MINISTRY OF ENVIRONMENT
AND PHYSICAL PLANNING
REPUBLIC OF MACEDONIA

3 THIRD NATIONAL COMMUNICATION ON CLIMATE CHANGE

1 EXECUTIVE SUMMARY

1.1. COUNTRY PROFILE

The Republic of Macedonia is a small (25,713 km^2), landlocked country that is located in the middle of the Balkan Peninsula in Southern Europe. It has a diverse **topography** with high mountains and deep valleys surrounded by mountains, picturesque rivers, large and small natural lakes, and spas. **Land use** for agriculture covers almost 50% of the surface area of the country, and forests cover approximately one third of the country. The country is divided into four river basins and has three large natural lakes. Macedonia is a "hotspot" for **biodiversity** in Europe, and over 16,000 species have been recorded in Macedonia, including 854 endemics. Eight of the nine biomes in the Balkan Peninsula can be found in the country.

In spite of the relatively small area of the Republic of Macedonia, the country has a diverse **climate**, with eight climatic regions. With the exception of 2011, the six most recent years (2007-2012) were among the ten warmest years for the period between 1951 and 2012, and a heat wave has been recorded in almost every year since 1987. Two basic pluviometric regimes are present in Macedonia: Mediterranean and continental. The areas with highest **precipitation** are the mountain ranges in Western Macedonia; the driest areas of the country are Ovche Pole, Tikvesh and the surroundings of Gradsko,

According to the most recent census in 2002, Macedonia has a **population** of 2,022,547, with an average density of 78.7 inhabitants per square kilometre. The average household had 3.58 members in 2002, down from 4.68 members in 1971, and the current trend is one of aging. In 2007, **life expectancy** at birth was 73.54 years (76 for females and 71 for males), while disability-adjusted life expectancy was 63 years. The 2005 birth rate was 11.04 per 1,000 population and the mortality rate was 9 per 1,000, resulting in a natural increase of 2 per 1,000 population. Chronic diseases present the biggest burden on public health and high-priority environmental health issues include access to safe drinking-water in rural areas, access to sanitation, waste and waste water management, chemicals and pesticides; and indoor air quality.

The Republic of Macedonia became an independent state on September 8, 1991, following the disintegration of the former Socialist Federal Republic of Yugoslavia, and it became a candidate for membership in the European Union (EU) in December 2005. The **political system** is a parliamentary democracy. As a small country, the Republic of Macedonia has a relatively open **economy** where foreign trade accounts for more than 90% of GDP. The **agriculture** sector, including the value added in the processing industry, contributes 11.5% of the country's GDP and provides employment to 21.7% of the workforce.[1] According to the latest data from the State Statistical Office, in 2012 the GDP decreased for 0.4%. In 2011, the unemployment rate in 2011 was 31.4%.

The Republic of Macedonia is a party to the United Nations Framework Convention on Climate Change (UNFCCC) as a non-Annex I country and party to the Kyoto Protocol without a quantified emissions limits and reduction commitment (QELRC). However, the country has acceded to the Copenhagen Accord, and it submitted a list of non-quantified mitigation actions. The First National Communication on Climate Change (FNC) and the Second National Communication (SNC) were adopted by the Government of Macedonia and submitted to the UNFCCC Secretariat in 2003 and 2008, respectively. In addition, the First Biennial Update Report will be carried out in the coming two years.

In terms of **climate change institutions**, the Ministry of Environment and Physical Planning (MOEPP) is the key governmental body responsible for development of climate change policies, the National Focal Point to the UNFCCC, and the Designated National Authority (DNA) for Kyoto Protocol implementation. MOEPP has a Climate Change Project Office, and most other relevant ministries have appointed Climate Change Focal Points, who are responsible for mainstreaming climate change into respective policies, strategies and programmes; for example, the Ministry of Health established a National Committee for Climate Change and Health in 2009 to serve as the responsible body for surveillance activities and decision-making. At the broadest level, a National Climate Change Committee (NCCC) was established by the Government consisting of representatives of all relevant stakeholders: government bodies, academia,

[1] Source: State Statistical Office

private sector and civil society. Climate change issues are incorporated into **legislation** in the Law on Environment, which details the preparation of GHG emissions inventories (Article 188) and an action plan for mitigation.

A cross-cutting **development priority** for the Republic of Macedonia is accession to the EU. The country has already initiated the process of harmonizing with EU commitments to the UNFCCC and relevant sections of the EU *acquis communautaire*. The Republic of Macedonia is not currently under any obligation to enter the EU emission trading system (ETS), but it may do so voluntarily. National priorities are also expressed in the National Strategy for Sustainable Development (2010) and the Second National Environmental Action Plan.

