically and not systematically. Awareness-raising has been undertaken only by relevant entity-level environment ministries, individual public debates, some unprofessional information disseminated in the media, and the occasional activities of NGOs.

5.3.2. Needs in education

In the current educational system the curricula does not include climate change elements. It is, therefore, necessary to develop programmes that will integrate environmental elements, including climate change into the curricula of primary, secondary and vocational schools as well as universities, in particular technical, bio-technical, economic, law and science faculties.

New curricula should be developed under the supervision of the Agency for Education, whereas the actual preparation should be given to schools with engagement of professionals from the field of economics. Observing the specific, formal, 'top down' approach to education would require the adoption of a national strategy on climate change education at all levels of education by the highest level of the state; that is, the Council of Ministers, competent ministries, institutions and agencies. A professional meeting would proceed this, where experience and best practices would be exchanged. The main actors here would be the Agency for Preschool, Primary and Secondary Education, and the Agency for the Development of Higher Education, which are responsible for curricula and standards. After specialized training of the management of the agencies, the next step would be the preparation of curricula for educators. These activities were endorsed by the statement of Deputy Minister of Foreign Trade and Economic Relations at a Conference on Climate Change Challenges held in Sarajevo in June 2008. Standards should be updated on the initiatives of employers, schools and all social partners. The process of updating and introducing new standards, plans and programs should be completed as quickly as possible.

Chapter 36 of Agenda 21, "Promoting Education, Public Awareness and Training" (UNESCO, 1992), emphasized that education is critical for promoting sustainable development and improving the capacity of people to address environmental and developmental issues. Since then, sustainable development has been a common concern in all UN conferences, and there has been a common consensus that education is a driving force for the change needed. It has also been pointed out that peace, health and democracy are mutually reinforcing prerequisites for sustainable development. The 2002 Johannesburg Summit broadened the vision of sustainable development and re-affirmed the educational objectives of the Millennium Development Goals. The UN General Assembly adopted the resolution to put in place a Decade of Education for Sustainable Development on December 2002. The United Nations Educational, Scientific and Cultural Organization (UNESCO) was designated the lead agency for the promotion of the Decade. The United Nations Decade of Education for Sustainable Development, or DESD (2005–2014) was officially launched during 2005 as part of a global effort to raise awareness and to inspire actions resulting in sustainable development (M. Biasutti, 2007).

The DESD provides several opportunities to enhance progress in the efforts to make sustainable development a focus of education around the world. It encourages educators, practitioners, and policy makers to form partnerships and to work together for a global imperative. The Decade could be considered as an opportunity to form collaborative links within an international movement, and to organise around a common set of principles and priorities. It could be interpreted also a vehicle for increasing public awareness of sustainable development within their local or regional contexts. The Decade invites celebration of our achievements to date, and calls on us to look forward, to have a vision of what we hope to achieve, and to create a strategy for achieving this vision. The DESD has a special role to play in showing how various processes of education can be used on a global level to help improve the global situation. The call to civil society is especially important. While governments and international agencies can make top-level policy changes, pass new laws, and re-structure institutions, new social programs are ultimately effective only to the degree that real changes take place at the grassroots level. Put another way, social action inevitably begins with individual citizens. And citizen action, focused through civil society organizations, has proven in many cases to be the best way to achieve lasting change (M. Biasutti, 2007).

For application of knowledge in development, the Education for Sustainable Development initiative is of great importance. Countries in Southeastern Europe allocate only modest funds per capita for development and implementation of knowledge, and because of their relatively small populations, they also have low funds in the absolute amount. The truth is, there are also international programs (the EU Framework Programme 7, for example) that provide for the inclusion of scientific potential from SEE countries, but these research programs support the development of scientific potential (which is significant) rather than applied knowledge for addressing acute development problems. This is why the establishment of certain forms of scientific cooperation in the development and implementation of sustainable development are proposed. These measures are crucial for forming the nucleus of future professional personnel in administration and economy and they also contribute to creating an environmentally aware civil society. The measures must be implemented in the long-term period, and it is only after two generations of students that they may be expected to yield visible results.

5.3.3. Needs in professional education and training

The concept of environmental protection and management as an administrative task is comparatively recent in BiH. There is, therefore, a need for strengthening the capacities of existing personnel in the environmental sector at all administrative levels. For that purpose, it is necessary to develop annual training programmes for environmental personnel, based on needs assessment. The training must be made compulsory for all personnel. In addition to professional training programmes, it is necessary to plan language courses and tests. The training may be organised in cooperation with one or more professional institutions which are capable of delivering such training programmes.

Environmental officials should organise trainings for industries in the form of training programmes focusing on pollution prevention and IPPC concept, Environmental Management System (EMS) and introduction of ISO 14000 standards with the aim of establishing adequate and efficient cooperation with the economic sector.

It is also necessary to introduce educational programs for activities of environmental protection and climate change at all administrative levels. In this way, especially on the basis of annual programs, existing staff could increase their skills and new staff would be trained.

It should also be kept in mind that the issues of environment and climate change are well documented, and that the majority of this documentation in the English language. This means that in order for BiH to be fully included in all activities related to climate change, the knowledge of its citizens of foreign languages, especially English, is very important. A general policy, hiring and training in the fields of environment and climate change should take language competencies into account.

5.3.4. Raising awareness

All of the activities related to education mentioned above, whether they relate to formal or informal education, need to be implemented in the constant presence of the media, as it is the fastest means of influencing public opinion. A bigger number of documentaries on climate changes is necessary as well as public debates and discussions on state TV stations with politicians, representatives of public companies and private entrepreneurs; i.e., decision-makers. Generally, it is necessary to come up with a high-quality professional campaign in that segment too, with the engagement of the best marketing agencies in the country and abroad that have been profiled in the areas of climate change, such as, Aquarius Ogilvy, BBDO, and McCann Erickson, which in their international portfolio have campaigns for raising awareness on climate change, and which have offices in BiH. At the same time, this would mean additional training for local reporters and public officials.

However, it is important that during the campaign and, in general, when we speak about climate change and adaptation to it, to avoid negative jargon and intimidation and create a positive picture about the needs and possibilities with a more moderate presentation of consequences. Research shows that people respond better to positive messages, which provide a local effect. Also, a common logo for a campaign is recommended that could serve as a backdrop for a campaign and a motif of recognition of the position of the state as a whole.

One example of a successful environmental awareness-raising campaign in BiH is the "Clean is Beautiful" campaign, which had the main message "Put the right thing in the right place." This campaign was conducted in BiH from the end of March 2008 to the end of June 2008, with the goal of affecting public behavior. The campaign was announced at a conference organized by the Ministry of Foreign Trade and Economic Relations of BiH in cooperation with the Ministry of Trade and Tourism of RS, Ministry of Environment and Tourism of FBiH, the Tourist Association of BiH, and with the support of the USAID Project of Increasing Competitiveness by Development of Clusters and Associations (BiHPAK).

5.3.4.1 Other stakeholders in raising awareness

Up to now, the role of the media in raising awareness on climate change has been insufficiently active, which has been interpreted, in addition to other things, as due to insufficient activity of the Focal Point and other competent institutions on raising awareness of the public on the issues of climate changes. The training held in the context of the preparation of this national communication marked the beginning of activities in this field.

In relation to this, it should be pointed out that around 100 NGOs working in BiH declare themselves as being primarily oriented towards environmental protection, as well as climate change, although, honestly speaking, for the time being they are neither as big nor as professional as they would need to be to carry the burden of real education to any significant part of the public. Experts that have been engaged in the preparation of the INC, have been used for providing professional explanations to the public through various media outlets.

