SECOND BIENNIAL UPDATE REPORT ON CLIMATE CHANGE OF THE REPUBLIC OF MACEDONIA

(CLIMATE CHANGE MITIGATION)





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Abbreviations and acronyms

AFOLU	Agriculture, Forestry and Other Land Use
CHP	Combined Heat and Power Plants
EC	Eurpean Commission
EU	European Union
FBUR	First Biennial Update Report
GDP	Gross Domestic Product
GHG	Greenhouse Gases
HPP	Hydro Power Plant
ICA	International consultation and analysis
INDC	Intended Nationally Determined Contributions
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
LNG	Liquefied natural gas
LPG	Liquefied petroleum gas
MARKAL	(MARKet ALlocation)
NCSP	National Communication Supporting Programme
OECD	Organization for Economic Co-operation and Development
RES	Renewable energy sources
SBUR	First Biennial Update Report
SDG	Sustainable Development Goals
STUGRES	Study on the Heating in the City of Skopje Analysis of Policies and Measures
TNC	Third National Communication
UN	United Nations

UNFCCC	United Nations Framework Convention on Climate Change
WAM	With additional measures
WEM	With existing measures
WEO	World Energy Outlook
WOM	Without measures
TPP	Thermal Power Plant

Chemical symbols

CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2-eq	Carbon Dioxide equivalents
N_2O	Nitrous Oxide

Units and Metric Symbols

Unit	*Name*	*Unit for*
g	gram	mass
W	watt	power
J	joule	energy
m	meter	length
Wh	watt hour	energy
toe	ton of oil equivalent	energy
Mass Unit Conversion		
1g		
1kg	= 1 000 g	
1t	= 1 000 kg	= 1 Mg
1kt	= 1 000 t	= 1 Gg
1Mt	= 1 000 000 t	= 1 Tg

Metric Symbol	*Prefix*	*Factor*
P	peta	10^{15}
T	tera	10^{12}
G	giga	10^{9}
M	mega	10^{6}
k	kilo	10^{3}
h	hecto	10^{2}
da	deca	10^{1}
d	deci	10^{-1}
c	centi	10^{-2}
m	milli	10^{-3}
µ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}

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Executive summary

The climate change mitigation analysis conducted in the Second Biennial Update Report (SBUR) builds upon and continues the analyses of previous studies: Third National Communication (TNC), First Biennial Update Report (FBUR) and the Intended Nationally Determined Contributions (INDC)[1].

In order to assess the mitigation potential of certain measures and policies, all sectors recognized by the Intergovernmental Panel on Climate Change (IPCC) methodology (Energy, Industrial Processes and Product Use, Agriculture, Forestry and Other Land Use and Waste) have been modelled in the SBUR. Moreover, when compared to previous studies, **significant improvements and upgrades** can be attributed to the modeling in the SBUR, among which are: harmonization of all sectors and categories with the IPCC methodology (the sectors are identical as in the Greenhouse Gases (GHG) inventory) so that trends can more easily be followed; use of a single methodology for GHG emission calculations in all sectors (IPCC methodology); integration of the separate models of all sectors[2] by introducing intersectoral connections on the basis of key drivers which are common for all sectors; use of a unified methodology when creating mitigation policies/measures which allows an integrated preview of the results through two scenarios (Mitigation scenario – Scenario with Existing Measures and a Higher ambition mitigation scenario – Scenario with Additional Measures) etc. In addition to these improvements and upgrades in the modelling, the private sector and the public administration were actively included in the process of preparing and choosing the measures and policies. In that regard, a number of meetings were organized in order to ensure acquaintance and alignment of the attitudes of different actors towards the suggested measures and policies. The modelling has been conducted for the period from 2012 to 2035.

Taking into account the changes in development which occurred in the meantime, the Reference scenario, reflecting a case with no implemented mitigation measures is firstly revised as a **Scenario Without Measures** (**WOM scenario**). This scenario has **no likelihood of occurrence** because it implies, for instance, that the efficiencies of devises used in households in 2035 would be same as the efficiencies of the devises used in 2012. Nevertheless, creating such a scenario **is of crucial importance** because it allows all measures to be compared to one referent option and it allows for the comparison of the effects (financial, environmental, energy related) of a certain measure or policy to take place. When the yearly total emissions in the WOM scenario are calculated, a gradual rise from 2012 until 2035 is evident; the emissions in 2035 amount to 25,585 Gg CO_2-eq which is a 49% increase compared to the emissions from 2012. The Energy sector continuously has the biggest share in the

[1] All documents are available on this link: http://klimatskipromeni.mk/Default.aspx?LCID=213

[2] In previous national reports on climate change, the analysis of some sectors were conducted with MARKAL, some with GACMO, others according to other methodologies and all of them used different input data.

total emissions, a share which in 2035 is estimated to be 68%, while the Waste sector has the biggest increase in emissions (around 130%).

Taking into consideration all national strategic and planning documents, over 50 mitigation measures were recognized out of which, with the participation of key actors, 46 measured were selected for modelling – 35 measures in the Energy sector, 8 measures in Agriculture, Forestry and Other Land Use (AFOLU) and 3 measures in the Waste sector. Each of these measures is represented with a separate table containing all necessary information, progress of implementation (timeframe, expected results and costs, implementing entity) and progress indicators.

In order to see which measures and policies should be prioritized, **the economic effectiveness or specific cost** (in €/t CO_2-eq), as well as **the environmental effectiveness or mitigation potential**[3] (in t CO_2-eq) for each measure and policy is calculated. It can be concluded that around 80% of the total reductions in emissions can be achieved through policies and measures with negative specific costs, known as win-win measures. The implementation of such measures not only reduces emissions, but creates financial savings as well. Furthermore, additional benefits of the measures/policies are also analyzed in light of their **potential for job creation** (green jobs). It is estimated that over 6200 green jobs will open until 2035 as a result of energy efficiency measures in buildings and low-carbon energy supply (renewable energy and gas). That makes the measures triple win (win-win-win) measures, simply because satisfy three criteria – economic, environmental and additional benefits.

Additionally, in the Second Biennial Update Report a study aimed at analyzing **ways to reduce the local pollution in the city of Skopje** (Study on the Heating in the City of Skopje Analysis of Policies and Measures - STUGRES) has also been conducted. According to this study, the implementation of three measures in Skopje (Construction of energy efficient buildings, Changing the heating practices and Increased acceptance of central heating) can result in enormous reductions of PM_{10} and $PM_{2,5}$ emissions from household heating, around 60% reduction of emissions in 2025 in comparison to 2015. From the list of measures, in collaboration with all relevant stakeholders, 35 **measures/policies** were marked as measures/policies with high realization probability because they deal with projects that have been started/are going to start in near future, are prioritized projects/policies in sectoral strategic and planning documents or have resulted from already passed laws or laws that will be passed in near future. These measures are included in the **Mitigation Scenario** which is also called the **Scenario with Existing Measures** (WEM). Another **Higher ambition mitigation scenario** has been created, which along with the existing measures contains additional measures/policies, thus obtaining the name **Scenario with Additional Measures** (WAM).