1.2. NATIONAL GREENHOUSE GAS INVENTORY

The national greenhouse gas (GHG) inventory was calculated for the years 2003-2009. Country-Specific Emission Factors were established for key source categories for the first time in this round of reporting, making possible the use of Tier 2 methodologies for some sectors. The five key source categories that were established for the Republic of Macedonia are as follows: CO_2 emissions from Energy Industries (coal, lignite); CO_2 emissions from Mobile Combustion, including Road Vehicles; N_2O (Direct and Indirect) emissions from Agricultural Soils; CH_4 emissions from Solid Waste Disposal Sites; and CH_4 emissions from Enteric Fermentation in Domestic Livestock.

Total direct GHG emissions in Macedonia for the year 2009 amounted to 10,252 kt CO_2-eq including land-use, land-use change and forestry (LULUCF). National emissions per capita in that year amounted to 5.6 t CO_2-eq. Emissions originated primarily from the Energy sector (73%, ranging mostly between 8,500-9,000 kt CO_2-eq per year), followed by Agriculture (13%, decreasing from year to year due to decreasing numbers of livestock) and Waste (7%, rising due to population growth). The Industry sector produces 7% of the country's emissions. The Land Use, Land-Use Change and Forestry sector accounts for 3–10% of emissions, depending on the amount of forest fires, the management of soils (limestone and fertilizer application) and the conversion of land in the specified year.

Looking at the direct GHGs, CO_2 accounts for 75–80% of emissions for the period covered (mostly from the burning of fuels in the energy sector), CH_4 accounts for 12–14% of emissions (mostly from agriculture and waste), N_2O accounts for 7–9% of emissions (from burning fuels and emissions from soils) and 1–2% are HFCs from the industry sector. For the indirect GHGs, Most of the NO_x (7% of total indirect GHG emissions in the period covered) and CO (32%) emissions come from the energy sector, from the transport and energy industries (coal, lignite), and from burning in agriculture (crop residues) and LULUCF (forest fires). NMVOC emissions (25%) originate from the industry sector, especially from mineral production processes, and a smaller share from the transport sector and from solvent use, while most SO_2 emissions (36%) arise from the energy industries, construction and transport.

A new institutional system was implemented to ensure the sustainability of the process of preparing GHG inventories. In addition to this, the Law on Environment was amended in order to establish a national system for the collection and management of data needed for the development of national GHG inventories. As part of the process, the National Climate Change Committee (NCCC) has been re-formed and was closely involved in the TNC preparation process. The development of country-specific emission factors was made possible due to the provision of data by private sector point-source installations and other national and governmental institutions, including the Chamber of Commerce and the State Statistical Office. This resulted in the introduction of several subsectors for the first time –such as aviation—and the introduction of a higher Tier methodology in many sub-sectors, including the cement industry, aviation, and railway transport.

Recommendations for future improvement of the inventory include:

- Developing local, sub-national inventories;
- Developing fuel-specific and combustion-specific emission factors for road and railway transportation;
- Establishing a national reporting system for GHG emissions by industry;
- Collecting the detailed information needed for estimating CH_4 emissions from enteric fermentation from cattle using a Tier 2 approach;
- Development of a forestry inventory that will enable attaining greater precision in estimates of GHG emissions from land use, land use change and forestry (LULUCF); and
- Undertaking additional measures to enhance the capacity for obtaining data on the waste sector.

1.3. VULNERABILITY AND ADAPTATION TO CLIMATE CHANGE

1.3.1. Climate variability

Analysis of the multi-year variation of the mean annual temperature shows that in the most recent 20 years (1994- 2012) the mean annual temperature has been constantly higher than the multi-year average. Differences in the mean annual temperature in comparison with the period from 1961 to 1990 range from 0.2°C to 0.5°C. This is consistent with results from the broader region. The warmest years recorded on the territory for the period between 1951 and 2012 and for which data from all meteorological stations are available are 1952, 1994, 2008, 2007 and 2010. The highest maximum air temperature in the country – an unprecedented 45.7°C – was measured in Demir Kapija on July 24, 2007. A similar analysis of precipitation for different regions of the country by years and by seasons – with a special focus on May and November as the months with the most rainfall throughout the year – indicated a general trend of decrease in rainfall. However, due to the fluctuations in levels of precipitation from year to year, it is difficult to establish the exact amount of this decrease in annual precipitation totals.

