Executive Summary

National Circumstances

Countrty Profile

Location	Southern Europe, central part of the Balkan Peninsula, 22° 41° 50'N, 22° 00'E; 25,713 km^2
Landforms	Macedonia is an elevated plateau of large, rolling hills and deep valleys, completely disected and surrounded by mountains. The Dinaric Alps extend down into Macedonia, and the highest point is in the Korab Mountain range, at 2,764 m. Major lakes include Ohrid (deepest lake in the Balkans), Prespa and Doiran. The Vardar River divides the country; other rivers of note include the Bregalnica and Cma.
Climate	Different climatic types and subtypes are combination of three major climate drivers: Mediterranean, Continental and Alpine.
Population	2,037,000 (year 2005) - Macedonian 64%, Albanian 25%, Turkish 4%, Roma 3%, Serb 2%, Bosniaks 0.5%, Vlachs 0.5%, Others 1% (Census 2002); Languages: Macedonian, Albanian, Turkish, Serbian; Religion: Orthodox 67%, Muslim 30%
Politics	Parliamentary democracy; Distribution of powers into the legislative (Parliament), the executive (the President of the Republic, the Government) and the judicial.
Economy	GDP: US$ 4.5 bn (2005); GDP per head: US$ 2,226.00 (2005); Annual growth: GDP Growth 3.8% (2005); Inflation: 0.5% (2005)

Climate Change – related Institutional and Policy Framework

UNFCCC Focal Point & DNA for CDM	Ministry of Environment and Physical Planning
Other Stakeholders	National Climate Change Comittee, Climate Change Project Office, UNDP/GEF, Academic sector, NGOs, Independent experts, International experts/Institutions, Private sector, Media
International Agreements	UNFCCC (ratified December 1997) and Kyoto Protocol (July 2004); Non-Annex I Country
National Strategic Documents	The First National Communication on Climate Change (March 2003); National Strategy for the First Commitment Period 2008-2012 according to the Kyoto Protocol (February 2007); National Strategy on Environmental Investments (to be adopted by the end of 2008)

Development Priorities and Objectives

National	National Strategy for Sustainable Development (NSSD); Second National Environmental Action Plan (NEAP II)
International (EU integration)	Transpsition and harmonization of EU legislation and implementation of the Stabilization and Association Agreement

National Greenhouse Gas Inventory

The national GHG inventory is prepared for the years 1999-2002 (with 2000 as base year), and covers the following **sectors**: Energy, Industrial processes, Agriculture, Land-use change and forestry, Waste and, for the first time, Solvents and other product use. Six **GHGs covered** by the UNFCCC are estimated: CO_2, CH_4, N_2O, HFCs, PFCs and SF_6. Beside these, information on indirect GHGs: CO, NOx, SOx and NMVOCs is provided. In addition, the GHG inventorying involved the following specific activities:

– Revision of the input data, taking into consideration data gaps and areas needing improvement identified in the stocktaking exercise. Again, the main source of information was the State Statistical Office (official yearbooks), as well as official data from other national institutions, such the MAFWE and MOI;
– Identification and development of methods for overcoming data gaps and application of higher Tiers for emissions calculation wherever possible;
– Recalculation of the time series for the period 1990-1998;

– Implementation of good practice elements to maximal possible extend: documenting and archiving (developing a full documentation of activity data and emission factors for the year 2000), QA/QC procedures, key sources analyses, uncertainty management.

This in turn resulted in a (more) **reliable time series 1990-2002** for the national GHG Inventories, reported in the National Inventory Report (NIR), complete and consistent **EXCEL database** (1996 IPCC EXCEL Spreadsheets), appended by the **full documentation of activity data and emission factors for the year 2000** (Documenting material).

The **total CO_2-eq emissions** in Macedonia range from 11.9 to 14.4 Mt CO_2-eq (for the year 2000 amount to 14,318 kt CO_2-eq) (Figure 1). Correspondingly, **the emissions per capita** for the year 2000 are 7.16 t CO_2-eq. The **main contributor** to the total CO_2-eq emissions is the energy sector with about 70% of the total emissions. The second biggest contribution comes from the agriculture sector with about 10-15%, while all other sectors are contributing with less then 10% each. The only exception is in the year 2000, when due to enormous forest fires, the emissions from the LUCF sector are about 14% of the total national emissions. About 75-80% of the equivalent emissions are direct CO_2 emissions from burning, 12-14% are CH_4 emissions, 5-9% are N_2O emissions and about 2% are CO emissions. The Figure 2 shows the contribution of the individual sectors and GHGs to the total CO_2-eq emissions for the base year (2000).