As a result of the proposed measures in the Scenario with Existing Measures (WEM) and the Scenario with Additional Measures (WAM), the total GHG emissions in 2035 drop by 25.2% and 27.8% respectively, when compared to the Reference scenario (WOM). The GHG emissions occurring in WEM in 2035 are only 2.6% higher than in 2012, while the 2035 emissions in WAM decrease by 14%

[3] Potential for reducing the emissions of greenhouse gases

when compared to 2012. Both scenarios' peaking year occurs in 2032 when the emissions are 18,130 CO_2-eq according to the WEM scenario and 17,510 CO_2-eq according to the WAM scenario. The Energy sector still dominates with its share in the total emissions (60.9% in WEM and 53.8% in WAM in 2035), but compared to the Reference scenario, the emissions of the WEM scenario decrease by 25% and the emissions in the WAM scenario decrease by 29% in 2030 (Figure 1). Hence, the majority of the suggested mitigation measures and policies are related to the Energy sector.

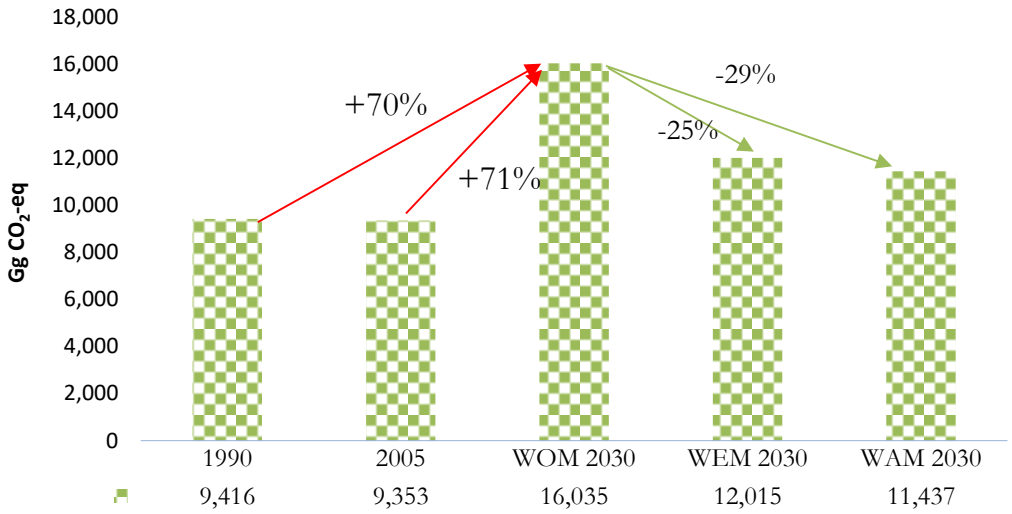


Figure 1. Comparison of GHG emissions from the Energy sector in 1990 and 2005 with the emissions in 2030 in WOM, WEM and WAM scenarios (in Gg CO_2-eq)

The results obtained from the analyses in this study cannot be directly compared with the goals defined in the Intended Nationally Determined Contributions (INDC) because:

- beside CO_2 emissions this study takes into account the emissions of CH_4 and N_2O which were not included in the INDC
- an emission factor has been attributed to the import of electricity
- as a result of the changes in the modelling, the change of input parameters (prices of fuels, Gross Domestic Product (GDP) growth, population growth etc.) the Reference scenarios in the SBUR is different from the Reference scenario in the INDC.

If one was to make a realistic comparison with the INDC goals, only the CO_2 emissions should be taken into account while the emissions related to electricity import should be disregarded. Additionally, a comparison with the INDC reference scenario should be made in order to assess the relative decreases with respect to that scenario. The results from the comparison are displayed on Figure 2 which shows that:

- in the year 2030 the Mitigation scenario (WEM) and the Higher ambition mitigation scenario (WAM) are more ambitious than the mitigation scenarios defined in the INDC,

- the Mitigation scenario in 2030 decreases the emissions by 34% (30% in INDC WEM, or 745 kt CO_2 more than INDC WEM; that is equal to around 10% of the total emissions from the Energy sector in 2014) compared to the referent Business-as-usual scenario in INDC,
- the Higher ambition scenario decreases the emissions by 37% (36% in INDC WAM, or 238 ktCO_2 more than INDC WAM; that is equal to around 3% of the total emissions from the Energy sector in 2014) compared to the reference scenario in INDC.

Figure 2. Comparison of the SBUR, INDC and FBUR, Mitigation and the Higher ambitious scenarios from the Energy sector with the INDC Reference scenario, 2030 (in Gg CO_2-eq)

The total investment costs in the Reference scenario for the energy sector in the period 2017-2035 amounts to 27,688 mil. €, while WEM is 2,056 mil. € costlier, so its' total investment costs are equal to 29,744 mil. € (Figure 3). The total investment costs in WAM are 2,203 mil. € higher than those of the Reference scenario and are equal to 29,891 mil. €. Out of the costs for implementing the mitigation measures in the Mitigation scenario (WEM), **investments** of **17,056.8 mil. €** are needed in the Energy sector for the period **2017-2035**. Similarly, the investments in the Energy sector in the Higher ambition scenario are equal to 22,638.0 mil. €. The average yearly investments in WEM are approximately 6.75% of the total average **annual GDP** (13,000 mil. €), while the same indicator in WAM is equal to 8.96%. If the investments from the private sector are disregarded, the investments for the period 2017-2035 in WEM are equal to 2,604.2 mil. € and 5,220.4 mil. € according to the WAM scenario (an amount that should be provided by the national budget, local self-governments, City of Skopje, AD ELEM).

Figure 3. Total investment costs in WOM, WEM and WAM scenarios (in mill. EUR)

The sector Agriculture, Forestry and Other Land Use is of significant importance because it possesses the **largest potential for absorbing CO_2 emissions**. From being a sector with usually negative emissions, it is estimated that after 2020 the amount of CO_2 emissions from wood in the forests will be larger than the amount of CO_2 emissions absorbed by the forests. This makes the forests unsustainable, i.e. the amount of wooden mass which is cut will be larger than the annual growth of new wooden mass. It is estimated that the total emissions from this sector in 2035 will be equal to 2,000 Gg CO_2-eq. In the Livestock category in the next 20 years, a 10% reduction in the greenhouse gas emissions from activities related to livestock production is expected (from 673.65 Gg CO_2-eq in 2014 to 603.15 Gg CO_2-eq in 2035). The reasons for this reduction lies in the assumption that the number of cattle will decrease, while at the same time an increase in the productivity per unit of livestock will take place. In the Land Use category it is projected that the greenhouse gas emissions of 290.08 Gg CO_2-eq in 2014 would increase to 514.52 Gg CO_2-eq in 2035, where as starting base the dynamics of use were considered for the period from 2000 to 2014.

In order to reduce greenhouse gas emissions, 8 measures have been proposed in the Agriculture, Forestry and Other Land Use sector. In the **Forestry** category, two measures that refer to better forest management are proposed, i.e. afforestation of transitional forest surfaces and reduction of the damaged area of forests from fires. With the help of these two measures, forest sustainability is ensured. For the realization of these two measures during the period from 2017 to 2035, **investments of 56 mil. €** are needed. In the **Livestock** category, 3 measures for mitigation of greenhouse gas emissions related to activities in livestock production have been developed. When defining these measures, it was important that their implementation was easy and that they were not based on specific strategies and policies or long-term subsidies. As a result of the implementation of these measures, the total emission of gases in 2035 would be 590.52 Gg CO_2-eq. For their realization **investments of 2.2 mil. €** are needed. In the Land category, three measures are envisaged for the reduction of greenhouse gas emissions and they are aimed at reducing land erosion and increasing of organic matter in the soil.

With their proper implementation a 20% reduction of emissions in 2035 could be achieved (410.05 Gg CO_2-eq). For the realization of these measures, **investments of 3.5 mil. €** are needed.