Analysis of data on extreme weather events (1961-2012) indicated that the number of summer days has increased significantly in recent years compared to the number at the beginning of the analysed period. Similarly, there has been a significant increase in the number of tropical nights in recent years. An analysis of cold waves and cold weather concluded that cold waves occurred much less frequently than heat waves. While there was a general trend of decline in the number of ice days per year, there was no general change in the number of annual frost days.

1.3.2. Climate change scenarios up to 2100

Climate change projections were carried out with the use of the MAGICC/ SCENGEN software package Version 5.3. Six IPCC SRES/AR4 scenarios were used in the process: A1B-AIM, A1FI-MI, A1T-MES, A2-AS, B1-IMA and B2-MES, and air temperature and precipitation changes were assessed for the period 2025–2100 (reference period: 1961–1990). Data from 18 models were used in the estimation, generating results for two central geographical points. Scenarios were generated for four characteristic years, for each central point, for each of the three values of climate sensitivity, and for each of the six scenarios. Values were produced for air temperature and precipitation changes monthly and seasonally.

The modelling results led to the following conclusions:

1. It is probable that there will be a continuous increase in temperature in the period 2025– 2100;
2. Compared with the period 1961–1990, the predicted changes for the period 2025-2100 will be most intense in the warmest period of the year;
3. It is possible that the average monthly temperatures at the turn of winter into spring will be levelled in this period;
4. A decrease in precipitation is predicted in the period 2025–2100, in all seasons and at the annual level, with the maximum decrease in the summer season;
5. The intensity of changes is greatest in the warm part of the year (in July and August, there may be no precipitation at all); and
6. In the cold period of the year, decreases in precipitation of up to 40% of the average monthly quantities are predicted.

In order to examine the robustness of their findings, the modellers also studied differences between the findings obtained and findings from three previous modelling efforts that produced projections for the Republic of Macedonia. The primary cause for the differences in the results was judged to be the use of different principles when estimating changes.

1.3.3.Sectoral vulnerability and adaptation analyses

An analysis of impacts, vulnerability and adaptive capacity was undertaken for eight sectors (agriculture and livestock, biodiversity, forestry, human health, tourism, cultural heritage, water resources, and socio-economic development) with a special focus on the Southeast (SE) Region, which was identified in both previous National Communications as being especially vulnerable to climate change.

Water resources in the Republic of Macedonia are sensitive to climate change with regard to both quantity and quality. Total average precipitation is expected to decrease by 8% in 2075 and 13% in 2100. Reductions in available surface water for the Vardar River are estimated at 7.6% in 2025 and 18.2% in 2100 and for the Bregalnica River at 10% in 2025 and 23.8% in 2100. Groundwater recharge in the Vardar River Basin will decrease continuously, reaching approximately 57.6% of current recharge levels in 2100. In conclusion, overall water availability in the Republic of Macedonia is expected to decrease by 18% in 2100. The Strumica River Basin (1,649 km^2, or 6.4% of the territory of the Republic of Macedonia), which is relatively poor in water resources, is a vulnerable region in both cases/ scenarios.

Significant barriers to adaptation in the water sector include poorly designed and maintained irrigation systems, unregulated use of surface and groundwater, lack of reliable data on water consumed for irrigation, water pricing practices, and ineffective implementation of the Law on Water. Priority adaptation measures should therefore focus on the development and improvement of water storage and supply infrastructure; coordination of water use; introduction of water-saving measures; improvements in water supply and use techniques in agriculture and industry; pricing and management measures for the energy sector; and measures related to disaster risk reduction.

The negative effect of climate change on **agriculture** in the Republic of Macedonia is increasing. The agricultural sector as whole, and particularly small farms, are expected to be exposed to prolonged heat waves, more severe droughts and floods. The climatic events in 2007/2008 and 2011/2012 with long dry periods and heat waves led to significant production losses. Less than 10% of agricultural land is irrigated, and with the exception of the western parts of the country, water deficiencies occur in summer, resulting in significant moisture stress for summer and annual crops.

The vulnerability assessment for this sector, which used models to analyse the SE Region, found that all crop families with a base temperature of 5.6°C and higher would start growing earlier, and that growing stages would shift dramatically in time. In the SE region, crop modelling for the baseline scenario indicated a reduction in wheat yields of 21% between 2000 and 2025 and 25% between 2040 and 2050 and a reduction in maize 56% in 2025 and by 86% in 2050. At the same time, all scenarios with adaptation measures contributed towards increased yields and a reduction in the negative impacts of climate change compared with the baseline scenario. The simulations presented above indicate that adjustment in sowing dates and depth as well as irrigation could produce substantially improved yields of wheat and maize in the SE region of the country under future climate change. However, these high yield scenarios also placed a great demand on water resources.