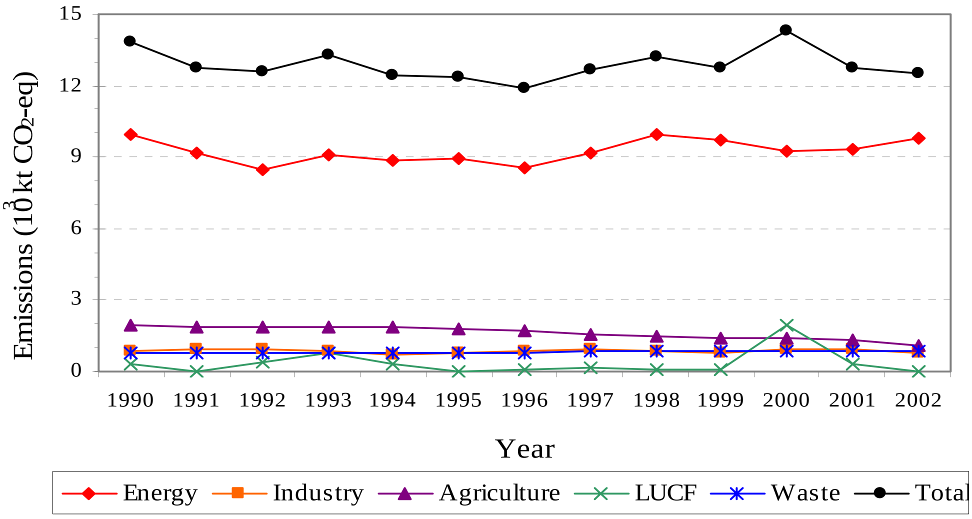

Figure 1. Sectoral and overall GHG emissions

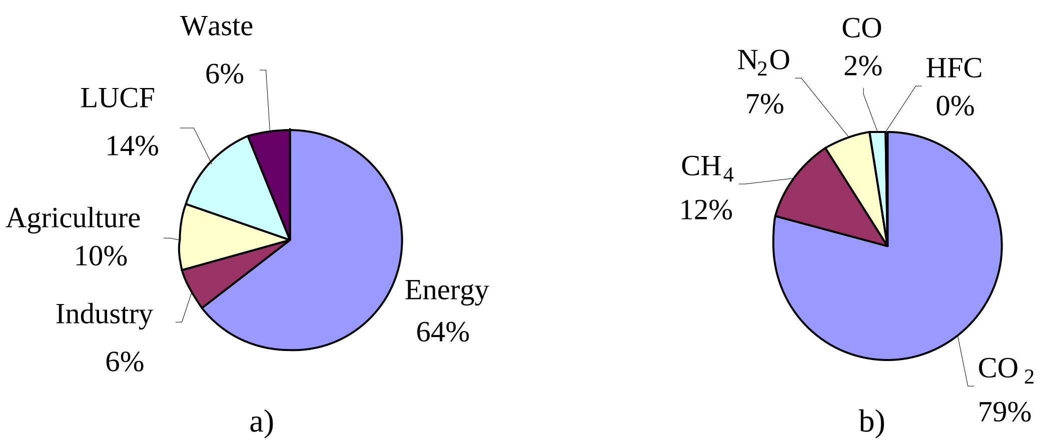

Figure 2. Sectoral contribution (a) and GHGs contribution (b) to overall emissions for the year 2000

Key Source Categories are identified using a predetermined cumulative emissions threshold of 95% of the total national emissions. It is shown that the most important key source in Macedonia is the Energy Industry (51.3%), which accounts for the GHG emissions from the lignite-fired power plants. The other key sources, which considerably lag behind, are: Road Transport (7.4%), Solid Waste Disposal on Land (6%), Enteric Fermentation (4.4%), Agricultural Soils (2.9%), Cement Production (2.9%) and Manufacturing Industries and Construction (2.9%).

The **uncertainty** related to GHG emissions from the Energy sector is estimated to 8.45%, while specifically for the major key source - Energy Industry, it amounts 10.75%. For the purposes of cross-check and verification, the uncertainty analyses were conducted by application of both, Tier 1 (analytical formulas) and Tier 2 (Monte Carlo simulations) methods, and the obtained uncertainty levels in both cases are almost the same.

In general, **considerable progress** has been acheaved in both, the i**nventory process itself** (technical capacity of inventory team, communication with data sources and other stakeholders, QA/QC procedures, documenting and archiving, regional cooperation), as well as the **results obtained** from the GHG inventarization conducted for the SNC (reliable data series for GHG emissions). However, there is still much room for improvements in order to enable application of higher-Tier methods in the subsequent inventories. The **methodological and technical reccomendations** involve:

- Developing country-specific lignite-conversion and CO_2-emission factor and CO-emission factor for lignite thermal power plants and lignite mines in Macedonia, as well as CH_4-emission factors for the fugitive emissions;
- Categorizing the combustion technologies in the non-energy industries (manufacturing industries and construction - industrial boiler plants and energy systems, district heating plants etc., transport, commercial institutional and residential etc.) and determination of category-specific emission factors;
- Incorporating the GHG emissions in the reporting scheme of the A and B IPPC installations;
- Developing CO_2 emission factors for metal production and cement production and improving the reliability of the relevant activity data;
- Establishing a farm register and Integrated Administration & Control System (IACS), for reliable agricultural statistics (including the population number of goats, mules and asses and practical measurements of some country's livestock characteristics;
- Developing a new forestry inventory including reliable data on wood decay, forest fires and illegal wood cut;
- Collecting data on the quantity and composition of the waste disposed at least at the bigger solid waste disposal sites

Furthermore, **a set of institutional and legislative measures** need to be undertaken in order to develop further the national capacity for archiving and updating inventory. A proper department on climate change shall be established and officially included within the MOEPP itself. Such a department shall serve as an advisory body to the MOEPP on issues related to climate policy and the implementation of the Kyoto Protocol, as well as with the EU Environmental Acquis on climate change issues. Identified institutions for different sectors need to be supplemented by existing infrastructure and technical expertise. In particular, deeper involvement of national institutions obliged for data collection (the State Statistical Office) is of crucial importance in order to make adjustments of the data collection methodology, aiming to cover identified GHG related data. Also the process of data management should be improved by adoption of a secondary legislation concerning data supply, processing, systematization, archiving both from the monitoring networks, as well as in accordance with the ratified international agreements. For mutual benefit, it is necessary to ensure linkages between GHG inventory and other pollutants inventories/cadastre, such as the Air Pollutants and Cadastre of Polluters.

Seen **in the light of EU accesion**, the more sophisticated GHG inventory will contribute towards providing a background for establishment of a national registry system, which will be country requirement. Before starting the designing process, a few amendments to the existing framework Law on Environment and to the Law on Energy are necessary in order to create background for creation of Law on GHG Allowance Trading and to transpose the Emission Allowance Trading Directive (EATD) into national legislation and for establishment of a Scheme for GHG Emission Allowance Trading. In that line, introduction of a learning-by-doing "pilot phase" for Emissions Trading for a two year period, aiming to strengthen capacities at the local authorities, companies and for the implementation of the system will be very helpful.

Vulnerability and Adaptation to Climate Change

Climate Change Scenarios up to 2100

Climate changes projections of the main climate elements (temperature and precipitation) are made for the 21st, i.e for the periods 1996-2025 (labeled 2025), 2021-2050 (labeled 2050), 2050-2075 (labeled 2075) and 2071-2100 (labeled 2100) in comparison to 1961-1990 (reference period labeled 1990). Six different climate scenarios for the appropriate sub-regions of Macedonia on the base of empirical downscaling were developed, as well as one scenario for entire country based on the direct Global Circulation Model (GCM) output. According to the results, **the average increase of temperature** is between 2.9°C in 2075 and 3.8°C in 2100, while t**he average decrease of precipitation** ranges from -8% in 2075 to -13% in 2100 in comparison with the reference period.

Sectoral Analyses

Figure 3. Vulnerability map

 Agriculture

The sub-sectors of crop production, soils and animal production are involved in the vulnerability analyses. The most important findings and recommendations are related to crop production. Hence, the following can be summarized regarding the expected **yield decrease** for vulnerable areas and crops as result of climate change impact (Figure 3):

1. In Stip, where most important crop is winter wheat, yield decrease from 14% in 2025, 17% in 2050, 21% in 2075 to 25% in 2100 is expected;
2. In Bitola, where most important crop is alfalfa, yield decrease from 58% in 2025, 62% in 2050, 66% in 2075 to 70% in 2100 is expected;
3. In Strumica, where most important crop is tomato, yield decrease from 72% in 2025, 75% in 2050, 79% in 2075 to 82% in 2100 is expected;
4. In Gevgelija, where most important crop is tomato, yield decrease from 75% in 2025, 78% in 2050, 81% in 2075 to 84% in 2100 is expected;
5. In Kavadarci, where most important crop is grape, yield decrease from 46% in 2025, 50% in 2050, 55% in 2075 to 59% in 2100 is expected;
6. In Skopje, where most important crop is winter wheat, yield decrease from 8% in 2025, 12% in 2050, 16% in 2075 to 21% in 2100 is expected;
7. In Resen, where most important crop is apple, yield decrease from 46% in 2025, 50% in 2050, 55% in 2075 to 59% in 2100 is expected;
8. Central Vardar Valley (Kavadarci, Negotino, Gradsko, inflow of rivers Crna and Bregalnica in river Vardar) **is the most affected area** with negative effect of climate changes in agriculture.

Total **direct economical damage** from yield decrease for winter wheat, grape and alfalfa would amount almost 30 millions Euros in 2025 and will increase up to 40 millions euros in 2100.

The **adaptation measures** involve irrigation, soil and water conservation, genetic and plant breading measures, new agricultural practices etc.