In the **Waste** sector, total GHG emissions are projected to increase by 97% in 2035 (4.944 Gg CO_2-eq) compared to 2012, where emissions from the sub-category Solid Waste Disposal remain the largest, with a share of 97.4% in 2035 (94.3% in 2012). To reduce the emissions in this sector, three measures have been proposed concerning the opening of new regional landfills, the closure of existing ones with methane combustion and selection of waste. It is predicted that through these measures the greenhouse gas emissions in 2035 will decrease by 7% compared to the emissions in the WOM scenario. For the realization of these three measures, **investments worth 93 mil.** € are needed.

For each scenario, Macedonia's progress has been analyzed on the basis of several **key indicators** for sustainable development related to climate change and energy. These indicators are in line with the EU's Sustainable Development Strategy (SDS) and the Global Sustainable Development Goals (SDGs). A comparative analysis of the obtained results with the EU average (EU-28) and the countries of Southeast Europe has been made. An important indicator regarding climate change is the **greenhouse gas emissions intensity of energy consumption**. It monitors the extent to which low-carbon fuels replace high-carbon fuels while meeting the energy needs and the extent to which the efficiency of technologies for production and use of energy has increased. In Macedonia, during the period 2007-2014, this indicator has been 10% - 20% lower than in 2000 (3.52 Gg CO_2/ktoe). Although there is an increase in the energy demand, which in the WOM scenario is predominantly satisfied by fossil fuels, this indicator is expected to decrease and should amount to 75% in 2035, which is 25% lower than its value in 2000. In the mitigation scenarios, as a result of energy efficiency measures, the energy consumption rate of growth is expected to be slower than that of the WOM scenario, while at the same time, with the replacement of lignite with natural gas and the greater utilization of renewable energy sources this indicator is expected to reach 65% in the WAM scenario, which is 35% less than in 2000.

Another important indicator is **CO_2 emissions per capita**, according to which Macedonia falls in the same category as Romania and Hungary, as a country with relatively low emissions per capita. In the Reference Scenario this indicator will have an increasing trend, while in the mitigation scenarios it would grow at a lower rate than in the Reference Scenario.

Finally, in accordance with the Mitigation scenario an **Action Plan** for mitigation of climate change was prepared, in which the stakeholders relevant for the implementation of all 35 measures and policies were identified. Furthermore, the plan contains information on each measure's type, source of finance, indicative future emission reductions, specific costs (cost of reduced t CO_2), necessary investments for the realization of the measures and the potential for green jobs creation. This Action Plan is a solid foundation for creating national policies that would enable low-carbon sustainable development of Macedonia.

Introduction

1 Introduction

The Republic of Macedonia is a party of the United Nation Framework Convention on Climate Change (UNFCCC) (Official Gazette of RM – 61/97), ratified the Kyoto Protocol (Official Gazette of Republic of Macedonia - 49/04) and has associated itself with the Copenhagen Accord (2009). Regarding the Paris Agreement (2015), the country submitted its Intended Nationally Determined Contributions for Climate Change (INDC), as per the Decision of the Government No. 42-17/91 of 28 of July 2015, as twenty third submission in the world. The Republic of Macedonia has signed the Agreement and the ratification process is underway. It is a non-Annex I country to the UNFCCC (developing country) and at the same time, it has a status of a candidate country for European Union (EU) membership, having thus to adhere to the EU Climate and Energy Policy, which actually takes in the commitments of the Annex I countries.

The Republic of Macedonia has submitted three national plans to the UNFCCC (in 2003, 2008 and 2014) and the First Biennial Update Report (FBUR) in January 2015, as the eleventh country in the world. Despite the fact that Macedonia is not an Annex I country, as an EU candidate, it has voluntarily made efforts to incorporate the UNFCCC reporting principles that apply to Annex I parties as far as possible (Table 1). Table 1 summarized the reporting obligations to the UN, the GHG inventories and national plans, the biennial update reports and mitigation activities and highlights how specific issues have been resolved in Macedonian conditions. The level of implementation has been assessed as: **Annex I like**, **Tends to Annex I like**, **Steps towards Annex I like**, **or Non Annex I**. Furthermore, having in mind that the Reference scenario (WOM), the Mitigation scenario (WEM) and the Higher ambition scenario (WAM) are the main elements for reporting of national mitigation efforts of Annex I countries, the mitigation analysis in the First Biennial Update Report was, for the first time, conceptualized in such a manner. This practice was continued in the Second Biennial Update Report as well, in order to contribute to the national capacity building for analytics as well as to the capacity building for policy makers and all stakeholders for fulfilling the upcoming (more rigorous) reporting obligations.

Table 1. Summary of UN reporting requirements

	Annex I Party	Non Annex I Party	Macedonia
		GHG Inventory Requirements	
Frequency	Submit annual inventories to the UNFCCC in an electronic format.	No set frequency; can be submitted in hard copy. Upon availability of resources	GHG inventory submitted in electronic format as part of the National Communication or Biennial Update Reports. **Annex I like**
Coverage	Trends in emissions of the six primary GHGs1, from 1990 to the most recent year for which data is available; includes sectoral	Trends in emissions for CO_2, CH_4, and N_2O only, with estimates for other gases encouraged but not required	Trends in emissions of the six primary GHGs are reported for 1990-2012, including the sectoral

	background data. Kyoto inventory systems have additional structural detail.	from 1990 or 1994 for the first inventory and 2000 or later for the second; sectoral background data is not required.	background data. **Annex I like**
Standards	Use both the IPCC Guidelines and Good Practice Guidance and thoroughly document emissions estimation methods and data sources.	Use IPCC Guidelines; use of the Good Practice Guidance encouraged but not required. Documentation of methodologies is encouraged.	The 2006 IPCC Guidelines and Good Practice Guidance used for reporting; Emissions estimation methods and data sources are thoroughly documented. **Annex I like**
Methods	Generally adopt higher-tier methods	Generally adopt lower-tier methods	Higher-tier methods are generally adopted. **Annex I like**
Review	Subject to annual review by expert teams following agreed upon review guidelines. At least once every five years, inventory systems are subject to a more detailed in-country review. Parties to the Kyoto Protocol are subject to more rigorous review, and if review teams determine a Party's inventory report or system is deficient, the Party may be judged to be out of compliance and subject penalties	No subject to review	Voluntary review by experts under the National Communication Supporting Programme (NCSP) conducted. **Tends to Annex I like**
	National Communications, BURs, and Mitigation Action Requirements		
NC Frequency	Submitted every five years	No specified frequency	Voluntary, submitted every five years **Tends to Annex I like**
NC Content	National Communications include a description of each mitigation policy and measure, organized by sector and gas. Description includes status, implementing body, and, if possible, estimated effect on emissions to date and in the future.	Encouraged but not required to report on mitigation policies and measures.	National Communications include a description of each mitigation policy and measure, organized by sector and gas. **Tends to Annex I like**
BR/BUR Frequency	First one on 1 January 2014, then every two years	First one in December 2014, then every two years	First one in December 2014, than every two years **Annex I like**
Content BR/BUR	Outline progress in achieving emission reductions and the provision of financial, technology and capacity-building support to	GHG inventory not more than four years old Information on mitigation actions	GHG Inventory from 1990-2012 Information on mitigation actions

	non-Annex I Parties.		**Steps towards Annex I like**
Actions	Subject to binding national emissions targets, and international monitoring and reporting requirements to verify the achievement of these targets	None	Voluntary international monitoring and reporting requirements **Steps towards Annex I like**
Review of NC	National Communications are also subject to international expert review, conducted in accordance with internationally-agreed guidelines	Not subject to review	Not subject to review **Non Annex I**
Review of BR/BUR	Subject to international expert review, conducted in accordance with internationally-agreed guidelines.	Process of international consultation and analysis (ICA)	Process of international consultation and analysis (ICA) **Non Annex I**

1.1 Economics and population

Macedonia is one of the smallest countries in the Southeastern Europe region, with around 2.066 million inhabitants. Its gross domestic product (GDP) equals to 7.7 billion € and the GDP per capita is 3,737 € (Table 2).