5.3.5. Objectives to be achieved prior to the preparation of the Second National Communication

The following objective has been designated as a priority in the areas of education, training and raising awareness regarding climate change:

- Activities on education regarding the effects and causes of climate change, as well as measures of adaptation, should be brought to the state level ;
- National and regional professional meetings should be held on the introduction of climate change issues in the curriculum at all levels of formal education (with best practices from neighboring countries shown) and the best model for BiH should be chosen;
- Educational institutions at the state level should adopt an education strategy on climate change for formal education at all levels, which implies:
    - Education of the highest state officials, including representatives of the Ministries of Education, Agency for Preschool, Primary and Secondary Education, Agency for Development of High Education, Pedagogy Institutes and similar institutions on the causes and effects of the climate change and on their integration into curricula and standards,
    - Education of stakeholders on CDM and on ways of submitting projects,
    - Education of professors and teachers on necessity of introduction of climate changes into education, as well as on teaching methods;
- An initial team of education experts for climate change in formal education should be appointed;
- National and regional professional meetings should be held on linking informal education and private and public companies with the aim of adapting to climate change and mitigate its consequences;
- Politicians, businessmen, representatives of the media should be educated on the effects and causes of climate change through projects in accordance with the state development strategy;
- Politicians, businessmen, representatives of the media should be educated on the CDM and on project submission;
- An initial team of education experts should be appointed for climate change in the economy;
- A logo and slogan for the state campaign should be developed for the near term.

5.4 Capacity Development

Adoption and application of knowledge has always been a critical element in the development of civilization. Within this process, the critical phases are as follows:

- Technological development characterized by a close link with social development: technological development has historically encouraged social development, in addition, social stress encourages technological development; these two types of mutually overlapping development have evolved through an uncontrolled, spontaneous process;
- An increase of the role of the state and consumer business management of technological inventions, characterized by a management processes, when technological development becomes controllable in terms of directions and intensity; for this type of dictated technological development there are no limitations, and the only condition is that there must be a consensus amongst politicians and citizens about the key role of science in development; the negative aspect of this period is fast growth of global utilization of resources and emissions (including greenhouse gas emissions), even in addition to the decrease of resource intensity (the "rebound phenomenon"), and;
- Availability of knowledge, supported by computerization, which becomes widely available to those who do have knowledge, and the organization of the use of knowledge and a type of development, supported by democratization, which would provide a decrease in the global utilization of resources and an increase of the level of satisfying needs (an increase in the social efficiency of resource use). Of course, each of these phases incorporates the previous phases.

Technological development, which forms the basis of social development, is – in the context of the social development paradigm of stimulated consumption – unsustainable. The role of management increases technical resource efficiency, but global consumption of resources has been increasing faster because of activities that increase the number of units and types of needs. Only the widest possible use of knowledge (with true democratization) will provide an increase in social efficiency. The countries of Southeastern Europe, despite losing a great number of scientific and professional workers, still have the potential to master the third phase of development (applied knowledge). A scientific gathering of energy science experts in Slovenia[33] showed great potential for innovations in technological procedures, the results of which would increase efficiency, primarily by decreasing energy use. The biggest number of lectures on the occasion was on economic case studies, where results to decreased consumption of energy have been achieved merely by applying knowledge.

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[33] 10th energy days, Portoroz, Slovenia, April 2008

Reasons for encouraging regional cooperation in capacity development include:

- Joint danger in areas with similar characteristics,
- Insufficient capacity for climate change adaptation in each of the states individually,
- Similar languages and the existence of traditional cooperation.

Furthermore, important key moments, which may accelerate establishment of cooperation, are:

- The states are in the process of acceding to the European Union (albeit at different phases),
- An existing framework established at the Environment Conference for Europe, Belgrade (EfE Belgrade, 2008) though the Ministerial Declaration "Building Bridges to the Future" supports building regional capacities and regional cooperation on issues of sustainable development,
- In addition to UNESCO as a stakeholder for education for sustainable development, a Regional Center for Education and Sustainable Development Information for Southeastern Europe was established in Sarajevo that could contribute to promoting scientific and research cooperation in the region.

Priorities for capacity building in the countries of Southeastern Europe are related to the following:

1. Monitoring and forecasting climate changes
    - Capacity building for participation in systematic observation networks,
    - Development/strengthening/improvement of national activities for strengthening public awareness and education as well as access to information, including information from international centers and networks,
    - Vulnerability assessment of nature, populated areas and the living world.
2. Adaptation of the economy to changed climate conditions
    - Coping with climate change (decline in quality of life, decline in capabilities of industrial branches and subjects),
    - Adaptation of primary activities to climate change (agriculture, forestry, cattle breeding),
    - Redirection of technological development in the area of energy, industry, construction.
3. Decrease of emissions
    - Finding/coping with technological needs and capacity building for assessment of technological needs, ways of obtaining and adopting, preparation, assessment and acceptance of projects,
    - Development of knowledge and technological development,
    - Inclusion into international programs for decrease of emissions of greenhouse gas, including programs of international cooperation and assistance.

The key element of the State program on education would be monitoring that would consist of:

- Monitoring emissions (i) establishing of a national system for emission calculations, including state registries of sources and technologies, (ii) improvement of methods and procedures for increasing the quality of calculations and measurement of emissions;
- Support to development, maintenance and assessment of a monitoring policy: (i) planning and development of a system for information gathering, monitoring and assessment of realization of programs and plans, (ii) establishment of a system for planning, reporting, monitoring and evaluation of the realization of programs and plans, (iii) development and application of the method for analyzing emission decrease, projections and scenarios, (iv) preparation of strategies, programs and plans at different levels, (v) preparation of legal regulations, economic and other incentive measures, (vi) recording and assessment of capacities for implementation of the climate programs, in terms of technologies, experience and knowledge, (vii) removal of barriers for effective implementation of programs, (vii) study background for preparation of projects, (viii) development and following of project financial mechanisms, (ix) cooperation with similar programs at the state and local levels, (x) development and promotion of the approach, methods and knowledge for planning in a sustainable development principle, (xii) preparation and support to demonstrational and pilot projects, (xiii) establishment of a system for implementation of Clean Development Mechanism (CDM), (ivx) international cooperation on the climate issues, (xv) networking of institutions and programs.
- Support to the question of impacts and adaptation: (i) development and planning of methods for assessment of impacts, sensitivity and vulnerability to the climate change, (ii) development of methods and measures for adaptation to climate changes,
- Observation, systematic monitoring and research: (i) inclusion into Global Climate Observing System (GCOS), (ii) research of climate changes, new technologies and solutions,
- Education and raising of public awareness: (i) providing information, (ii) education and development of public awareness, (iii) other activities which serve to establishment of a system for implementation of policies and measures, and (iv) reporting to the Convention,
- Introduction of indicators for monitoring of achievements: (i) decreased emission quantities and increase of carbon sinks, (ii) amount of investments in projects for emission decrease, (iii) number of projects for mitigation of climate changes, international and local (executed, ongoing and being developed), (iv) number of new employment positions created for application of measures, (v)

proportion of domestic and imported component in projects, (vi) adopted and developed new technologies, (vii) saving of energy and other resources realized by application of measures, (other positive effects from application of measures (decrease of local dirtying, improvement of international cooperation, etc.), (viii) media and professional interest for the climate issues, (ix) level of public awareness of climate issues, (x) other indicators specific for application of individual measures. It is necessary to establish databases for monitoring and assessment of achievements.

- Financing: (i) costs for establishing of planned climate program per years (periods), (ii) priority steps: international cooperation mechanism in accordance with the Kyoto Protocol.

5.5. Preparation of operational programs to inform the public

Knowledge and awareness of climate change in BiH is not sufficient. Neither the public nor the business community nor politicians are aware that the territory of BiH is vulnerable to climate change and that the impacts of climate change will be felt the quality of life and work. That is why a priority task is the provision of relevant information to all stakeholders.

Basic information that everyone should receive is as follows (see Fig. 5.5.1.):

1. Bosnia and Herzegovina is vulnerable to climate change,
2. There are adaptation methods, meaning adaptation to changed conditions (coping with, partial or complete adaptation) and adaptation through the application of measures to decrease of global emissions (mitigation),
3. Developed countries are ready and have committed through international agreements to help developing countries to adapt to climate changes.

In order to implement adaptation programs, it is necessary for the information to reach the following groups:

1. All levels, forms and types of education,
2. All citizens,
3. Private businesses, and
4. All public sector employees.

It is expected that holders of information, in addition to the state, also include:

1. Business associations and businessmen (exchange of experience),
2. Authorities and
3. Professional and non-governmental environmental organizations, which are interested in providing information.