The economic analysis of impacts and vulnerability found that economic losses in all scenarios with adaptation measures for wheat were lower than the losses from traditional production practices. For maize, from 2015 to 2025, the proposed scenarios easily counterbalanced the negative climate change effects, but in the second period from 2025 to 2050 most of the scenarios show negative financial results, even with adaptation interventions.

A case study on the influence of the excessive heat on **livestock breeding** found that the yearly number of live born pigs was 2.14% less per litter when taking high temperatures into account. Higher temperature was also associated with prolonged conception of the sows, which increased non-productive days. The economic losses were evident: total annual losses reached 386,928 MKD (~EUR 6,260). Adaptation options identified included the following: genetically heat-tolerant breeding animals; adoption of special feed and feeding techniques in excessive heat; housing conditions with proper ventilation, in-house air conditioning and cooling systems; and continuous productivity monitoring. Clear economic calculations are also needed in order to determine the most appropriate time to invest in adaptation measures.

Additional analysis of **viticulture** showed that table and wine grapes are both vulnerable to increases in temperature – which can be ameliorated by effective irrigation and UV nets.

Adaptive capacity in the agricultural sector is low due to a variety of key factors: (a) small primary producers with low annual income and ability to implement adaptation measures, which in some cases can be costly; (b) small plots, which prevent effective implementation of adaptive measures; (c) insufficient financial support to the farmers to cope with the negative impacts of climate change; (d) low awareness among the key players about climate change and its negative effects in agriculture; (e) weak networking and an insufficient level of cooperation between scientific institutions; (f) lack of effective organizations to disseminate good practice to farmers; (g) lack of modern production technologies and practices and a lack of dissemination of research results to potential users; (h) insufficient experience with implementing modern approaches in assessing impacts and projecting future trends. Proposed adaptation measures for the sector include possible support programs for certain crops, modern irrigation practices, and an increase in organic farming.

The assessment of the **biological diversity** carried out for the TNC consisted of identification of vulnerable habitats and species and an expert assessment of their vulnerability. Besides this possible invasive species, suitability of the national protected area system in relation to climate change and functionality of the bio-corridors in Macedonia were also analysed. Modelling was carried out for the selected habitats and species. The vulnerability assessment identified 18 vulnerable habitats, 58 plant and 224 animal species. The expert assessment made for all habitats and species presented results regarding the distribution changes that may be expected (vertical and horizontal redistribution, phenological changes, especially among some bird species), and even disappearance of some habitats (lowlands wetlands) and species (plant and animal species living in mountains, wetland and riparian habitats).

By using MaxEnt modelling software, the possible changes in two habitats were predicted for two plant species and for one endogean insect, using the A1B emissions scenario. The modelling of species confirmed the expert opinion that in the following 50 years unsuitable climate conditions will occur for the analysed plant and animal species (*Pedicularis ferdinandi, Crocus cvijicii*; *Trechus goebli*) and their vertical redistribution may be expected (towards higher altitude). However the community of kermes oak (*Ouercus Coccifera*) (Pseudomacchia) showed unexpected results according to which this community shall “relocate” to the mountains in Eastern Macedonia, while the expert opinion assumed its relocation from the Southern Povardarje Region towards North, along the River Vardar valley.

Constraints and gaps that are specific to the biodiversity sector in the Republic of Macedonia included a lack of data regarding climate impacts on biodiversity, particularly in mountain ecosystems; lack of a protected areas system that takes climate impacts into consideration; and the absence of *ex situ* conservation efforts. Seven of the actions proposed in the Action Plan within the SNC for biodiversity were partially or fully implemented (most of them within the reports commissioned for the Third National Communication).

The **forestry** sector in the Republic of Macedonia is expected to experience a high level of impact from climate change, especially boreal forests, where those impacts could be dramatic. The major sources of exposure (and associated impacts) for forests in the country are increasing temperatures, increasing frequency of forest fires, and changes in forest productivity. The most significant impact on forest management in the period between the SNC and the TNC has been forest fires: approximately 2,800 forest fires have been recorded in the period 1999-2012 that have burned almost 130,000 ha of forest and forest land, resulting in direct and indirect damage estimated at around EUR 67 million. The following segments of forest management are deemed to be most vulnerable till 2025: forest management planning, forest utilization, forest protection, hunting and tourism, and silviculture.