Table 2. Basic information on countries of Southeastern Europe (2014)

	Population (million)	*GDP (billion €)*	*GDP per capita (€)*	*Unemployment*
EU 28	506.94	13,197.4	26,033.3	10.2%
Bulgaria	7.25	39.5	5,452.5	11.6%
Greece	10.93	185.5	16,977.6	26.3%
Croatia	4.25	43.3	10,189.4	16.0%
Romania	19.95	137.4	6,888.5	7.0%
Montenegro	0.62	3.3	5,321.5	19.1%
Macedonia	2.07	7.7	3,735.7	27.9%
Albania	2.90	9.1	3,127.9	16.1%
Serbia	7.15	30.1	4,209.5	22.2%
Bosnia and Herzegovina	3.84	13.4	3.488.7	27.9%
Kosovo	1.82	4.9	2,716.6	35.30%

1.2 Basic characteristics of the sectors

1.2.1 Energy

Compared to the other sectors, the Energy sector by far has the largest share in the GHG emissions in the Republic of Macedonia. This is due to the fact that, in the Republic of Macedonia, this sector is mainly based on fossil fuels, primarily coal, which account for over 80% of the total energy demand.

In the last few years a certain decreasing trend of the share of fossil fuels can be noted, primarily due to an increase in the import of electricity, which additionally increases the import dependence of the Republic of Macedonia, evaluated around 50%. There is also an increasing trend of the share of renewable energy in the total energy requirement, which from 10% in 2012 has increased to 15% in 2015. The efficiency of Macedonia's energy system (conversion from the total required energy into final energy) is about 68%. This value is almost at the same level as the member countries of the Organization for Economic Co-operation and Development (OECD) Europe, where it is about 70%.

As a result of the low GDP per capita, Macedonia falls in the category of countries with high gross inland consumption and high final energy consumption per unit of GDP despite the low energy consumption per capita. The total energy required per unit of GDP is around four times higher than the average of the European developed countries.

From the aspect of climate change, an important indicator is the greenhouse gas emissions intensity of energy consumption, which monitors the extent to which low-carbon fuels, such as natural gas and RES, replace high-carbon fuels, such as lignite and other coal, in the production and consumption of energy. From the comparison with the EU countries and neighboring countries, it can be concluded that Macedonia's emissions of greenhouse gases per consumed unit of energy are low. Expressed as an index relative to 2000 (2000 = 100%), the value of this indicator in the past years ranges from 80% - 90%. For EU countries this indicator ranges from 90% -100%.

Another significant indicator of climate change is the emission of greenhouse gases per capita. According to this indicator, an average citizen of the Republic of Macedonia emits 30% less emissions than an average citizen of the EU-28 or approximately the same as the citizens of Romania and Hungary.

1.2.2 Industrial Processes and Product Use

The GHG emissions from Industrial Processes and Product Use (IPPU) in the Republic of Macedonia originate from production industries or from the use of ozone depleting substances for air conditioning. The metal industry is the main contributor to the emissions of this sector with a dominant level of emissions from the production of ferroalloys. Cement production is the second largest contributing category to GHG emissions. The rest of the emissions are the result of the use of substituents of ozone depleting substances. Only a small part of the emissions come from the chemical industry sector, as there is no developed chemical industry in the country.

1.2.3 Agriculture, Forestry and Other Land Use

Forests and forest lands are the main sinks of CO_2 emissions in the Republic of Macedonia. They cover around 1.3 mil. ha and are characterized by great variety of species, but are of poor quality and low annual growth. More than 70% of the forests are of vegetative origin, about 90% are composed

of deciduous tree species and around 90% are state-owned. The total wood reserve is estimated at about 70 mil. $м^3$, and the total annual current rate of growth is estimated at around 1.7 mil. $м^3$.

In the Republic of Macedonia, the activities related to livestock production emit greenhouse gases mainly as a result of enteric fermentation and management of manure. On the other hand, greenhouse gas emissions from crop production are a consequence of several major sources, such as inadequate and excessive fertilization with mineral fertilizers, which in the long term cause serious reduction in organic matter in soils and significant CO_2 emissions, rare and inadequate application of manure, conversion to land use from extensive to intensive plant production system, inadequate management of arable land and improper management when fertilizing.

1.2.4 Waste

The Waste sector is the second largest source of greenhouse gases in the Republic of Macedonia. The following categories act as contributors to the emission of greenhouse gases: Solid Waste Disposal, Biological Treatment of Solid Waste, Incineration and Open Burning of Waste, and Wastewater Treatment and Discharge. The greenhouse gas emissions from this sector follow a monotonously growing trend. This is due to the increase in the amount of generated waste which in 2014 reached around 765.6 Gg of communal and around 5.681 Gg of industrial waste. In 2014 about 370 kg per capita of communal waste were generated and 75% of that waste was taken to landfills. The share which wasn't disposed in landfill has been covered by the category Incineration and Open Burning of Waste. If analyzed as CO_2-eq, methane emissions (CH_4) account for most of the total emissions of the Waste sector.

In terms of composting, it can be stated that it is still in the onset as only 1.945 t biological waste was composted in 2014.

Improvements in modelling

2 Improvements in modelling

In order to assess the effects of GHG emissions' reduction when applying certain measures/policies, for the purposes of this project, modelling of all sectors that are part of the IPCC methodology (Energy, IPPU, AFOLU and Waste) is conducted. As a basis, already developed models for the purposes of previous analyses (Third National Communication on Climate Change, FBUR, INDC, etc.) are used, though in this document numerous novelties are introduced, significant improvements and modelling upgrades are made, which can be summarized in the following points:

- **General improvements:**
  - Adjustment of sectors and categories according to the division in the IPCC methodology is performed, thus the GHG inventory and the climate change mitigation part have the same classification by sector and by category, wherewith the GHG emissions' forecasts are able to follow the emissions' trends in the inventory;
  - Complete integration of separate sectoral models is implemented, i.e. intersectoral binding predicated on key drivers common for different sectors is taken into account (Figure 4). For instance, same GDP data used in the Energy sector, is employed in the sectors IPPU and Waste as well. Same data for population is used in sectors Energy and Waste. Additionally, the calculated industry growth is used as an input in the sector Energy as well as the sector IPPU. The results from the AFOLU sector pertaining to sustainable biomass utilization (the amount of biomass used for heating) and from the sector Waste (the amount of biodegradable waste) are taken as an input in the sector Energy;
  - Revision and update of data for population and GDP, in line with the latest projections made by the UN, the National Bank of Republic of Macedonia and the World bank, are executed;
  - By means of adjustment of the methodology for calculation of GHG emissions in all sectors (IPCC methodology), creation of Reference scenario, wherein total GHG emissions' projections until 2035 are computed, is enabled;
  - Same methodology in measures/policies for climate change mitigation is applied, in this manner enabling an integrated visualization of results obtained from two scenarios (WEM and WAM);
  - Besides the aforementioned improvements and upgrades in the modelling, inside the process of creation of measures and policies, private sector and public administration have been actively involved. In that direction, individual consultation meetings aimed at getting acquainted with the proposed measures and policies and coordination of different views have been organized.