A complete information system will be proposed within the Second National Communication. The bases of the concept are mentioned here:

The role of the state:

- There must be a state body in charge of systematically providing information; it is desirable that this activity is supported by an international organization; for example, UNDP. One form of work of this organization is existence of website "Climate change in BiH" (a central website).
- Formation of websites of other organizations, but with a link to the central website.
- A competent state body should issue appropriate publications and brochures. These should, in addition to basic information on climate change, to be oriented towards specific objectives related to adaptation to climate change, as suitable for conditions in BiH.

The role of business organizations:

- Trade associations in BiH should have a common approach to climate change, as well as developing a common program for informing their members (entrepreneurs) about the issue. This program should contain: (i) best practice in the area of improving energy efficiency in industry, the building sector, the transport sector, etc.); (ii) information on means of support from the state and international organizations.

The role of professional and non-governmental organizations:

- Professional and non-governmental organizations should have interest, objective and methods of work in order to provide information related to climate change – vulnerability and adaptation measures. Business and industry, as well as the government, should support these activities, as the work of these organizations is the most efficient compared to funds invested.

It is particularly important to inform the business community about climate change issues. This community needs two types of information:

- Information on the extent to which conditions in the business environment have changed and may change in the future (e.g., changes in precipitation that are significant for agriculture and hydropower); and
- Information on new technologies (the application of these technologies will not mitigate climate change in BiH, but their application will improve socio-economic development according to the principles of sustainable development).

This communication proposes the establishment of a mitigation network through which entrepreneurs would be introduced to:

- New international technologies and their availability in BiH;

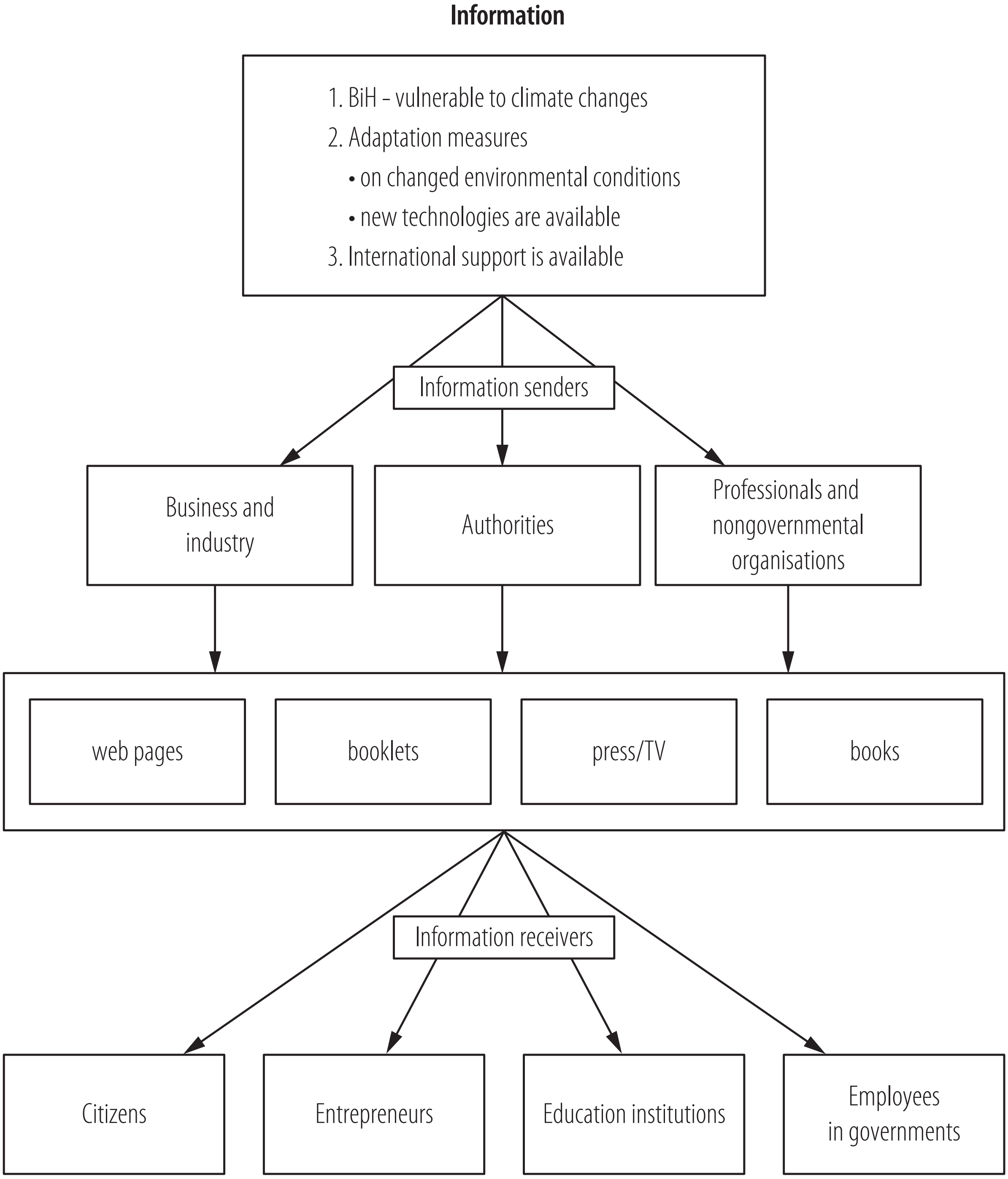

Fig. 5.5.1.: Scheme of raising awareness on climate changes, vulnerability and needs of education.

- Conditions that the government ensures in order to promote application of those technologies; and
- Experience with the application of those technologies in BiH.

The Ministry of Environment and Tourism of FBiH, supporting a project of consulting companies and non-governmental organizations, has financed the formation of a climate change web portal (see Figure 5.5.2.). The portal was made by the Regional Center for Education and Information on Sustainable Development in Southeastern Europe (REIC).This portal will be used to disseminate an electronic newsletter about climate change, which will be sent to subscribers, and to provide information to those offering services in the areas of mitigation and adaptation in BiH (and later in Southeastern Europe as a whole), such as consulting services in research, production, and engineering.

It is foreseen that maintenance of the portal will be done on a voluntary basis and that its relatively low operating costs will be covered by sponsorship.

5.5.1. Preparation of national climate web portal and establishment of integrated information system

Work on the creation of a national web portal on climate change will be continued as well as informing the public on the situation of climate change in the world and in BiH. In this sense, it is necessary to develop an information system which that include all information sources, including meteorological institutes and research institutes, as well as users of that information.

A national climate web portal would contain:

- Data and prognoses of climate change in BiH,
- Vulnerability assessment of BiH, vulnerable natural resources, as well as projected impacts on living conditions, all in relation to climate change,
- Programs of adaptation to climate changes in BiH and in the world, and
- Information on incentive mechanisms for implementation of mitigation measures (local and international).

5.6. Delivery of information on capacity building activities

When it comes to BiH, there were almost no activities on strengthening state capacities in relation to climate change. In addition to interested companies, no mechanism for approving CDM projects (such as a DNA office) has been introduced. Assistance from the European Commission was provided in this area, but there are still no results. Several CDM projects are being prepared in BiH. Although no compensation may be obtained for the emissions resulting from these projects in the form of Certified Emission Reductions (CERs) as yet, it is expected that under the pressure of private business interests, there will be a DNA office established at the state level to approve CDM projects.

One good example of capacity building in the area of climate change is the work of the Institute for Standardization of BiH, which has adopted several national standards (BAS ISO standards) for calculating GHG emissions.

Needs and constraints related to capacity building are discussed in greater detail in Section 6 of this communication.