The results of the International Cooperative Programme (ICP) forest assessment for the Republic of Macedonia indicate that the health of forests in the country for the period (2006-2013) has remained more or less the same. However, around 45% of the trees are in Classes 1 and 2 on the scale of needle/leaf loss (>10<60%), which means that they will be most vulnerable to future climate change. Results for water availability for trees (soil moisture) during the same period indicated that a majority of trees examined have consistently had insufficient water. If there are climate extremes, negative changes in forest health can be expected even in the period up to 2025. While there has been no significant change in forest productivity for the period 2006-2013, it is possible to expect increased productivity of forests due to rising temperatures and CO_2 fertilization in the period up to 2025. However, water deficits could decrease productivity, as could natural disasters. While it appears that forests in the Republic of Macedonia will be able to increase their carbon sink capacity in the period up to 2025 due to increased productivity, the estimation of the forest carbon sequestration will require very complex long-term research.

Adaptation measures unique to the forestry sector include the development of a comprehensive programme for adapting forestry to global climate change; the establishment of 5 monitoring stations in forest regions; the introduction of technologies for efficient biomass usage in forestry; procurement of proper vehicles for fighting forest fires; a thorough biomass stocking exercise (the last one was conducted in 1977); and integration of climate change considerations into forestry management plans.

Research on climate impacts on **human health** for the TNC focused on the (SE) Region. The SE Region is especially sensitive to climate extremes such as floods and droughts. Understanding the health implications of flooding has increased in recent years, but knowledge gaps still remain. While heat waves are also very frequent in the SE Region, cold temperatures are still likely to contribute to the majority of temperature-related health effects over the coming decades. The analysis of the frequency of the emergency calls confirmed that the elderly are more vulnerable to extreme heat and cold than younger people, so future health burdens are likely to be amplified by an aging population. Furthermore, findings in other locations in the country and projections provided in maps of the European Environmental Agency indicate that it is likely that the range, activity and vector potential of many ticks and mosquitoes will increase in the SE Region in the decades to come. Finally, hospitals, health centres and care homes may be adversely affected by high temperatures during heat waves and by flooding.

While most of the goals in the National Climate Change Health Adaptation Strategy have been achieved, areas that require action include: 1) inter-sectoral engagement and coordination, including the involvement of the local governments; 2) follow-up on knowledge of climate health risks (among health workers); 3) improved information and transparency in food safety control and implementation of the Hazard Analysis Critical Control Point System (HACCP system); 4) strengthened vector-borne communicable diseases monitoring system, particularly in the SE Region; 5) more precise meteorological observations and projections in order to take precautionary measures in high-risk periods; and 6) inclusion of the SE Region into the existing national air pollution alert system. Specific measures suggested include ultraviolet (UV) radiation protection and monitoring; an early warning system for flooding; pollen monitoring; and cost-benefit analyses for adaptation measures in the health sector.

A vulnerability assessment of the **tourism** sector was commissioned for the TNC, methodologies included interviews with private and public sector stakeholders on their attitudes and actions concerning climate adaptation, a case study of winter tourism, and a review of regional-level documents. The study found that tourism sector stakeholders seemed to be both unaware and unconcerned about the impact climate change might have on their businesses and are thus taking no mitigation or adaptive measures, and climate change did not figure into Government tourism planning. For example, the tourism sector is to invest in mid to low altitude ski resorts that evidence from other parts of Europe indicate are at risk with a high degree of certainty.

Adaptive policies and measures were identified in four key areas: 1) research (site-specific case studies, vulnerability assessments, and action plans); 2) advocacy (outreach to key stakeholders in the industry and to the general public regarding risks to leisure activities); 3) training (mentoring, awareness-raising in the sector, training for specific climate-related changes); and 4) risk preparedness (planning throughout the tourism supply and value chains, monitoring and reporting site-specific changes).

An assessment of the **cultural heritage** sector was commissioned through the regional project "Climate Change Adaptation in Western Balkans" that developed an impact matrix of risks to be expected by climate change and the relevant parameters describing the composition of the site and the surrounding area. Three cultural heritage sites were selected for study based on a participatory workshop of cultural heritage professionals, and rapid vulnerability assessments were carried out. At the archaeological site of Stobi, severe damage is expected before 2100; at the Skopje Aqueduct, climate-related effects are destabilizing the aqueduct, threatening collapse; and at the Plaosnik archaeological site Ohrid, the threat of frost damage is being countered by mortar repair and surface coverage of the archaeological remains. The assessment recommended the development of a National Action Plan for addressing climate change adaptation in the cultural heritage sector. Key needs include vulnerability assessments of built and archaeological heritage, a monitoring program for damages, the identification of tools and adaptation measures for the main categories of cultural heritage in the Republic of Macedonia, and a long-term management strategy.