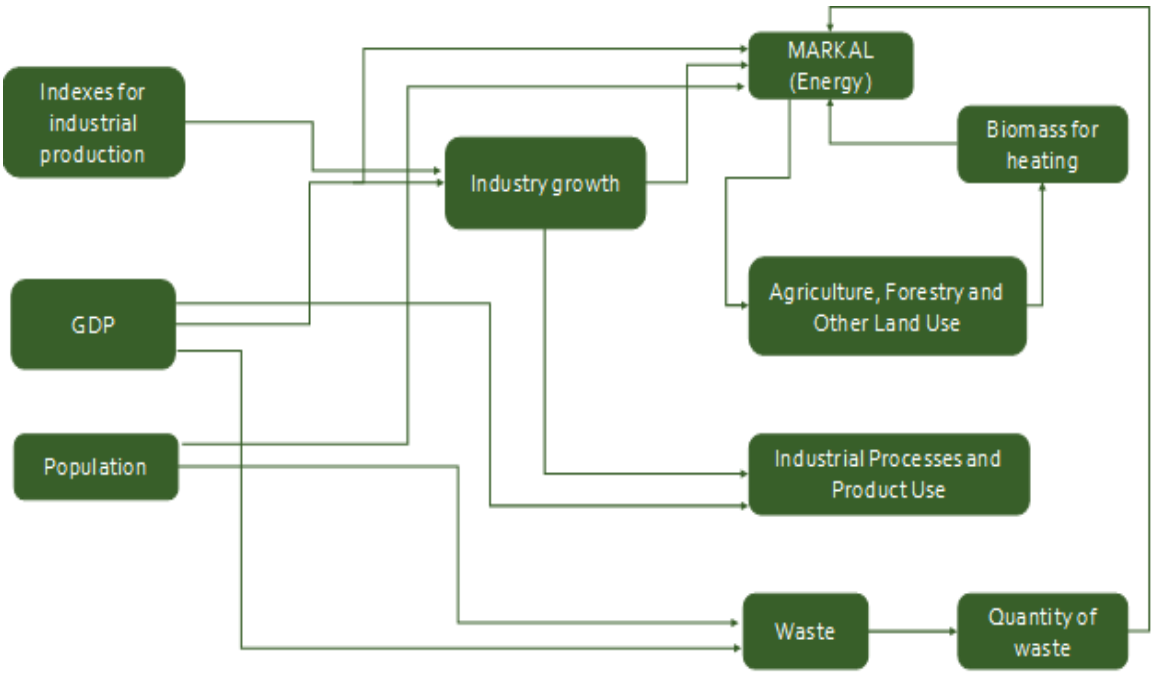


Figure 4. Cross-sectoral binding

- **Sector Energy:**
  - Except calibration of the model (MARKAL) for the base year (2012), additionally, validation and verification of the model for three-years period (2013, 2014, 2015) are carried out;
  - Revision and update of fuel prices in accordance with the latest data derived from the Energy Regulatory Commission, and World Energy Outlook 2015 and World Energy Outlook 2016 are executed;
  - Data derived from results of the inquiry "Energy Consumption in households, 2014" undertaken by the State Statistical Office and of the inquiry "Study for analysis of ways of household heating in Skopje valley" supported by UNDP are modelled, thus allowing more precise definition of the current situation in Macedonia;
  - The modelling in the section of calculating the projections of energy necessitated for heating and cooling is improved by introducing appropriate indicators, such as: heating degree days and cooling degree days;
  - Complete adjustment with the IPCC methodology in the section of calculating GHG emissions is performed, thereby enabling calculation of CH_4 and N_2O emissions beside CO_2 emissions;
  - Calculation of GHG emissions by imported electricity is enabled and CO_2, CH_4 and N_2O emission factors are defined;

- Improvement of the modelling in the section of industry growth and development forecasting is made, based on data for added value and the index of industry production of the corresponding industry and the GDP;
- Climate change mitigation measures in category Manufacturing Industries and Construction are implemented and evaluated for the first time.

► **Sector IPPU:**

- New model for calculation of emissions' projections based on data for the added value in each of the existing industries and the GDP is developed.

► **Sector AFOLU:**

- New models for calculating the emission's projections compliant with the IPCC methodology for each of the three categories: Livestock, Forestry and Other Land Use.
- Mitigation measures in category Forestry are introduced.

► **Sector Waste:**

- For the sake of applying common input data with the other sectors, a new Excel model for calculation of emissions compliant with the IPCC methodology comprising all subcategories is developed;
- Except the GDP and population, projections of the input data, waste per citizen is made.

Reference scenario

3 Reference scenario (WOM)

The necessity of creating scenarios that will help revealing the amount of GHG emissions in a certain year, in fact implies the creation of the development in one city, state or region. In the interest of defining the development, many factors in different sectors have to be known. The objective of this document is to determine the factors that influence the development of a certain sector and based on the methodology prescribed by IPCC to calculate the GHG emissions in Macedonia. This is of particular importance for creation of policies and definition of adequate measures for decreasing the GHG emissions.

In order to determine the contribution of certain measure or policy toward decreasing the GHG emissions, it is indispensable to create a **Reference Scenario or Without Measures (WOM)** scenario. This scenario has **no likelihood of occurrence** because it implies, for instance, that the efficiencies of devises used in households in 2035 would be same as the efficiencies of the devises used in 2012. Nevertheless, creating such a scenario **is of crucial importance** because it allows all measures to be compared to one referent option and it allows for the comparison of the effects (financial, environmental, energy related) of a certain measure or policy to take place. In this chapter, exactly this type of scenario is developed, that will serve to appraise the benefits of proposed measures and policies in aspect of decreasing the GHG emissions and economic benefits.

Analyses conducted for development of each sector in Macedonia are based on **input data** derived from official documents and researches, and only part of them are based on assumptions. Key documents used as data sources are given in the annex of this document, and are additionally referenced and explained in the text of each sector separately.

The modelling is executed for the period 2012-2035. In order to carry out a proper **verification of the model,** i.e. to ascertain whether the model gives real projections, as a base year adopted (retained) is taken 2012 (alike the document elaborated for the Paris Agreement, INDC), whereas the verification is performed for 2013, 2014 as well as for 2015 as the latest year with official statistical data. In spite of postulating 2030 as a target year, for the last year in the modelling 2035 is chosen, due to reflection of the trend after 2030 and to comprise the processes that would happen after 2030. Namely, in the period 2030-2035, TPP Bitola is expected to be phased out, while the capacity of renewable energy technologies is to be increased, resulting in GHG emissions' decrease. Furthermore, in the same period, it is expected that numerous energy efficiency measures are to give considerable results. Maximum GHG emissions are also foreseen in this period, i.e. **peaking year** – until that year the emissions will increase, and after it they will experience a descending trend.

Projections for all sectors are made and in each sector respective key assumptions and methodology are given, and at the end, of course, results are presented. In the last section of this chapter the total GHG emissions are illustrated.