6. CONSTRAINTS AND GAPS

6.1. Introduction

This chapter provides an overview of limitations and obstacles related to institutional, legal, financial, technical, and human resource capacities in BiH affecting the implementation of obligations under the UNFCCC. Information about these obstacles and limitations is based on the findings of previous studies and projects in BiH. At the time this communication was compiled, it was not possible to develop a proposal for and overview of the appropriate needs and methods for overcoming obstacles, as they were largely dependent on other activities/tasks in the project.

The "Functional Review of the Environmental Sector in BiH", which took place between September 2004 and March 2005 (Functional Review, 2005), included a study that identified all weaknesses and obstacles in public administration in the environmental sector in BiH. The functional review also came up with a set of recommendations regarding the rationalization and reorganization of functional capacities and resources taking into account prevailing governmental expenditure constraints. One of the findings of the functional review was that the jurisdiction of the state is very limited, which affects country-wide coordination. With three levels of autonomy and up to four levels of administrative layers, public administration is in general very complex also in the environmental field. The study also found that the environmental administration was still undersized and unskilled for the challenges and obligations it would have to face. Understaffing in environmental agencies remains a serious obstacle to fulfilment of the obligations of BiH considering the implementation of requirements under UNFCCC.

6.2. Institutional constraints

Pursuant to the Dayton Agreement, the implementation of the environmental policy in Bosnia and Herzegovina (BiH) is within the competence of the Entities. In the Federation of Bosnia and Herzegovina (FBiH) this falls within the jurisdiction of the Ministry of the Environment and Tourism of FBIH, and in the Republic of Srpska (RS) within the jurisdiction of the Ministry of Physical Planning, Civil Engineering and Ecology. In the Brčko District this area is regulated by the District Government.

The BiH Coordinating Committee for Environment was established in 1998 by the decisions of the Entity governments. It had the task of harmonizing and coordinating environmental policy at the level of Bosnia and Herzegovina.

Pursuant to the Law on Ministries, the Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina is responsible, along with the entity-level ministries, for the international obligations of BiH in the field of environmental protection. However, the responsibility for obligations under the UNFCCC and development of the INC rests with the UNFCCC Focal Point, a position that is located at the Ministry of Physical Planning, Civil Engineering and Ecology of RS.

Jurisdiction of the state administration in environmental matters is quite limited and reduced to functions that are mainly related to international cooperation and necessary coordination. There is an evident lack of both vertical and horizontal cooperation and coordination among competent institutions, and these mechanisms are of particular importance for international and national activities. The main disadvantage is inability of the administration to supervise and manage multilateral environmental agreements. For example, a serious shortcoming in the administration of international obligations is the failure to fulfil reporting obligations, designate national focal points, and carry out monitoring duties. At the BiH level, there is the Agency for Statistics; however, it does not have the data necessary for production of emission inventory. The same goes for entity-level statistical institutes.

Good management would require a national strategy for international environmental cooperation, the setting of priorities with regard to the obligations, estimation of the expected annual costs of implementation, a cost-benefit analysis prior to taking over international obligations, clarification of internal institutional responsibilities, and timely reporting to the decision-making and supervisory bodies on the state and entity levels.

The National Environmental Action Plan (NEAP) was the first document specifically focused on environmental protection problems that was adopted in both entities. It was prepared by the World Bank in both entities in parallel with the participation of representatives from ministries, the scientific community, and NGOs from BiH.

More impact is attributed to the Poverty Reduction Strategy Paper (Mid-Term Development Strategy of BiH 2004-2007), which was adopted in early 2004. It is a general document addressing mainly economic and social issues, and it also covers environment and water. Although it follows the priorities set out in the NEAP, it is more concrete in designating the necessary follow-up actions. The most serious shortcoming both of these documents is that they have not been adopted by the government, nor have they been integrated into the work of the ministries responsible for sectoral policies: transport, energy, agriculture, tourism, etc. Implementation of environmental policies will not be possible without integrating environmental concerns into sectoral policies. This principle, which is fully recognized and implemented within EU member states through the Cardiff process, is still missing in BiH.

The preparation of a number of strategies and plans is required by law. Both entities have so far produced Environmental Protection Strategies, which are now in the phase of being adopted.

In spite of the preparation of the NEAP, the PRSP, and a Solid Waste Management sub-sectorial strategy, policy preparation capacity in BiH remains weak. The implementation rate of the measures envisaged in these documents is equally low. A number of policy and strategy documents are still pending, although their adoption is required under the relevant laws.

6.3. Policy Constraints

There is no comprehensive environmental policy at the state level and no institution entirely dedicated to the environmental protection issues, either from the policy and legislative point of view, or from the technical and implementation point of view. The only state-level ministry that has responsibility for environmental issues – Ministry of Foreign Trade and Economic Relations of BIH (MoFTER) – only deals with selected aspects of environmental issues, primarily those related to international relations. There is still no law on environment at the state level that would establish the legal framework for environmental policy at the state level and at the same time establish a legal basis for a national environmental policy.

A framework environmental law is needed at the state level to define the goals and organisation in the field of environmental protection in a comprehensive way. In addition, there is a need for a central actor whose main task will be to organise and execute the country's environmental agenda.

Environmental policy in BiH also suffers from the insufficient use of economic and fiscal resources. The policy for the introduction of new economic instruments and the use of the existing economic instruments must be strengthened to truly modify the behaviour of people and institutions to support better environmental protection, to provide incentives for reducing pollution, and to raise funds for investment in the improvement of environmental quality. At present, some existing economic instruments do not work as they should, including charges and fees for water management. Other instruments do not work at all: for example, no charges are being collected from enterprises for the emission of air pollutants. Their performance is not monitored. In short, the institutional capacity for administering effective and forceful policies remains weak.

The entity environmental protection funds were established by entity-level laws on environmental funds. The environmental protection fund were established to support the following activities: 1) the promotion of the development of an environmentally sound economic structure; 2) the prevention of environmental damage; 3) the remediation of environmental damage that has occurred; 4) nature conservation in protected areas; 4) the motivation and promotion of the most efficient techniques and alternatives; 5) the improvement of public environmental awareness; and 6) environmental research. Efforts to ensure the successful operation of the funds are still ongoing in both entities.

6.4. Constraints affecting environmental monitoring

In BiH there is no comprehensive environmental monitoring and data collection system, which results in the lack of an information system for environmental protection. At present, different data are gathered by various institutions without coordination and in the absence of a unified database. There is no exchange of data and communication between the institutions gathering data and higher governmental agencies, nor is there information about existing data. While there are some state-of-the-environment data, they are either obsolete and out of date or incomplete and unusable. The existing environmental data as well as general statistical data are not being exchanged between the entities, which makes it difficult to get a comprehensive picture of links between developmental activities and the state of the environment, or the indicators underpinning the decision-making process at the level of the state.

A section on GHG Reporting along with BiH Air EIS questionnaires and the Review of the Air Emissions Information System were developed during the EU CARDS-funded "Support to Air Monitoring" project. BiH EIS questionnaires, along with the additional pollutant release and transfer register (PRTR) reporting questionnaire, should cover all the needs for collecting data for GHG emission calculations in line with the European guidelines.

6.5. Constraints affecting analysis and decision-making

The preparation of the INC included a review of all available documents developed for BiH and its entities with financial help from abroad (the UN, WB, EC donors) or from the budgetary funds of the entities. Those documents are important, as they provide information necessary for the preparation of the INC, but many of them have not been approved through the standard BiH political procedures, and therefore they cannot be considered official state documents. A special problem is statistics, which incomplete and are compiled at the entity level (for example, the number of citizens was established for the last time in 1991). These are great problems that require constant improvement and updates, as well as the engagement of the entity and state governments.

Documents as the NEAP and others that were verified through official BiH procedures still have at that time provided a good platform for coordination of activities in environmental sector, and on basis of that entity environmental strategies have been developed. In addition, new documents are necessary that can identify long-term strategic directions for sustainable development with the respective specificities and interests of the entities.

6.6. Financial constraints

There is a lack of financial transparency in the environmental sector. This does not necessarily mean that the government's financial practices are obscure or concealed. Specifically, data on administration expenditures in the environmental sector are very poor. As environmental administrative activities are extremely diffuse and are mostly only a small part of bigger units that are primarily responsible for some other sector, it is generally difficult to make separate cost calculations for the environmental sector.