Biodiversity (Figure 3)

1. Alpine zone: It can be expected that most of the present alpine pastures will disappear. Significant disturbance is expected for high mountain pit bogs, source areas and upper flows of the streams and rivers. Some of the high mountain springs and all of the pit bogs will dry-out and thus, all of the plant and animal species that are characteristic for these habitats will dissapear. These threats are even more significant for other Macedonian high mountains: Korab, Jakupica, Nidze, Pelister etc;
2. Refugial communities: The changes would be so significant and fast that the species will not be able to adapt to the new conditions and to shift neither horizontally nor vertically. Thus, it can be expected that most of the refugial communities will disappear;
3. Pseudomaquis (Submediteranean oak shrubland): Climate change will show positive effect on the distribution of pseudomaquis in Macedonia. This habitat type will broaden its distribution range northwards and upwards. Positive effects of the climate change can be expected for some xeric grassland communities as well. However, the extent of the expansion will depend on agricultural activities (especially crop growing and grazing);
4. Nidzhe and Mariovo: Although the vertical movement of the vegetation on this mountain range is possible, it can be expected that the vertical shift will be disabled by several obstacles. It is hard to believe that migration of species will occur with same speed as the predicted speed of climate change;
5. Dojran Lake: The lake ecosystem and surrounding wetlands will suffer catastrophic consequences. Dojran Lake makes good example of the changes that will happen during the climate change since similar disturbance was recorded in the previous period. Huge financial resources will be needed in order to maintain satisfactorily balance of the ecosystem;
6. Swamps and temporal/intermittent wetlands: These habitats are characterized by the presence of endemic and relict species of crustaceans and other animal species as well as some rare plant species for Macedonia. It is almost certain that the underground waters will decrease and part of these ecosystems will dry-out. As a result, many important species for Macedonia will face disappearance. The most threatened are the Pelagonija wetlands, Negorci swamp, Monospitovo swamp etc.

The most important **adaptation measures** involve: Preservation of the last remains of riparian communities in Vardar valley; Elaboration of distribution map of the major ecosystem types, map of biomes and mapping of habitats and vegetation types; Development of sufficient network of meteorological stations; Strengthening capacities of the staff .

Forestry (Figure 3)

1. Concerns entire territory of Macedonia: According to the official climate change scenarios for Macedonia, and also from experiences, possible impacts up to year 2050 in the forestry sector are:
   - More intensive process of forest dieback, particularly in the oak's belt;
   - Migration of tree species toward higher altitudes and change of floristic composition of current forests;
   - Increased population of some pests (particularly insects and fungi), because of physiological stress of trees;
   - Increase in number of forest fires and burned area.

   These impacts will increase expenses in the forestry sector and are expected to cause significant economic damages.
2. Veles is most affected region. From 1999 to 2006: 145 forest fires; 15,226.3 ha burned area; **economic damage** was estimted to 24 million Euros.

The most important **adaptation measures** involve: Forest rehabilitation with the local endemic oak species and other endemic varieties through introduction of silvicultural and planning measures; Strengthen preventive measures that improve forest management and minimize the risks of fires; Increase monitoring and observation pilots in the most vulnerable and economically valued forests.

Health (Figure 3)

1. Mortality (concerns entire population of Macedonia): Due to climate changes, in the next decades, decrease of several percents in some of the colder months is expected regarding the total annual monthly mortality (January 4%, October 4%, November 2%). On the other hand, in the warmer months increase of 4-11% of the total annual monthly mortality is expected (mostly in April, May, June and it will be average 10% higher than the period 1996-2000);
2. Heat waves (concerns entire population of Macedonia): Persons with health problems, especially cardiovascular and respiratory diseases have high risk of increased mortality during heat waves. Deprived communities, lacking wealth, social institutions, environmental security and robust health, are likely to be at greatest risk of adverse health effects from climate and other environmental changes;
3. Foodborne diseases (concerns entire population of Macedonia): The seasonal index by months and the number of registered patients affected by sallmonelosis for the period 1980-2005 in the Republic of Macedonia and the projection for 2030 showed two picks in summer months which are not well expressed and one possible in winter months because of decreasing the average monthly temperature in future period;

The most important **adaptation measures** involve: Control and monitoring of entire food chain; implementation of Weather Early Warning System alarming timely the population, particularly vulnerable groups, about extreme weather events; Education, awareness raising and creation of legal frameworks, institutions and an environment that enables people to take well-informed decisions.