3.1 Energy

The complexity of the energy system makes the forecast of the energy consumption quite complicated. When simplified, one can say that the energy demand is nothing else but a determination of our own necessities, in our homes and places we work, e.g. heating and cooling, lighting, refrigerating and freezing, washing the dishes and the clothes, watching TV, using our computers, phones etc. On the other hand, with the growth of population, the number of homes and jobs increases. This also implies greater needs, resulting in higher production of the industry. All the above mentioned sectors are interlinked by the energy and the need for it. From this follows that the GDP and the population are key drivers in this sector, but their forecast, primarily of GDP is especially difficult. When forecast is made, one should be wide-awake since the GDP growth and the energy demand growth do not always mean growth of energy consumption. Fuel prices on the national and international market, technologies employed in each of this sector's categories as well as their efficiency contribute toward decrease of the consumption. This is the reason why is of outmost importance to have:

- good input data,
- good energy planning model,
- calibrated and verified model.

3.1.1 Key assumptions

Macroeconomic drivers

Every year, the UN generates projections of the world **population** until 2100, creating several scenarios at the same time. In the next figure (Figure 5), the Macedonian population in different scenarios is shown. At the time of composing this report, all population scenarios have been analysed, and because of this reference scenario it was decided to use the scenario named as **Constant-Fertility**.

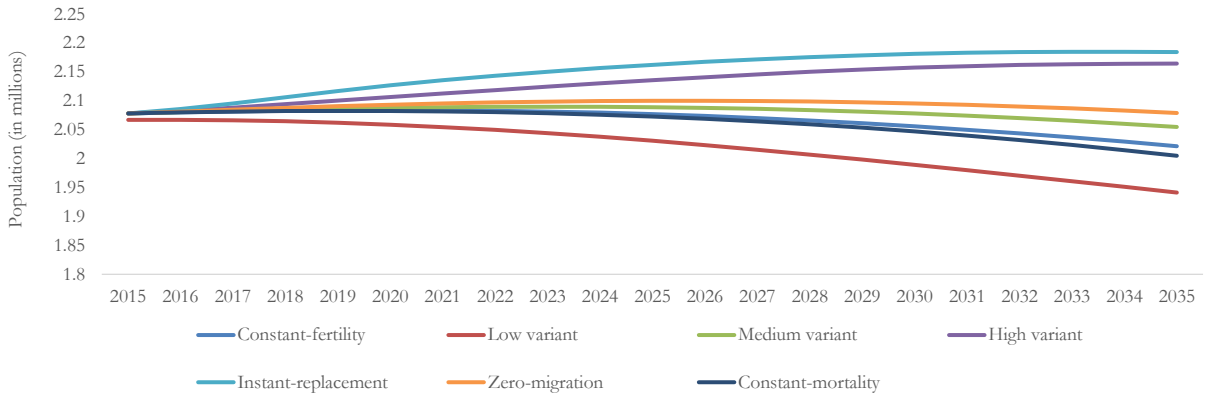


Figure 5. Projections of the population in the Republic of Macedonia according to scenarios United Nations (in millions)

The official available GDP projections by the National Bank of the Republic of Macedonia and the World Bank refer to the near future, until 2020. In pursuance of long-term projections, several scenarios following these institution's short-term scenarios have been developed. In Figure 6, three of them with different average annual growth rate are depicted: 2.48% (Low growth), 4.34% (Medium

growth) and 6.71% (High growth). It has been decided to use the scenario with **Medium growth (4.34%)** of the GDP.

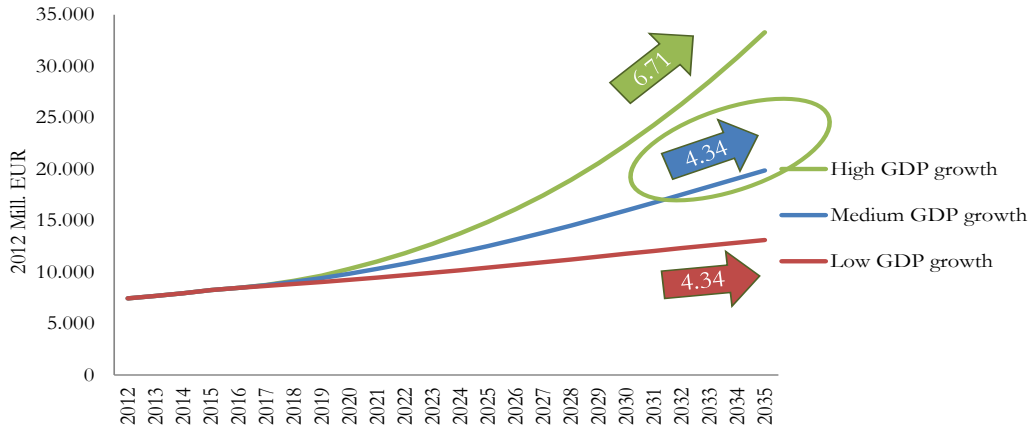


Figure 6. Projections for GDP growth in the Republic of Macedonia (in 2012 Mill. EUR)

Fuel prices

When determining the energy consumption, particularly when least-cost based models are employed, the determination of fuel prices is of great importance. Within the reference scenario, **prices of domestic fuels by the Energy Regulatory Commission** for the period 2012- 2015 are used, whilst the prices on the **foreign markets** that have their impact in Macedonia as import-dependent country, are taken from the last projections given in the **World Energy Outlook (WEO) 2015 и WEO 2016** (Figure 7).

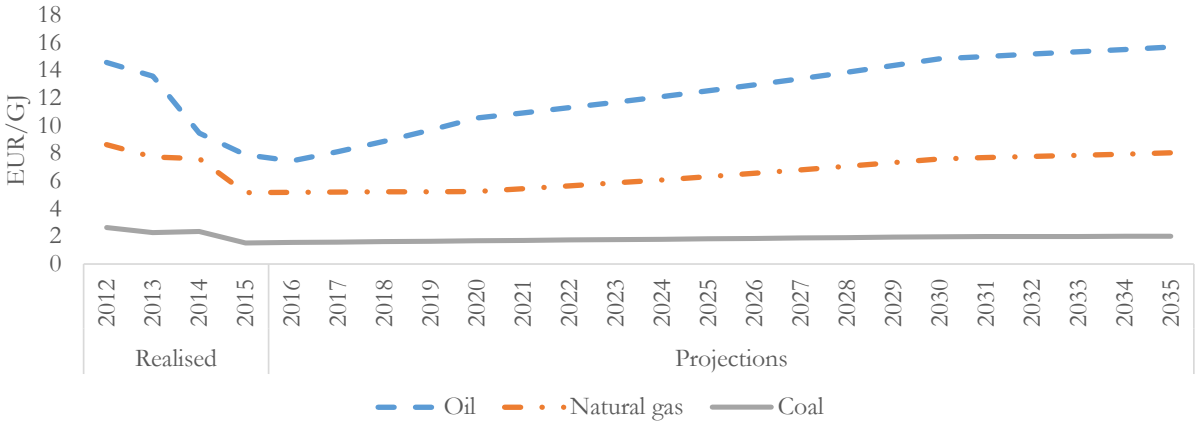


Figure 7. Realised and projected fuel prices according to WEO 2016 (in EUR/GJ)

Moreover, the price of the imported electricity is the one found on a power-exchange. Forecasts show that in the following 4-5 years the electricity price would reach the level of 35-45 €/MWh, depending on the season and the period, albeit until 2035 it would increase to 70 €/MWh.