The FBiH Law on the Environmental Fund (Official Gazette of FBiH, No. 33/03) and the RS Law on the Environmental Fund (Official Gazette, No. 51/02) identify sources of revenue for the funds. These include charges for environmental pollution and the use of natural resources, transfers from the entities' budget, bank loans and grants from donors. In both entities, the funds are independent bodies, but neither fund is operational yet.

6.7. Human resource constraints

Following a feasibility report prepared by EU experts in cooperation with BiH representatives assessing whether the country is ready to open negotiations on a stabilisation and association agreement with EU, the report of the European Commission which was submitted to the EU Council in 2003 stated that the environmental capacities of the BiH administration were far below the required level.

Furthermore, the 2004 Environmental Performance Review (EPR), prepared by the United Nations Economic Commission for Europe, contains a similar conclusion. In addition to a comprehensive set of basic recommendations, the Commission came up with a recommendation that priority should be given to administrative capacity building.

6.8. Mitigation and adaptation measures and projects

The country's underdeveloped capacity to implement measures aimed at adaptation to climate change results from lack of knowledge and lack of awareness of the risks of climate change for Bosnia and Herzegovina. Given the diversity of climate in BiH and the fact that the climatic regions in BiH do not coincide with the boundaries of administrative regions, adaptation to climate change should rely on the particular climatic characteristics of individual regions.

Organisation-wise, it is necessary to tailor the data collection and processing methodology to particular geographic characteristics of individual regions and to set up a state-level observatory which will be responsible for effective operation of the entire climate information system as well as its modifications and improvements.

In line with Section 3 of this report, the concept of regionalisation of BiH from the standpoint of vulnerability, adaptation and management looks as follows:

- administrative units (entities): management of adaptation measures
- geographical regions: homogeneous areas from the standpoint of adaptation measures
- climatic zones: regions with identical levels of vulnerability

6.9. Multilateral/bilateral contributions to address constraints

The very preparation of the INC implies participation in the creation and development of capacity in BiH as required by this document. In the long term, it will be essential to integrate all activities into the processes of long-term development and into sectoral development plans.

From the moment when BiH signed and ratified the UNFCCC and designated an Operational Focal Point, the country moved to establish a body that could harmonize all activities in the field of environmental protection, including climate change.

The Environmental Steering Committee, which has paid attention in a professional and just way to harmonization of all the activities in the field of environment, needs of each entity and Bosnia and Herzegovina as a state, has played a key role. By selecting a Focal Point for the UNFCCC (the Ministry of Physical Planning, Civil Engineering and Ecology of RS), those activities have been focused on organization of work that would enable BiH to become an active member of the UNFCCC as soon as possible under its designation as a "Non-Annex I Party."

After several consultations and workshops and the formation of a special secretariat for professional support to this Convention within the organizational focal point, a Climate Change Committee of BiH was formed in 2000, consisting of around 30 experts of different profiles from across BiH, including the Brčko District.

The Committee, in cooperation with the UNDP, was very successful in running the process of making a project proposal for the preparation of the BiH INC. The project proposal was positively evaluated by the GEF, and financing for the preparation of the INC was approved. Even though the Committee performed thorough preparations for the beginning of the work on the INC, there were difficulties in carrying out the tender process for the selection of contractors, which is quite common in BiH. The UNFCCC Secretariat and the GEF were informed about these difficulties in the middle of 2007.

With the aim of overcoming these problems, and with the full support of the state and entity governments, as well as the GEF and the UNFCCC Secretariat, UNDP Bosnia and Herzegovina has organized work on the preparation of the INC. Thus, real work on preparation of the INC began only in 2008. At this time, with strict adherence to Instruction 17/CP.8, the UNDP has involved domestic experts in the preparation of the INC to the greatest extent possible. More than 45 experts from BiH have been involved so far in the preparation of the INC. On the other hand, the obligation of political approval and endorsement, which is standard practice under the Convention, is delegated to the Focal Point (Ministry of Physical Planning, Civil Engineering and Ecology of RS), which has been assisted in the submission of the document to the UNFCCC by MOFTER, which is also a political GEF Focal Point for BiH.

In the former preparation of the INC, several training, workshops and debates were held with the participation of different stakeholders and different expert teams. This is logical, as BiH practically has no professional and scientific institutions to assume the role of organizing the preparation of the complete INC or even of some of its parts. The members of the current inter-disciplinary expert group mentioned above are in constant contact, and the group presents the seed of future institutions which will, in time, achieve the level needed to successfully implement activities foreseen by the INC.

6.9.1. Priority Needs by Sector

In summary, adaptation of BiH to climate change is related to:

- Inclusion into international process of decrease of GHG emissions and increase of carbon reservoirs, with international incentive to make it economical,
- Application of measures for minimizing risks from climate changes,
- Adaptation of development and the way of life to climate changes, and
- Enduring climate changes (and dealing with consequences).

Table 6.9.1. summarizes key policy and activity needs by sector:

Sector/Type of Activity	Key Needs
State Development Policy	• Consider international flows of development related to climate change • Utilize international programs and support for emission reductions with an emphasis on jobs creation in BiH from the resulting projects and markets. • Assess vulnerability to climate change and adaptation measures
Biodiversity and Environmental Protection	• Monitoring general impact on inland ecosystems and biodiversity, including the shift of vegetation zones (tiers) in horizontal and vertical directions, shift and changes in habitats of individual types of flora and fauna, the disappearance of species, changes in quality and quantity of biocenosis, fragmentation of habitats, and changes in ecosystem function. • Monitoring specific impacts, such as impacts on types of plants, impacts on plant communities, impacts on soil and fresh water biocenosis, physiological and ecological impacts on fauna, and impacts on coastal ecosystems.
Protected areas and the most vulnerable ecosystems	• Assess the socioeconomic effects of ecosystem loss. • Develop the elements of an activity plan for the prevention, decrease and mitigation of negative socioeconomic impacts. • Manage protected areas and special interventions needed at given locations.
Energy Policy	• Incorporate measures for increasing the technical and social efficiency of energy use (investments in "negawatts" are 5 to 10 times more cost-effective than investments in new capacity). • Adapt policy and practices to reflect change energy use patterns resulting from milder winters and hot summers and integrate these changes into construction and space heating and cooling practices. • Adopt policies to reduce the use of imported fossil fuels and replace them with local sources of clean energy.

Sector/Type of Activity	Key Needs
Environmental Policy	• Include climate change into state-level strategies on environmental protection.
Forest Management Policy	• Implement measures for increasing connective carbon in forest biomass, afforestation of productive overgrown forest soil, increasing forest cover cultivated by thinning, and planting shrubbery on the area of degraded forests. • Increase the efficiency with which trees are used and increase the utilization of wood. • Prevent forest drying due to the consequences of climate change. • Increase the rational use of wood consumption in heating and in industrial energy use. • Use forest biomass for the production of non-carbon energy resources.
Technology Development	• Invest knowledge into the development of new technologies and the adoption of existing technologies.
Energy	• Replace carbon-intensive fuels that are currently used. • Increase the share of centralized heating systems and small co-generation. • Increase the share of solar energy, wind energy, and geo-thermal energy, while continuing to develop the current practice of using small hydropower plants. • Improve the heat insulation of buildings. • Improve district heating efficiency and heating management in cities. • Introduce measures to improve the management of electrical power outside of heat generation. • Reduce consumption in household with efficient lighting and appliances. • Increase energy efficiency in the buildings sector.
Hydrology and Water Resources	• Assess the implications of development in the context of reduced water resources. • Improve the water management system. • Assess the impacts of climate change on hydrology and water resources. • Assess the impact of climate change on the water management system. • Adjust to changed water flow patterns.
Industry	• Assess possible measures for reducing emissions in the production of coke and ammonia. • Assess possible measures for reducing emissions in the production of nitric acid. • Assess possible measures for reducing emissions in cement production.
Transport	• Assess measures to mitigate emissions related to transport in urban areas and long-distance passenger transport (road to rails shift). • Assess domestic production of transport fuels (natural gas, bio-diesel, methanol, hydrogen) without jeopardizing food production.
Waste Management	• Implement measures to decrease the amount of waste generated. • Increase re-use and recycling of waste. • Introduce measures for decreasing methane emissions from landfills and coal mines utilizing methane.