Water Resources (Figure 3)

Descending linear trends of minimal, average and maximal annual discharges are observed in the rivers: 1. River Vardar-Skopje, 2. River Vardar-Demir Kapija, 3. River Radika-Boskov Most, 4. River Strumica - Novo Selo, 5. Crna Reka – Skocivir, 6. River Bregalnica-Oci Pale, 7. River Bregalnica-Stip, 8. River Treska-Makedonski Brod. For the series of average annual discharges, percentage of reduction of the average discharge for 2000-2003 compared with 1961-1970 ranges from 33.4 to 58%;

9. Ohrid Lake: Oscillations of the water level are rather small and they are a result of the controlled outflow of the river Crni Drim from the lake;
10. Prespa Lake: There were average oscillations of the water level in the period 1961-1986, from when the water level started drastically to drop-down. Absolute annual minimum of the water level of -445 cm occurred in 2002;
11. Dojran Lake: Oscillations of the water level were relatively balanced until 1986, when drastic drop of the water level started and lasted until 2002, causing ecological disaster. Absolute annual minimum of the water level of -388 cm occurred in 2002;
12. Water outflow: Oscillations of the available water resources are much higher in the last 40 years. The linear trend of the water quantities which outflow from Macedonia is descending, with a drop of around 70 million m^3 on annual level.

The high priority **adaptation measures** are proposed in the following domains: Irrigation and water supply of population, floods and droughts, erosion and sedimentation, water resources management; water quality and monitoring.

Several major **constrains and gaps** were identified during preparation of the thematic studies on vulnerability assessment. The most persisting one is a problem in data availability, consistency and transparency. Existing monitoring in climate and groundwater conducted by Hydro Meteorology Service in the country is facing permanent problems in operation, slow modernisation of equipment, reducing of monitoring network etc. Soil monitoring does not exist, as well as ground water monitoring. Basic maps and data bases are very old and/or hardly available (soil map, vegetation map, land use map etc.). Modern tools for vulnerability assessment are needed almost in all vulnerable sectors (hardware, software and training of personnel).

Opportunities for implementation of adaptation measures are related to accumulated knowledge and awareness among scientific community about climate change and knowledge about vulnerable sectors and adaptation measures. Very important opportunity, especially in agricultural sector is the accumulated experience to cope with drought and high temperatures and existing indigenous technologies and crop varieties used in the country. Decision-makers, especially from MOEPP are aware of the problem and there is interest for adaptation strategies. Recently NGO sector became more interested in climate change issues especially due to GEF Small Grant program that is supporting activities in climate change operational program. On the other side, **the barriers** lie in the capacity constraints at systemic, institutional and individual levels.

Intersectoral Adaptation Action Plan was developed for the period 2008-2011. It involves four major areas: Institutional and legal measures; Identification, assessment and mitigation of climate change negative impact; Monitoring; Strengthening capacities at institutional, systemic and individual level.

Also, some **specific projects** were proposed for financing **-** three from the water resources sector, one from agriculture and two from biodiversity. Further efforts should be employed in order to **set national criteria** and to make **prioritization** among and within the vulnerable sectors. The **most attractive projects** would be the ones coming from the highest priority sectors and also from the intersection of two or more vulnerable sectors (**synergetic approach**). The **linkages with climate change mitigation** should also be considered, as well as possibilities for **realization of the adaptation projects at regional level.**

Climate Change Mitigation

The **main aim** of the analyses is to assess the climate change mitigation potential of the country following the projected developmental lines of the national economy. In Macedonian conditions the mitigation analyses target the folowing **sectors**: Electric Power, Industrial Energy Transformations and Heating, Transport, Waste and Agriculture. For each of the sectors several developmental scenarios for the **period 2008-2025** are defined – **baseline (business-as-usual) scenario** and **mitigation scenarios** which include appropriate mitigation measures/practices/ projects/interventions. The optimal year of implementation for the most of the measures was defined, imposing maximal emission reduction and minimal expenses as optimization criteria.

Electric Power

In line with the projected growth of the national economy, the electricity consumption will constantly increase with assumed annual growth rate of 3.5% in the first 10 years and of 3% in the second 10 years of the analyzed period. The goal of the power system expansion planning is to cover the electricity needs, taking into account the production capacity over the analyzed period of the existing power plants (including reserves of the existing energy sources), as well as the real possibilities for building new generating capacities.

The **baseline scenario** is based on the thermal power plants with domestic lignite.On the candidates' list are the following TPPs: TPP Mariovo with 209 MW net, the fourth unit of TPP Bitola with the same capacity of 209 MW net, new TPP Negotino at the same location as the existing one with 300 MW net (supplied with domestic lignite from the new mine nearby).

The **first mitigation scenario** is the variant of utilizing the capacity of the gas pipeline for electricity generation in two gas CHPs. One of them is the planned CHP Skopje with installed power of 234 MW which is under construction, and the second one is CHP with installed power of 300 MW with still not defined location. These CHPs would replace the the lignite-fired candidates from the baseline scenario (TPP Mariovo and TPP Negotino).

The **second mitigation scenario**, besides CHPs, assumes reduction in electricity needs for about 2000 GWh, which is a result of the liberalization of the electricity market for large industrial consumers (Feni, Silmak and the Steel Industry). Furthermore, it assumes that at the end of the planning period, the year 2025, the cumulative effect of the progressively increasing utilization of renewable energy sources (small hydro, wind and biomass) for electricity generation is generated annual amount of 180 GWh. In the applied model for power system expansion planning, this effect is embodied by introduction of a small hydro power plant with capacity of 25 MW and annual production of 45 GWh every four years (2010, 2014, 2018 and 2022).