Sectoral vulnerability assessments also included an assessment of **socio-economic vulnerability** focusing on the SE Region. Research for this study was closely coordinated with work on disaster risk reduction in the Republic of Macedonia and consisted of a socio–economic vulnerability assessment of the population in the ten municipalities in relation to disaster risk and climate change. Municipalities were then categorized by their score on a social vulnerability index, acknowledging data constraints due to comparability and classification issues and – most importantly – a lack of disaggregated data on household income and employment. Selected populations (the elderly, children, etc.) and municipalities were assessed by their level of social vulnerability.

Several **constraints and gaps** were identified during preparation of the thematic studies on vulnerability assessment within this study. The most common included: data availability, consistency and transparency; institutional structures (particularly coordination); low levels of investment in research; and a shortage of well-qualified and trained personnel, especially in monitoring and data processing technologies and the implementation of adaptation measures. A common problem in the implementation of adaptation measures is a focus on short-term measures over longer-term measures such as risk management. Annex II presents an overview of proposed **priority adaptation measures** with a brief description of their characteristics.

1.4. MITIGATION

The climate change mitigation analysis is built upon the analyses conducted under Second National Communication, but also accounts for other developments particularly for the specific position of the country under the UNFCCC, as an EU candidate and as a member of the European Energy Community. It also includes detailed analysis of a number of Nationally Appropriate Mitigation Actions (NAMAs) which were submitted by the country as a part of its submission for the Copenhagen Accords**.** As a member of the Energy Community, the Republic of Macedonia is already committed to complying with the *acquis communautaire* related to energy – involving, for example, renewable energy usage, energy efficiency standards in buildings and equipment, energy efficiency incorporated into public procurement, and related to the reduction of certain pollutants (e.g. SO_x and NO_x) from power plants. Additionally, if the Republic of Macedonia enters the EU by 2020, it will be required to implement EU mitigation policies and be part of the EU effort-sharing scheme for emissions reductions of 20% by 2020. This will include measures such as those for the Energy Community and additional measures related to, for example, the participation in the EU emissions trading scheme (EU-ETS). If the does not enter the EU, it will probably continue transposition of climate-change related directives but at a slower pace. It would then have choice between joining Annex I and offering Quantified Emission Limitation or Reduction Commitment (QELRC) type of target, or to stay in the position of a developing non-Annex I country and offer a target in the form of baseline deviation. In all cases similar types of policies and measures will likely be implemented, but with different speed and intensity. As part of the development of mitigation actions, NAMAs are also being prepared for the City of Skopje related to transport and energy.

An analysis of mitigation options related to **energy** uses the MARKAL energy system model to Project energy demand, costs, and associated GHG emissions from various development scenarios up through 2050. Under the Baseline scenario, energy consumption is projected to grow by 48% in terms of final energy by 2032, and by 102% by 2050. The most significant share in final energy consumption is related to diesel and electricity use, as well as natural gas, available through import. Under the baseline for new power plants and devices a total investment is expected of around EUR 4,005 million plus an additional EUR 95 million for new transmission and distribution networks. CO_2 emissions would change from ~9.5 Mt in 2011 to ~14 Mt in 2032 - then reducing sharply and increasing again to ~14 Mt in 2050 with power generation making up the largest share.

Three different sets of mitigation scenarios were analysed. Related to energy supply, the most cost-effective areas for mitigation were found to be the following:

- Installing natural gas-fired power plants instead of coal plants;
- Hydropower development;
- Wind power development; and
- Some solar power development.

In addition to power supply, mitigation measures related to reducing or altering energy demand will be important – particularly involving:

- Energy efficiency improvements in the buildings sector;
- Various measures in the transport sector for low carbon fuels, awareness raising for efficient driving, changed travel behaviour, improvement of the vehicle fleet, and advancement of vehicle equipment; and
- Improvements in industrial processes for improving energy efficiency.

In the **waste** sector, emissions are projected to grow in the baseline scenario up until at least 2030 related to population and economic growth. In examining the various scenarios of actions that can be taken for municipal solid waste, the most cost-effective scenario which also yields significant GHG reductions is that of closing and reclamation of existing landfills and burning of landfill gas on flare (which has very low marginal abatement costs), introduction of MBT with composting, and production of RDF.