Sector/Type of Activity	Key Needs
Agriculture	• Conduct a vulnerability assessment in plant cultivation and livestock breeding. • Apply new farming techniques to decrease soil evaporation. • Investigate the use of agricultural biomass as a source of energy. • Improve application techniques for organic fertilizers in order to decrease N_2O emissions. • Reduce methane emissions due to enteric fermentation. • Assess anaerobic fermentation related to the decomposition of organic fertilizers and the potential for biogas. • Assess carbon sequestration in agricultural soil. • Utilize biomass for energy generation. • Improve the application of organic and mineral • fertilizers to reduce N_2O emissions. • Support organic agriculture. • Reduce emissions from the application of mineral fertilizers. • Decrease methane emissions from livestock breeding. • Improve livestock feeding through the use of mechanical and chemical treatments of livestock feed and organic and inorganic additives. • Assess the use of hormones. • Increase the efficiency of reproduction. • Modify paunch flora to reduce emissions related to enteric fermentation. • Improve management and use of manure.
Service Sector	• Assess the range of new services that will be generated by changes in economic and social development related to climate change.
Public Health	• Develop "safe havens" from extreme weather events. • Assess the potential impacts of climate change on the food supply. • Consider changes in working hours and work patterns. • Develop the health care response to climate-related morbidity due to circulatory diseases, psychological disorders, and respiratory illnesses.
Socio-economic Develop-ment	• Assess potential job losses (and potential additional jobs in new areas) due to climate change. • Assess potential public damages. • Assess the potential damages to individuals.

Table 6.9.1. Priority policy and activity needs for BiH.

At a regional level, the countries of Southeastern Europe should establish a framework for the re-orientation of development based on cooperation, from which national programs for climate change mitigation would develop. National programs would establish a framework for systematically dealing with climate change issues in accordance with set targets. This program would include the following aspects: institutional, legislative, organizational, scientific, human resource development and public awareness about issues of the climate and development.

6.9.2. Priorities of future policy frameworks

In line with Section 3 of this report, the following gaps and limitations have been identified for the purpose of prioritising future policy frameworks, measures and actions:

- Incoherency and incongruity between strategic and development documents (in forestry, agriculture and water management) and biodiversity management;
- Lack of well-defined research addressing the current problems in the fields of biodiversity and implementation of relevant international conventions and directives;
- Very low level of public awareness of the importance of biodiversity for preservation of fundamental environmental values, in particular in climate change management;
- Extremely low number of scientists, experts and institutions focusing on biodiversity and its preservation,
- Lack of financial resources and funds for scientific research in the field of climate change and biodiversity as well as the environment as a whole.

Priority tasks:

- Carry out the Initial National Communication on Climate Change and to identify in it the impact of climate change on biodiversity and adaptation measures;
- Establish a framework setting down long-term activities aimed at addressing the problem of climate change;
- Establish a framework for adoption of a national climate change adaptation strategy as a general adaptation plan;
- Define measures and activities for mitigation of the impact of global climate change on biodiversity and ecosystems in BiH;
- Improve the knowledge on global climate change, especially in connection with the anthropogenic effects on global climate change and their potential impact on biodiversity in BiH;
- Develop and perform vulnerability analysis for ecosystems (including agro-ecosystems) and habitats against projected climate change;
- Develop a set of adaptable monitoring measures for conservation and restoration;
- Assess the existing environmental monitoring programme for the purpose of determining whether there is a need for additional monitoring of biodiversity and communication of new climate change information;
- Develop scientific tools for assessing the impact of climate change on local fish and wildlife populations and habitats;
- Assess the vulnerability of forest resources to climate change (special attention will be given to the understanding and development of management practices so as to reduce, to the extent possible, the risk of forest fires and insect pest outbreaks);
- Comprehensive training assistance to small landowners, increased possibility for fire control planning and proper management of public land;
- Develop a database on the effects of climate and products on forestry practices (e.g. reforestation techniques and pest control) which are considered most adaptable to climate change as well as information on how to reduce the risk of forest fires and insect pest outbreaks;
- Ensure that the actors in South-eastern Europe and national adaptation teams are provided with up-to-date information on the impact of climate change on forests and the preservation of forests through relevant seminars, workshops and media outlets.

6.10. Priority project proposals

Rather than identifying specific project proposals, it should be stated that the following criteria will be used to identify projects that are a high priority for BiH:

- Projects relevant for increasing energy efficiency,
- Projects focusing on the use of renewable energy sources,
- Projects aimed at removing obstacles to efficient energy use,
- Projects in agriculture.

7. INTERNATIONAL COOPERATION

7.1. International Cooperation in Global Environmental Agreements

By signing and ratifying the UN Climate Change Convention in 2000, Bosnia and Herzegovina officially became a part of international cooperation in the area of climate change. From the very beginning, BiH has been present regularly at all COP meetings as well as at the meetings of expert bodies within the UNFCCC Secretariat. After observing the work within the Convention, the idea of forming a regionally-based group was realized, and the Open Balkan Group has officially existed and operated for several years (Macedonia, Serbia, and BiH), and it will continue to work with the Central Group (consisting of Croatia and Turkey).

Both the beginning of the preparation of the INC and the preparation process itself has involved international cooperation, first and foremost the organizational and professional assistance of UNDP and the financial assistance of the GEF. By ratifying the Kyoto Protocol, BiH has demonstrated its interest in and need for inclusion in the mechanisms, which are offered to signatories of the Protocol. Implied post-Kyoto changes will present a major challenge for BiH to become involved more intensely in international cooperation and to function as an active partner. The basis of all those activities will certainly be the INC and especially the SNC. In addition, cooperation established between the Southeastern European countries for the last several years in the sphere of environmental protection and climate changes should be noted. The active participation of BiH at the Belgrade Conference on the Climate Change Action Plan on regional activities related to adaptation to climate change is confirmation of this type of cooperation.

Complementary activities between the three UN Conventions – Climate Change, Biodiversity and Desertification – are certainly necessary for harmonized activities in BiH, but they also present an unusual opportunity for international cooperation that would help BiH to realize development according to the principles of sustainability.

7.2. Regional cooperation

Regional cooperation as it is understood here refers to the cooperation that happens within Southeastern Europe or the Western Balkans (the latter designation does not include the two countries that are members of the EU – Romania and Bulgaria). Regionalism presents a strategic way to address adaptation to global changes, considering that there is an increasing number of countries lacking capacities and resources to deal independently with challenges imposed by the changes. In the area of economy, it is getting more difficult for individual countries to resolve basic problems (energy, transport infrastructure, protection of the environment, etc.) at a national level, whereas a regional approach may address these problems more successfully. In addition, economic policies, or individual sectoral policies that have been agreed upon at a regional level, are as a rule more stable and coherent, as non-compliance can be sanctioned. Also, marginalized countries organized as a region can significantly increase their power of negotiations vis-à-vis the international community. The creation of regional networks and structures increases the outlook for economic stability and establishes a more open and more stimulating business environment. The creation of a regional economic zone also contributes to the removal of investment barriers, and it provides for the easier resolution of conflicts in the business sector (SEE- FAP, 2008).

Generally speaking, regional cooperation makes it easier to provide 'public goods' such as water, energy, transport, communications and freedom of movement. At the same time, it contributes to the prevention of 'public evils,' such as natural or man-made disasters, weapons and drug smuggling, trafficking and organized crime. Regional cooperation also decreases the risk of cross-border conflicts. It encompasses many areas of economic and social life, political structure, internal security, environmental protection, culture, etc. This cooperation is a rather complex and multi-layered process of establishing connections within a region, and it does not imply only relations between the states and national administrations, but also among many other social stakeholders, such as business and civil society.