All three developmental scenarios assume operation of the existing thermal - TPP Bitola (3 x 209 MW net) and TPP Oslomej (1 x 109 MW net) and hydro power plants until 2025. Also all three scenarios incorporate the same HPPs candidates: Boskov Most, Cebren and Galiste.

The scenarios are developed by making use of the **software tool WASP** (Table 1), which provides for fully satisfying the electricity needs, with minimal emissions related to electricity production and with minimal total costs (investments, fuel and O&M costs).

Table 1. Schedule of the new electricity production capacities (result of the WASP optimization process)

	BASELINE SCENARIO			**FIRST MITIGATION SCENARIO**			**SECOND MITIGATION SCENARIO**	
Start year	Candidate	P (MW)	Start year	Candidate	P (MW)	Start year	Candidate	P (MW)
2008								
2009			2009	*Gas CC (CHP Skopje)*	*234*			
2010	HPP Boskov Most	66	2010	HPP Boskov Most	66	2010	HPP Boskov Most	*66*
	TPP Bitola 4	209					*Gas CC (CHP Skopje)* **25MW (REN)**	234
2011								
2012								
2013								
2014							**25MW (REN)**	
2015	HPP Galiste	194	2015	*Gas CC*	*300*	2015	HPP Galiste	194
	TPP Negotino coal	300						
2016			2016	HPP Galiste	194	2016	*Gas CC*	*234*
2017								
2018			2018	HPP Cebren	280		**25MW (REN)**	
2019	HPP Cebren	280				2019	HPP Cebren	280
2020	TPP Mariovo	209						
2021								
2022						2022	*Gas CC* **25MW (REN)**	*300*
2023			2023	TPP Bitola 4	209			

Other sectors

The **baseline scenarios** in all other sectors are based on the assumptions in the respective sectoral strategies, although it should be noted that the mitigation analysis was constrained by the lack of sectoral developmental plans, relevant data (historical and present), as well as other relevant national studies. Reduction in GHG emissions (**mitigation scenarios**) from other sectors would be achieved through improving energy efficiency in the industrial sector and households, promotion of sustainable transport, implementation of landfill gas collection and flaring technology, implementation of systems for biogas collection and combustion at pig farms etc.

The **environmental evaluation of the scenarios** (detailed calculations of GHG emissions and local pollution) is performed by making use of the **sowtware tool LEAP**. As per the projections for GHG emissions presented in Table 2, a considerable increase in the total GHG emissions by the year 2025 will occur compared to the projected value for the year 2008 (in absolute value of 9,900 kt CO_2-eq, or relatively about 71%) if the usual practice is applied without imposing the constraint for GHG emissions reduction (basleine scenario).

The situation can be improved if the developmental paths integrate practices/measures leading to GHG emissions reductions. Hence, the first mitigation scenario (as defined in the sectoral analyses) leads to 46% increase of 2025-value of the total emissions compared to 2008-total emissions or absolute difference of 6,400 kt CO_2-eq. This increase in the total emissions is further reduced to 32% (absolute difference of 4,000 kt CO_2-eq) if the developmental paths follow the second mitigation scenario.

Table 2. Total GHG emissions at the begining and at the end of the analyzed period

	2008-total GHG emissions [kt CO_2-eq]	2025-total GHG emissions [kt CO_2-eq]
Baseline scenario	14,040	23,947
First Mitigation Scenario	13,904	20,348
Second Mitigation scenario	12,645	16,713

The major rise in the electricity-related emissions (absolute difference of 6,400 kt CO_2-eq and 78% relative increase to the 2008 value) reflects the so-called black, lignite-based baseline scenario for the national power sector (Figure x, a). Under baseline scenario, the other sectors also exhibit significant rise in the GHG emissions, as the 2025 values compared to the 2008 values are 75% (transport), 71% (heating and industry), 60% (agriculture) and 6% (waste) higher (Figure 4a). Largest achievement under mitigation scenarios is associated with the electricity sector. Namely, the relative increase of the electricity-related emissions is reduced to 14% by the second mitigation scenario as a result of introduction of the gas fired CHPs, reduction of the electricity consumption for the value of the large consumers and introduction of renewable energy sources (Figure 4b).

The mitigation analysis was finalized with **National Action Plan for Climate Change Mitigation** which incorporates measures/practices/projects/interventions in each of the sectors that contribute to reduction in GHG emissions. In wider sense, the National Action Plan also defines country specific instruments which will enable implementation of the proposed direct measures (Economic and fiscal instruments; Regulations and standards, Voluntary agreements; Information and public awareness; Research and development). These "non-technical" measures of the national climate change mitigation action plan, in fact, provide linkages and **diffusion of the climate change mitigation objective into all the other relevant national policies** (energy, industry, transport, agriculture, forestry, environment, waste management, etc.).