Emission factor of imported electricity

The accumulated experience of RCESD-MASA team from previous reports connected to Climate change mitigation (Third National Communication on Climate Change, FBUR and INDC) and the consultations with the international expert enabled certain changes of views regarding the import of electricity. Namely, in previous reports, pursuant to the IPCC methodology, the import of electricity, did not have an emission factor. That means that the total national GHG emissions depend on the inverse proportion to the import of electricity. Hence, the experiences from these practices are negative, mainly because of the fact that the import of electricity can be treated as climate change mitigation measure. In order to avoid such situation and to obtain more real decreases of emissions based on mitigation measures (not made up through import), CO_2, CH_4 and N_2O emission factors for the imported electricity are set up. The latter is in accordance with the European comparator made by the Joint Research Center (JRC), wherein sustainable emission factor at European level has been defined. This comparator is sustainable because beside the current situation, it takes into account the further development of the energy system at European level. The comparator is based on fossil fuels (since the electricity production from renewable energy sources is presumed to substitute exactly the same amount of electricity from fossil fuels), i.e. on the following mix of technologies for production of electricity:

- 25% coal-fired thermal power plants with combined cycle with integrated gasification combined cycle – IGCC;
- 25% conventional coal-fired thermal power plants and
- 50% thermal power plants Combined cycle gas turbine – CCGT on natural gas with different length of the gas pipeline network (16.7% with length of 4.000 km, 16.7% with length of 7.000 km and 16.7% liquefied natural gas).

Detailed data used in the calculation of the European average emission factor are given in Table 3.

Table 3. Reference emission factor for electricity in Europe

	Electricity production	***Unit***	***Quantity***	***Comment***
KOEL1	Conventional on char coal	$gCO_{2eq.}$/MJel.	261.5	43.5% efficiency
KOEL2	Coal (IGCC)	$gCO_{2eq.}$/MJel.	234.6	48% efficiency
GBEL1b	Natural gas (CCGT)	$gCO_{2eq.}$/MJel.	118.2	58.1% efficiency, 4.000 km gas network for transport of natural gas
GBEL1a	Natural gas (CCGT)	$gCO_{2eq.}$/MJel.	129.4	58.1% efficiency, 7.000 km gas network for transport of natural gas
GREL1	Natural gas (CCGT)	$gCO_{2eq.}$/MJel.	126.5	58.1% efficiency, liquefied natural gas (LNG)
		Emissions		
Average	(25%/25%/16.7%/16.7%/16.7%)	$gCO_{2eq.}$/MJel.	**186.4**	

CO_2	Output	g/MJ	169.4
CH_4	Output	g/MJ	0.61*
N_2O	Output	g/MJ	0.006**

Manufacturing Industries and Construction

Additionally, improvement in the growth and development of the industry is made. Here, this necessity is seen in the lack of long-term forecasts of growth and development of the industry, similarly as the lack of long-term GDP forecasts. For that purpose, firstly, grouping of industrial branches' added value according to the National Classification of Activities has been conducted, as the grouping of industrial branches in the Energy Balance. Then, for every industrial branch, the dependence of its added value on the GDP, has been determined. As a result from the short historical series of data and big fluctuations in the industry for some of the industrial branches, large increases in forecasting the added value have appeared. Beneficial to avoiding this, the dependence of the total added value in the industry on the national GDP has been additionally inspected. The outcome show high correlation, which is the reason why it was presupposed that the total growth of the industry depends on the GDP. To corroborate it, furthermore, the index of the industrial production is included.

Transport

Price decreases of the oil derivatives on a global level in the period 2012-2015, especially in 2016, have contributed to the growth of the consumption in this sector with a growth rate bigger than all previously made forecasts, not just for Macedonia, but also worldwide. If the implementation of the policies for the import of used vehicles of the Government of the Republic of Macedonia is added as well, the picture for the transport sector in Macedonia is drastically changed. In favor of the possibility of the model (MARKAL) to reflect newly emerging conditions, despite changes in the oil derivatives' prices, complete revision of the number of vehicles (new and old) bought in Macedonia, average number of kilometers traveled, average number of tones of goods transported, etc., is conducted.

Residential and non-specified (Commercial and Service)

Great improvement relative to the input data in Residential category is the complete incorporation of studies that stem from the inquiry "Energy consumption in households, 2014" carried out by the State Statistical Office and from the inquiry "Study for analysis of ways of household heating in Skopje valley" supported by UNDP, where data that can help more precisely determine the energy demand in this sector, thus paving the way for better projections. These data include:

- Number of households;
- Members per household;
- Total area, heated area;
- Information about the construction of the buildings (windows, insulation, year of construction, etc.);

- Appliances used for heating and cooling and the degree of their use;
- Number of refrigerators and other appliances, etc.

In the calculation of the projections of energy needed for heating and cooling in the Residential and Non-specified categories, improvement has been made by introducing annual indicators: heating degree days and cooling degree days. The introduction of these annual indicators is of paramount importance for verification of the model (MARKAL). For the period 2012-2016, real data derived from Weather Underground have been used and as seen in Figure 8, which shows the energy demand in the Energy sector except transport, in 2012 and 2015, as a result of the lower average temperature, there was a greater heating demand, than in 2013 and 2014, where the demand is significantly reduced due to the higher average temperature. Energy projections for the period after 2016 are performed using average heating and cooling degree days. These degree days are calculated based on the historical data for the period 2000-2016, again using the source Weather Underground.

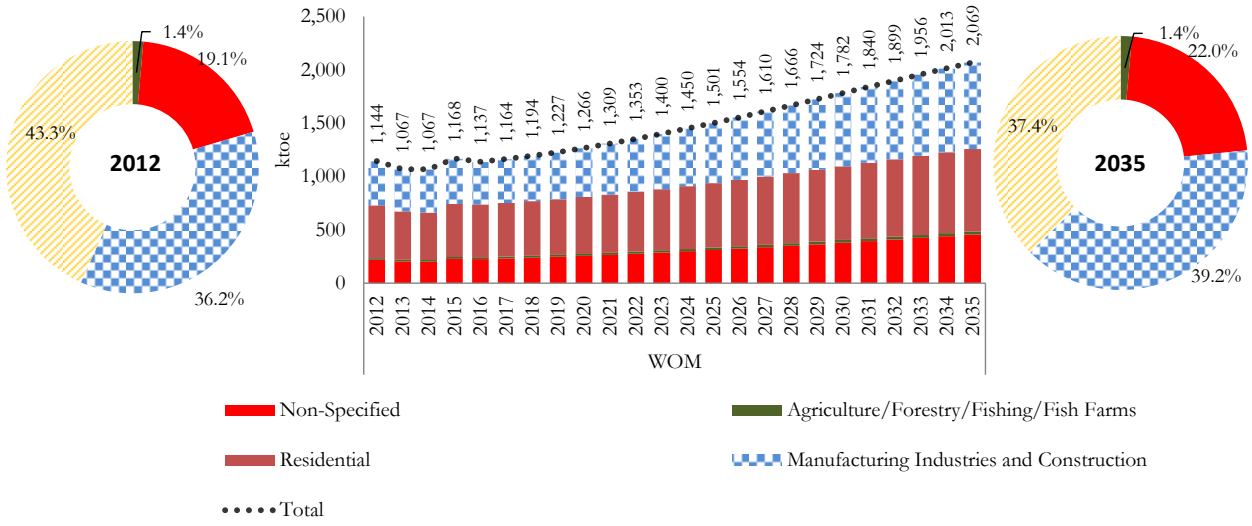


Figure 8. Useful energy by categories (in ktoe)

In the Reference scenario it is presumed that on the demand side technologies with higher efficiency than the ones existing in the base year 2012 will not be procured. There is just a possibility for switch of technology utilizing one type of fuel with technology utilizing other type of fuel.