In the course of the last decade, a large number of regional organizations for this area has been established. The creation of these organizations happened due to the concurrent impact of both national and international factors that have increased regional inter-dependency and changed the role of the state and the character of multilateral arrangements. The Western Balkans is now a post-conflict region on the borders of the European Union that is both an active participant and a more passive recipient of foreign influences, such as the framework of European and Euro-Atlantic integration, in which it has chosen to participate. It seems that the most significant result of different movements on the national, regional and European scene is clearly a strengthening of autonomous domestic political and economic stakeholders in accordance with progress towards European integration. In other words, increasing capacity for European integration will also increase capacity to address domestic and regional issues (SEE/CCFAP, 2008).

7.2.1. The Energy Community of the SEE region

The European Community (EC) and the countries of the Balkans joining the Athens process and Athens Memorandum of Understanding of 2002 and 2003 have signed the Energy Community Treaty (Brussels, 22nd November 2005, Sarajevo 27th July 2006). The basic objectives of the Treaty are the creation of a single energy market in SEE through: (i) implementation of the EC acquis communautaire on energy, environment, competition and renewable energy; (ii) establishment of a specific regulatory framework which allows for an efficient networked energy market on the entire territory of the contractual parties, as well as on part of the EC territory; and (iii) establishment of a market of networked energy (electricity and gas) with no internal borders for the parties to the Treaty (ECT, 1994).

The objective of the Treaty is to improve the environmental situation related to the network, including increased energy efficiency and renewable energy. With this treaty, importance is given to the Kyoto Protocol, and each of the parties has undertaken to accede to the Protocol. The application of renewable energy and energy efficiency – as stated in the treaty – provides advantages in terms of safety of supply, environmental protection, social cohesion and regional development.

7.2.2. Regional Cooperation Council (RCC)

As a successor to the Stability Pact for Southeastern Europe, the Regional Cooperation Council supports regional cooperation and supports European and Euro-Atlantic integration in SEE. In its work, the Council is focused on six priority areas: economic and social development, energy and infrastructure, judiciary and internal affairs, security cooperation, human potentials development, as well as parliamentary cooperation as a cross-cutting theme. The seat of the RCC is in Sarajevo. The RCC has undertaken strengthening cooperation in the area of energy, precisely according to the principles of the Energy Community Treaty, establishing the Energy Community as one of its priorities. The Council has reacted to the crisis by sending messages to leaders of the state in dispute, but they have not managed to take the initiative at an extraordinary session of the competent of the region in relation to the crisis. The assumption of regional ownership, at which the Council develops regional cooperation, makes it a priority regional forum for debates, initiatives, agreements and incentives in this area.

The RCC Secretariat hosted the first Ministerial Conference on Combating Climate Change in the SEE, in Sarajevo on November 13, 2008. This event formed an integral part of the framework program (REC BH, 2008). The purpose of this ministerial was to reach an agreement on joint activities towards the fourteenth Conference of Parties of the UNFCCC, which was held in Poznań, Poland in December 2008. The Framework Action Plan for combating climate change in the SEE region relates to Albania, Bosnia and Herzegovina, the Former Yugoslav Republic of Macedonia, Montenegro and Serbia, and it is open to all interested countries in the SEE region.

7.2.3. Belgrade Climate Change Initiative

Recognizing the importance of climate change for sustainable development and poverty eradication in the SEE region and the importance of integrating climate change considerations into the development of key economic sectors in the SEE countries to protect the environment and facilitate partnership and cooperation between the SEE countries and other countries in the UNECE region, the Belgrade SEE Climate Change Initiative was adopted by the "Environment For Europe" Sixth Ministerial Conference in Belgrade, Serbia, which was held on October 10-12, 2007.

Under the Belgrade initiative, the Ministers agreed: (i) that the interested countries of the SEE should strengthen their political support for the implementation of the SEE/CCFAP-A (ii) that the interested countries shall support the SEE pilot project aimed at setting up operation of the Sub-regional Virtual Climate Change Centre hosted by the Republic Hydro-meteorological Service of Serbia that will contribute to coordination implementation of the SEE/CCFAP-A; (iii) that in order to develop and implement the SEE/CCFAP-a programs, countries of the SEE shall establish partnerships with relevant international organizations; (iv) to invite countries of the SEE, international organizations, financing institutions, donors, and other stakeholders to join this open-ended initiative and to be involved fully, sharing their experience and providing much needed support for sub-regional climate change activities (SEE/CCFAP 2008).

The full title of the climate change center established in Belgrade under the ministerial agreement is the Southeastern Europe Virtual Climate Change-related Centre for Research and Systematic Observation, Education, Training, Public Awareness, and Capacity Building (SEE/VCCC). SEE/VCCC is comprised of a network of national institutions from participating countries (ministries, hydro-meteorological services, scientific institutions, NGOs, and other stakeholders).

The decision to establish the SEE/VCCC in Belgrade also creates excellent opportunities for achieving many aims and tasks given under the UNFCCC through international cooperation at a regional level. Also, this type of cooperation is in accordance with aims and ambitions of Europe, and it is therefore rather logical that Bosnia and Herzegovina will be able to use all the advantages provided by international cooperation.

7.2.4. Igman Initiative

The Igman Initiative represents a form of regional cooperation for the non-governmental sector with the basic aim of renewing cooperation and the normalization of inter-state relations. On January 23, 2009, the initiative organized an ad hoc Energy Forum in Belgrade on the theme "Regional Energy Safety and Solidarity – Challenges and Perspectives." The forum included participants from a regional network of non-governmental organizations from Bosnia and Herzegovina, Montenegro, Croatia and Serbia. The initiative has highlighted renewal of cooperation in the region, and it also includes the inevitable dimension of stimulating political dialogue and cooperation in the area of energy as one of the key areas in modern international relations. Cooperation in the area of energy is an inevitable precondition for sustainable development and progress in all states in the region. The immediate impetus for holding the forum was the unprecedented energy crisis that the region experienced due to the termination of natural gas deliveries from Russia. Energy interdependence is a fact that should be additionally emphasized in the promotion of regional cooperation (Igman Initiative, 2009).

8. RECOMMENDATIONS AND NEXT STEPS

With the submission of its Initial National Communication, Bosnia and Herzegovina has undertaken an important step towards understanding and addressing climate change issues. The INC represents a landmark document that is the product of cooperation across scientific disciplines and geographic regions. However, it is only a first step in addressing the challenges represented by climate change and its effects. Three recommendations have emerged from the findings of the report to support continued work in this area: 1) Develop a national climate change mitigation strategy and action plan; 2) Take steps to implement commitments under the South East European Climate Change Framework Action Plan for Adaptation (CCFAP, 2008); and 3) Begin preparations for the Second National Communication as soon as possible.

8.1. Climate Change Mitigation Strategy and Action Plan

It is necessary to develop a Climate Change Mitigation Strategy and Action Plan for Bosnia and Herzegovina. While the INC is an important start, it is a reporting document. BiH urgently needs policies and measures that will allow it to undertake its commitments under the UNFCCC, and for the effective coordination and implementation of these policies and measures, the country requires an over-arching strategy to guide its work.

The Strategy should:

- define the national policy on mitigation of climate change in BiH and the relationship with the national economic and development plans;
- define the policy, measures and activities that are necessary for implementation; and
- define the implementation arrangements, including the direct inclusion of the entity-level governments.

The Climate Change Mitigation Strategy should also contain short-term, mid-term and long-term objectives with regard to implementation of the UNFCCC and the Kyoto Protocol, and it should establish a framework for the Action Plan. The Strategy should also establish priorities for action and assess the costs and benefits of priority activities both in terms of GHG abatement and in terms of other economic and social benefits.

The Action Plan should identify the policy tools, technical and other measures, organization, key actors, responsibilities, costs, funding options and an implementation timeframe. It is necessary to involve all stakeholders and the general public in the development of both the Strategy and the Action Plan.