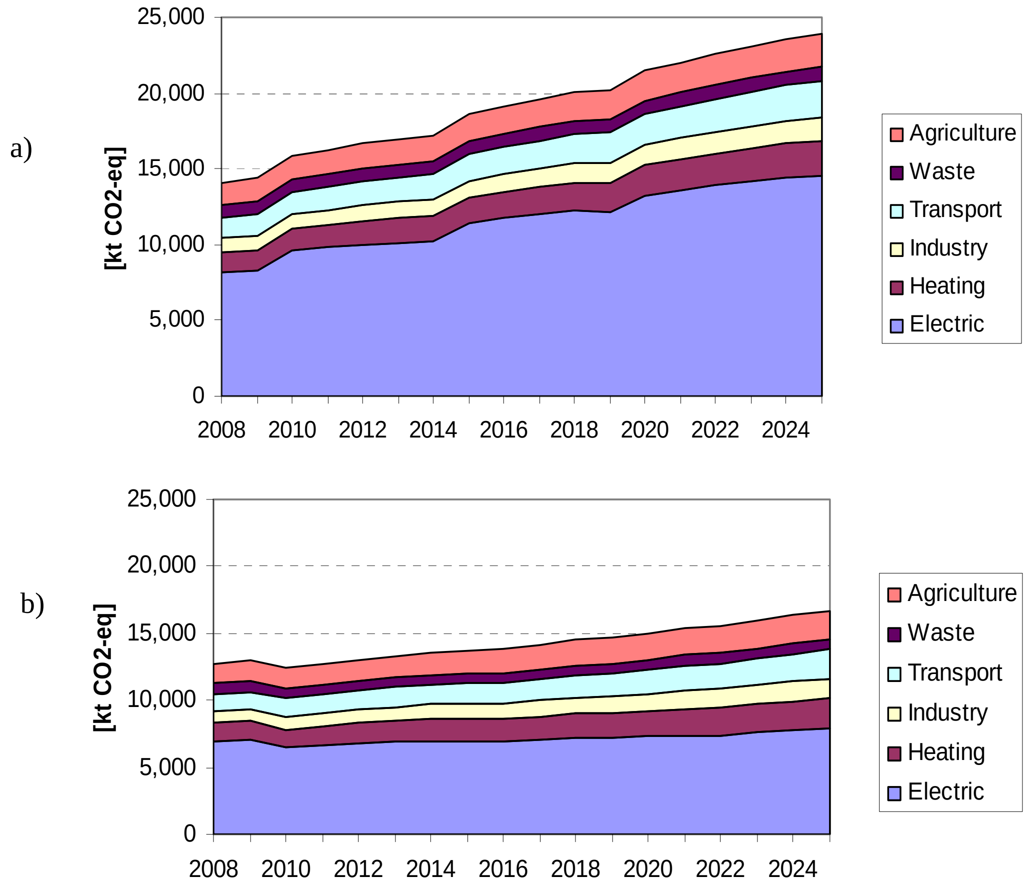

Figure 4. Projections of the sectoral and the total GHG emissions:
a) Baseline scenario; b) Second mitigation scenario

Other Relevant Information

Transfer of Technologies

The comprehensive assessment of the prospects for transfer and diffusion of climate-change-friendly technologies in Macedonia was realized under the top-up actiivity between the two National Communications. Sixteen mitigation options were evaluated, along with the emerging barriers and ways for their removal. The evaluation is performed using GACMO costing model, which compares each mitigation option with the baseline and determines its economic and environmental effectiveness. The resulting marginal cost curve indicates a **total achievable reduction** of 20% with respect to baseline emissions. The finding that almost half of the considered options are of win-win type represents the **main driving factor** for the technology transfer, although, reducing the baseline emissions for less then 3%, these options have relatively low environmental effectiveness. On the other hand, options with largest mitigation potential are most difficult for implementation, mainly due to the lack of financing and low prospects for attracting foreign investments. Furthermore, there is a limited awareness for the need to incorporate energy efficient and environmentally favorable technologies into private and public decision-making, which is additionally impaired by the uncertainty related to the energy and economic savings expected from those technologies. Also, the country lacks a necessary infrastructure in terms of institutions, legislative framework and economic incentives, as well as individuals capable to deliver the required technical, managerial and financial services.

Systematic Observation

Measurments, monitoring and research related to climate-meteorological and hydrological parameters in the country are performed by the **Hydro Meteorological Service (HMS).** Meteorological observing system in the country consists of 14 main meteorological stations, 19 regular climatological stations, 26 phenological stations, one aerological station, 6 hailsuppression centres and about 200 precipitation stations as well. There are also two automatic stations installed in Gostivar and Skopje-Zajcev Rid. 27 meteorological stations in the country provide different types of meteorological reports as a part of the World Weather Watch. The HMS also monitors surface and groundwater quantities.