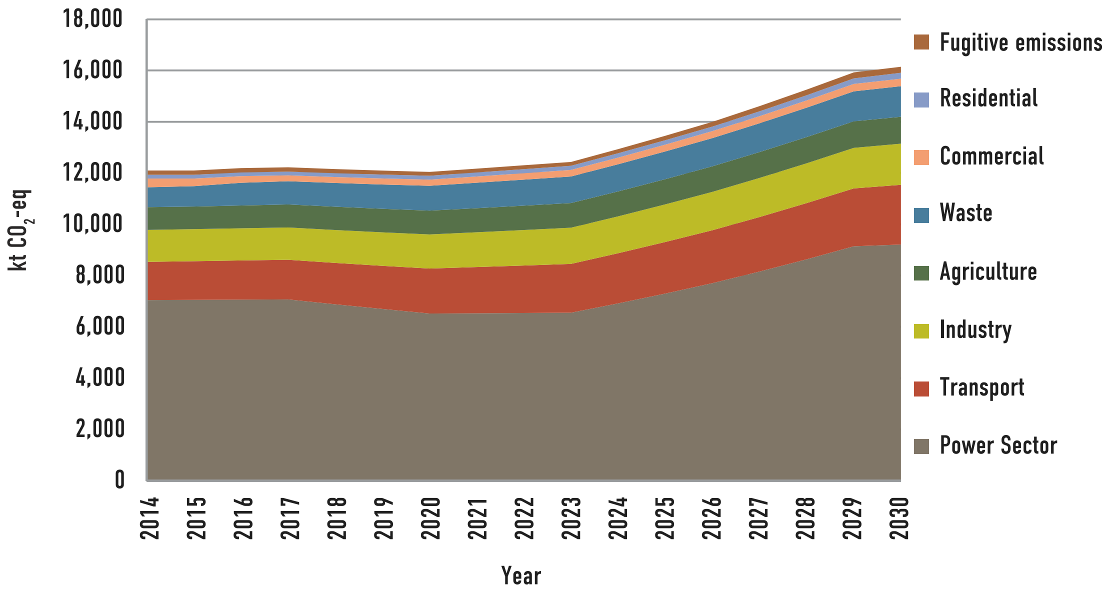
Agricultural activities are expected to increase due to growing demand for food and with that the increase of GHG emissions from this sector is inevitable. Detailed analysis was carried out of the potential for the following mitigation options in agriculture as a part of the TNC:

- Increase in organic agriculture
- Livestock management for less GHG-intensive enteric fermentation
- Improved crop residues management
- Improved sprinkler and drip irrigation
- Altering tillage techniques
- Improved management of fertilizers
- Improved manure management
- Production of biogas from farming

The analysis found that the technical mitigation potential of agriculture is extremely large, especially relative to emissions from the sector. In terms of abatement costs, the sector is particularly attractive, with many abatement options being cost neutral or net-profit-positive (increases in agricultural production, already economically justify the adoption of some mitigation activities), with low capital investment required.

In **summary** the GHG emissions under the baseline scenario are projected to change from around 12,100 kt CO_2-eq to around 16,150 kt CO_2-eq or by 33% (Figure 1-1). In the period 2014-2023 the amount of the emissions is almost the same, but after this period it is expected that there will be significant growth of the emissions in the power sector and the level of the total emissions progressively increases. The highest growth sector is the residential sector with 60% growth, followed by transport with 56% and waste with 54%.

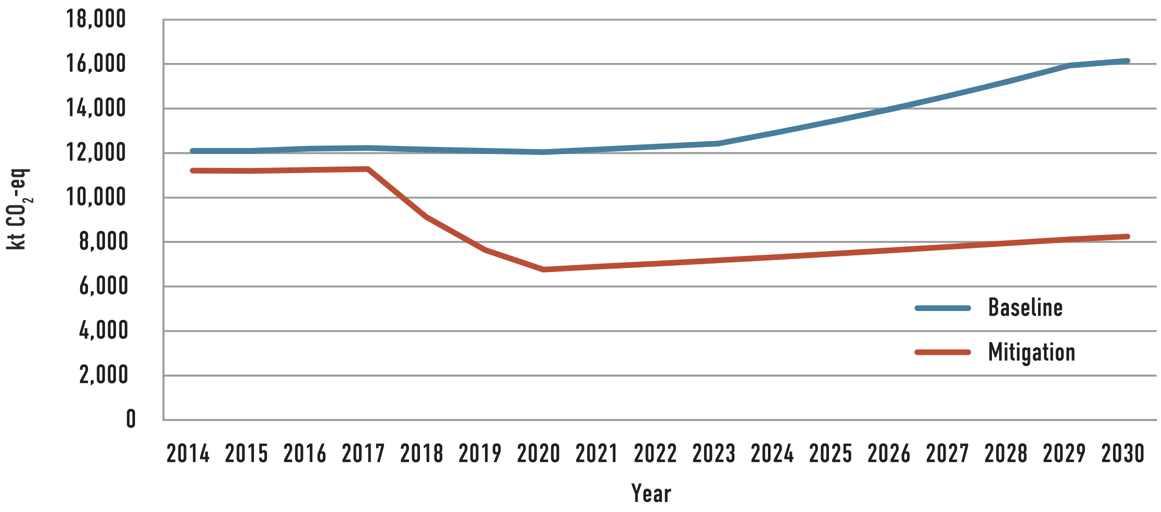
FIGURE 1-1: Emissions Projection under Baseline Scenario (kt CO_2-eq)