The process of developing the national strategy is an opportunity to increase general knowledge about climate change issues, to discuss these issues, and to make progress towards integration of climate change policy into different sectors in accordance with national development priorities and principles of sustainable development. In the course of this process, it will be necessary to conduct the following activities:

- Carry out a needs assessment with the aim of:
  - making an in-depth analysis of institutional, legislative, organisational, HR and financial needs for the purpose of developing capacities of the UNFCCC and Kyoto Protocol implementation system.
  - gathering information about good practices in the transition countries and developed countries of the European Union that have adopted the strategy and action plans for implementation of the UNFCCC and the Kyoto Protocol.
- Ensure that implementation monitoring mechanisms are put in place.
- Ensure improved knowledge regarding the causes and effects of climate change in BiH.
- Establish international cooperation with countries that are already implementing the UNFCCC and the Kyoto Protocol, encourage the transfer of knowledge, experience and good practice in capacity development, and promote cooperation in projects focused on reducing GHG emissions.
- Establish promotional mechanisms for energy efficiency and renewable energy, as it is not possible to achieve any kind of serious penetration of related technologies without organized support from the entities and the state.
- Revitalize the existing environmental funds, and consider profiling them as "environmental and energy efficiency funds."
- Detail implementation arrangements, particularly with regard to the entity-level governments.
- Involve local communities in mitigation activities, as they are the primary end users or beneficiaries of most mitigation activities. Climate change mitigation is a matter of sustainable development

for them, particularly in areas such as biomass energy development. Many autonomous commercial activities that mitigate emissions are already happening in local communities.

8.2. Adaptation Framework

Bosnia and Herzegovina should continue to research the issues of vulnerability and adaptation, building upon the efforts in this Communication and the multi-country Climate Change Adaptation Framework (referred to as the SEE/CCFAP-A) in which Bosnia and Herzegovina if participating (CCFAP, 2008).

The SEE/CCFAP-A outlines key areas for sub-regional cooperation that include the following:

- Climate change observation, monitoring, and forecasting
- Climate modeling and scenarios
- Risk reduction related to potential climate-related threats
- Socio-economic information on climate impacts in the SEE region
- Information exchange and research in key sectors including energy, agriculture, forestry, ecosystems, land use, transportation, coastal zones, water resources, and health

Within the SEE/CCFAP-A, Bosnia and Herzegovina has expressed interest in coordinating sub-regional activities of the Framework countries in the area of adaptation in energy and agriculture. All of the cooperative activities undertaken with the SEE/CCFAP-A will provide important information for state-level decision-making on climate change policies and programmes in BiH.

The timeframe of the SEE/CCFAP-A is 2009-2015, and it is designed to be compatible with the timeframe of other international initiatives, including the Millenium Declaration, the Johannesburg Plan of Implementation, the Hyogo Framework for Action for building resilience to disasters, and the EU actions that include the Green Paper on Adaptation and the Water Initiative.

8.3. Second National Communication

Bosnia and Herzegovina should take steps to initiate a second national communication (SNC) as soon as possible. The urgency of this measure is due several factors.

1. The current team of interdisciplinary experts from across the country represents an important asset, and it is necessary to ensure continuity in their work so that these linkages are not lost.
2. A number of key socio-economic and economic documents are currently under development in BiH, including an energy strategy, a national development plan, and sectoral economic development plans. The SNC will be able to utilize their findings and can thus strengthen the sections of the communication that present national circumstances, assess potential impacts and vulnerability, and provide an overview of the potential impact of proposed mitigation measures.
3. The analysis conducted for the SNC will in turn support the Climate Change Mitigation Strategy and Action Plan and strategies to adapt to climate change that are developed in the context of the SEE/CCFAP-A by providing improved information for decision-makers and the public.

List of Acronyms

AOGCM . . . . . . Atmosphere-Ocean Global Circulation Model
BD . . . . . . Brcko District
BiH . . . . . . Bosnia and Herzegovina
CARDS. . . . . . Community Assistance for Reconstruction, Development, and Stabilisation
CDM. . . . . . Clean Development Mechanism
CEAS . . . . . . Council of European Aerospace Societies
CER . . . . . . Certified Emission Reduction
CORINAIR . . . . . . CORE Inventory of AIR Emissions
CRF . . . . . . Common Reporting Format
DABLAS . . . . . . Danube Black Sea Task Force
DNA . . . . . . Designated National Authority
DOC . . . . . . Degradable Organic Carbon
EBRD . . . . . . European Bank for Reconstruction and Development
EC . . . . . . European Commission
ECA . . . . . . Europe Climate Assessment
EEA . . . . . . European Environment Agency
EF . . . . . . Emission Factor
EIB . . . . . . European Investment Bank
EPR . . . . . . Environmental Performance Review
ESCO. . . . . . Energy Service Company
ETS . . . . . . (European Union) Emission Trading System
EU . . . . . . European Union
EU . . . . . . Reuro
FAO . . . . . . Food and Agriculture Organization
FBiH . . . . . . Federation of Bosnia and Herzegovina
FIPA . . . . . . Foreign Investment Promotion Agency
GDP . . . . . . Gross Domestic Product
GEF . . . . . . Global Environmental Facility
GIS. . . . . . Geographic Information System
GWP. . . . . . Global Warming Potential
HHW . . . . . . Household waste
HPP . . . . . . Hydropower plant
HVAC . . . . . . Heating, Ventilation, and Air Conditioning
ICAO . . . . . . International Civil Aviation Organization
ICPDR . . . . . . International Commission for the Protection of the Danube
ICRC . . . . . . International Committee of the Red Cross
IPA. . . . . . Instrument for Pre-Accession Assistance
IPCC . . . . . . Inter-governmental Panel on Climate Change
IPPC . . . . . . Integrated Pollution Prevention and Control
INC. . . . . . Initial National Communication
IWRM . . . . . . Integrated Water Resources Management

JNA . . . . Yugoslav National Army
KM. . . . . Convertible Mark (official currency of BH)
MDGs . . . . Millennium Development Goals
MEI . . . . Multilateral Environmental Agreement
MoFTER . . . . Ministry of Foreign Trade and Economic Relations
MSW . . . . Municipal Solid Waste
MUNEE . . . . Municipal Network for Energy Efficiency
NCSA . . . . National Capacity Self-Assessment
NDVI. . . . . Normalized Difference Vegetation Index
NEAP . . . . National Environmental Action Plan
NGO . . . . Non-governmental organization
NHDR . . . . National Human Development Report
NMVOC . . . . Non-methane volatile organic compounds
PET . . . . Potential Evapotranspiration
PHARE. . . . . Programme of Community Aid to the Countries of Central and Eastern Europe
PHEWE . . . . Prevention of acute Health Effects of Weather conditions in Europe)
PRSP. . . . . Poverty Reduction Strategy Paper
PRTR. . . . . Pollutant Release and Transfer Register
QA . . . . Quality Assurance
QC . . . . Quality Control
RAPS . . . . Re-scaled Adjusted Partial Sums
RCC . . . . Regional Council for Cooperation
REIC . . . . Regional Center for Education and Information in SEE
REReP . . . . Regional Environmental Reconstruction Programme for South East Europe
RES . . . . Renewable Energy Sources
RET . . . . Real Evapotranspiration
RS . . . . Republic of Srpska
SAA . . . . Stability and Association Agreement
SEA . . . . Strategic Environmental Assessment
SEE . . . . Southeastern Europe
SFOR . . . . Stabilisation Force
SFRY. . . . . Socialist Federal Republic of Yugoslavia
SPI. . . . . Standardized Precipitation Index
SRES. . . . . Special Report on Emissions Scenarios
SWMS. . . . . Solid Waste Management Strategy
TAR(IPCC) . . . . Third Assessment Report
THI. . . . . Temperature-Humidity Index
TOE . . . . Tons of oil eqvivalent
UNDAF . . . . United Nations Development Assistance Framework
UNDP . . . . United Nations Development Programme
UNEP . . . . United Nations Environment Programme
UNFCCC . . . . United Nations Framework Convention on Climate Change
USAID . . . . United States Agency for International Development
USD . . . . United States Dollar
WSSD . . . . World Summit on Sustainable Development

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Ministarstva za prostorno uređenje,
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