The Project **River Monitoring System in Macedonia** (RIMSYS) supports the authorities of Macedonia in strengthening their capacity to document long-term changes in the water pollution and the hydrological regimes of the most important rivers of the country. Project RIMSYS started with a first phase in 2000, with the objective to improve monitoring system on rivers with installation of 18 river monitoring stations and the environmental laboratory at the HMS.

Regarding the air pollution, monitoring includes: air quality monitoring; measuring of stationary sources emission; monitoring and assessment of trans-boundary, long-range distribution of air pollutants; monitoring of those pollutants which have a great impact on human health.

Research and Development

The climate change is among the research areas of many academic institutions in the country. Hence, The Research Center for Energy, Informatics and Materials of the Macedonian Academy of Sciences and Arts **(ICEIM-MANU)** has been acting in the field of climate change for more then a decade, preparing the National Inventory and Mitigation Analyses for the purpose of the National Communications as well as carring out climate-change-and-energy related research at national and international level. The **Faculty of Civil Engineering** is involved in the bilateral research project dealing with advanced water management practices. The **Institute of Agriculture** is active in the similar field, participating in a regional research focused on transboundary lakes in South Eastern Europe. **Faculty of Agricultural Sciences and Food** is participating in several regional projects aimed at exchange and transfer of know-how and expertise for adaptation to climate change. Furthermore, **Faculty of Mechanical Engineering**, with its **Center for Climate Change and Energy Technologies** and **Center for Cleaner Production**, is active in the field of climate change mitigation and technlogy transfer. A good example of partnership between science and policy-making is the cooperation of the **Faculty of Technology and Metallurgy** wich jointly with MOEPP participated in EU FP6 project related to eco-houses and innovative eco-efficient materials.

It can be concluded that in Macedonian conditions the Research and Development (R&D) becomes decisive factor in all the efforts to limit climate change and its costs and negative effects to society and the environment. Moreover, the climate-change-related R&D is being built upon the following two elements: **translational research** (establishing/strengthening the partnerships of type academia-businesses, academia-policy-making or even academia-businesses-policy-making) and **international cooperation** (in particular, participation in EU Framework Program 7, where climate change is among the top priorities for cooperation).

Education and Traning

The environmental issues, especially climate change are not sufficiently present in the educational curricula of primary and secondary schools and the universities. However, the relevant institutions and individuals are aware of the need to increase the coverage of these issues at all educational levels. Good examples of integrating climate change issues in their syllabuses are: The Postgraduate Programmes at Faculty of Mechanical Engineering, and Faculty of Agriculture, as well as the Environmental Management Postgraduate Study at Southeastern European University.

Public Awareness

A variety of public awareness activities with different means and target groups with have been implemented by MOEPP, Climate Change Project Office, NGOs, national experts and policy-makers, as well as intergovernmental multilateral organizations (like UNDP).

However, in order to provide for organized and sinhronized approach, development of a **National Survey** to assess needs and requirements for implementation of Article 6 of the UNFCCC can be recommended. The survey should be followed by the overall **Communication Strategy on Climate Change** which after its implementation stage will bring change to our behavior and way of doing things. The main goal of the strategy will be not only to raise visibility in this direction, but also to mobilize and promote new partnerships in order to achieve a higher degree of general awareness and encourage actions to be taken by all stakeholders (Government, private sector, donor community, civil society, media and general public). The partnership-building component will aim at creating synergies with all the interested parties, a range of actors whose contribution is critical and in particular the private sector. By such an approach, better mutual understanding between policy-makers and the public on climate change issues, with a special focus on the private sector as key driver, will be achieved.

Capacity Strengthening

The capacity strengthening (institutional set-up, legislation and regulation, human capacities) is addressed in all thematic areas of climate change, as a part of the respective action plans and follow-up recommendations.

Information and Networking

The national climate change web site www.unfccc.org.mk is the most important national source of information. There are many good examples of networking and regional/international partnerships and exchanges: Successful cooperation and knowledge exchange with recognized Slovenian climatologists; Belgrade Initiative, aimed at enhancing regional cooperation of interested South-Eastern European countries in the field of climate change; Experience sharing among experts worldwide, as well establishing links for future cooperation in potential regional projects through the Knowledge Network for Second National Communications from Non-Annex I Parties to UNFCCC, established by the National Communication Support Programme.

Financial Resources and Technical Support

The budgets of the relevant ministries (MOEPP, Ministry of Education and Science, MAFWE) do not contain direct allocations for climate change issues, so these projects are mainly financed/co-financed by international institutions (GEF Small Grant Programme, World Bank).

In general, the available financial support (particularly national one) of climate change activities in the country is scarce and limited, so there is an urgent need for fund-rising, involvement of private sector and awareness rising of policy-makers.