The main contributor in the total GHG emissions is projected to be the power sector with around 58% during the whole planning period, followed by the transport sector with 12%-14% share, followed by industry with around 10%.

The combination of the most aggressive mitigations scenarios in energy, waste and agriculture sectors would lead to a significant drop in GHG emissions – from 11,200 kt CO_2-eq to 8,250 kt CO_2-eq. The introduction of a CO_2 price starting from 2020 would cause the closure of the existing lignite power plants and prevents entrance of new coal power plants, which is estimated to decrease the level of the GHG emissions in the power sector by more than 65%. The total GHG emissions in the mitigation scenario in the period 2014-2017 are reduced by around 8%, after this period the reductions become more aggressive and in 2030 emissions would be 50% less than the baseline scenario (Figure 1-2).

FIGURE 1-2: Total emissions under the baseline and mitigation scenarios (kt CO_2-eq)



1.5. OTHER RELEVANT INFORMATION

In the area of **technology transfer**, the Republic of Macedonia submitted its TNA report entitled "Evaluation of Technology Needs for GHG Abatement in the Energy Sector" in 2004. An assessment of the bilateral development assistance projects implemented in Macedonia identified one formal climate technology transfer project, which promoted geothermal energy.

The Government of Macedonia oversees a unified system for **systematic observation** of the climate that consists 19 primary meteorological stations and 2 meteorological radar centres with full-time staffing; 12 climatological stations, 116 rain metering stations, and 24 phenological stations with part-time staffing; and 14 automated meteorological stations. Constraints and gaps in this system include personnel shortages, maintenance difficulties, and lack of field vehicles.

Current **research and development (R&D)** policy is guided by the Programme of the Government of the Republic of Macedonia for the period 2011-2015, and more specific policies and measures including laws, national strategies, and national programs. Key bodies include the Ministry of Economy, the Ministry of Education and Science, MOEPP, and several other agencies and innovation centres. A total of 23 climate change-related R&D projects have been supported by EU Framework Programmes and other EU financing mechanisms.

Climate change **education** is still not adequately incorporated into the national educational system. Currently, there are three faculties in the state university system that have graduate, post-graduate level and/or PhD programs connected to climate change and sustainable development. A 2009 EU **public awareness** survey showed that climate change was perceived by Macedonians as the third most serious problem currently facing the world. On a scale of 1 to 10 with 10 indicating that climate change was an "extremely serious problem" and 1 indicating that climate change was "not a serious problem at all", the average response given by Macedonians was 7.4. In terms of knowledge, a little less than half (46%) of Macedonians surveyed in 2009 felt generally well-informed about the causes of climate change.

Government **public outreach** efforts have been conducted by the public relations office of MOEPP and municipalities; bilateral and multilateral donor-funded projects have included public outreach in broader programs; and several NGOs have also been involved in outreach. A 2012 assessment of climate change communications identified a lack of activities targeted at specific stakeholder groups, and a Climate Change Communications Strategy and Action Plan has been developed in response. Within Macedonia, MOEPP provides **information and networking** related to climate change on its website. The Hydrometeorological Service also participates in information exchange and networking at the regional level (in meteorology and in disaster and risk reduction) and globally through the WMO.

Capacity strengthening activities range from specific capacity to implement emissions trading and greenhouse gas inventories to more general capacity related to climate policy and management. For the TNC, a new institutional system was implemented to ensure the sustainability of the process of preparing GHG inventories. A number of trainings and networking events have occurred in the period since the SNC in which Macedonian experts, government officials, and citizens have been involved. General capacity needs in climate change include broad support for the National Hydrometeorological Service, support for a National Climate Technology Centre and Network, and expanded cooperation with EU initiatives.

Financial resources for climate change activities come primarily from two sources: 1) bilateral and multilateral donors; and 2) the Global Environmental Facility (GEF). Since joining the GEF, the Republic of Macedonia has received five country-level grants and two regional/global grants related to climate change.