Energy Industries

On the supply side, beside the existing technologies, a possibility to include the following new technologies is considered:

- Thermal Power Plants (TPP) on domestic lignite and TPP on imported coal with high calorific value;
- TPP and Combined Heat and Power Plants (CHP) on natural gas to the capacity of the existing gas pipeline;

- Renewable sources with feed-in tariffs (hydro, wind, photovoltaic, biogas and biomass) to the capacity for which the Energy Regulatory Commission has already issued at least Decision for at least a Decision for a temporary preferential producer;
- No new large hydropower plants are planned (due to the lack of interest of investors and/or resistance of NGOs and local residents);
- No connection to a new regional gas pipeline is planned, given the current situation in the region, which means that only the capacity of the existing pipeline is available.

3.1.2 Method

As support and help in forecasting the energy demand in the period until 2035, the MARKAL (MARKet ALlocation) program package is used. MARKAL is a complexed model for planning the development of the overall energy sector at local, national and/or regional level. Different parameters such as energy and fuel prices, power plants prices, their characteristics, characteristics of the construction buildings etc., are input data on the basis of which the program chooses an optimal technological mix to meet the energy demand at a minimum price.

In order to meet the electricity demand, the MARKAL model chooses those technologies that have the lowest cost of electricity generation, which includes the investment costs of a particular energy facility, the fixed and variable maintenance costs as well as the costs of fuel consumed by a certain power plant or if the electricity from imports is cheaper, the model imports electricity. In the process of optimization, MARKAL implements the balance of both, the power and the electricity produced.

The model itself is divided in two part, supply and demand side. Both, on the supply side and on the demand side, there are two types of technologies: existing and new. The existing technologies imply those technologies used in the base year, in this case 2012. These technologies have a certain lifetime, after which they will be replaced with new technologies.

In the prediction of useful energy demand in Manufacturing Industries and Construction, a correlation between the added value in this category and the GDP in Macedonia was made. It has been found that there is a high correlation between these two parameters (according to the Pearson coefficient[4]) and the equation for their linear dependence is calculated and shown in Figure 9. Based on the GDP projections (depicted in the chapter Macroeconomic drivers) and based on the obtained equation, a forecast of the added value in the Manufacturing Industries and Construction category is made. Furthermore, based on the average percentage share of each industrial branch, a distribution of the added value for each industrial branch was made.

[4] Pierson's coefficient represents a measure of linear correlation between two variables. It determines the degree of the connection between the variables, or whether there is association between the variables of interest, the magnitude of association, as well as the direction of the relationship

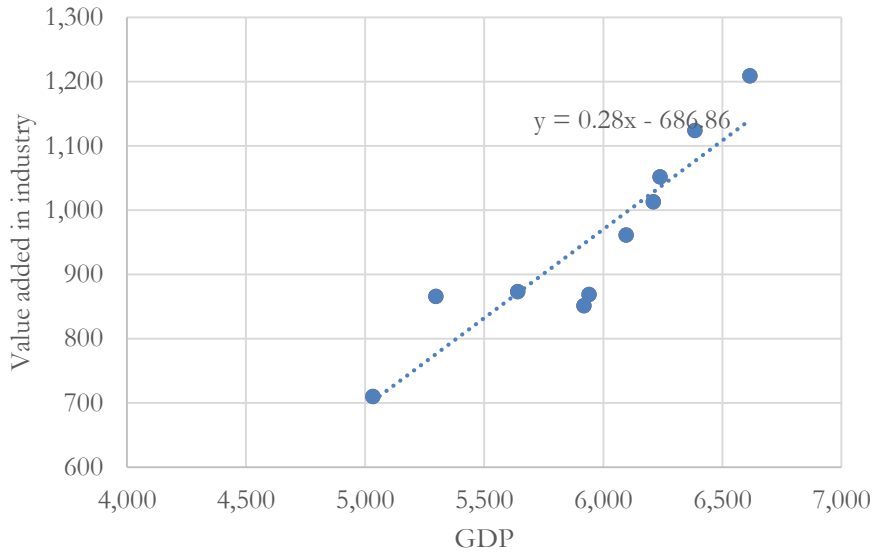


Figure 9. Dependence between value added in the category Manufacturing industries and construction and GDP

In the direction of enabling comparison of the results with the document elaborated for the Paris Agreement (INDC), 2012 is chosen as a base year. The official statistical data for the following three years (2013, 2014 and 2015) are a solid base for examining whether the model (MARKAL) works properly and whether the basic assumptions entered reflect the real state. Additionally, the results for the GHG emissions are compared to the emissions obtained in the National Inventory, where the IPCC methodology has been applied. The difference in 2012, in the aspect of emissions and energy consumption is less than 0.01%. In 2013, the final energy consumption experienced small difference of 2%, in 2014 of 4.6%, and in 2015 of 7.5%. (Figure 10). One can feel free to say that these percentages are acceptable, if one takes into account the constraint of the model to use technologies with the same efficiency as the ones in 2012. By implementing the measures of the Third National Energy Efficiency Action Plan, which estimates the energy savings just for the period until 2015, this difference is annulled.

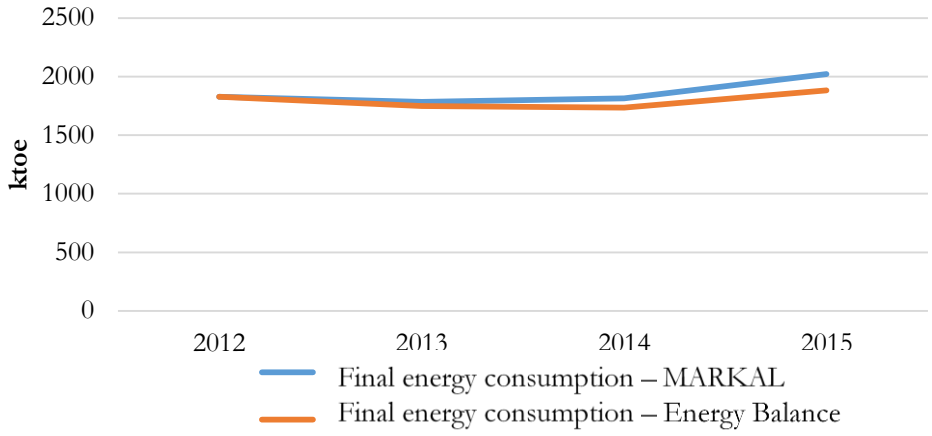


Figure 10. Comparison of the Final energy consumption from the Energy Balance (State Statistical Office) and the results obtained from MARKAL

In this chapter, it is important to emphasize that for the first time in Energy sector, when it comes to projections, CH_4 and N_2O emissions are calculated, thus achieving complete compliance with the IPCC methodology.

3.1.3 Results

Final energy consumption

Based on the projections of useful energy and taking into account the available technologies in 2012 in Macedonia in all sectors on the demand side, the MARKAL model, based on least-cost criteria, determines the final energy consumption by 2035. The results obtained for the final energy consumption indicate:

- Increase by **91%** in 2035 relative to 2012, i.e. from **1,830 ktoe** to **3,497 ktoe** (Figure 11);
- Average annual growth of **2.9%**;
- Increase of the share of natural gas from **1.2%** in 2012 to **6.3%** in 2035;
- Decrease of the share of biomass of **2.5%**, oil products of **2.2%** and heat of **0.9%**.

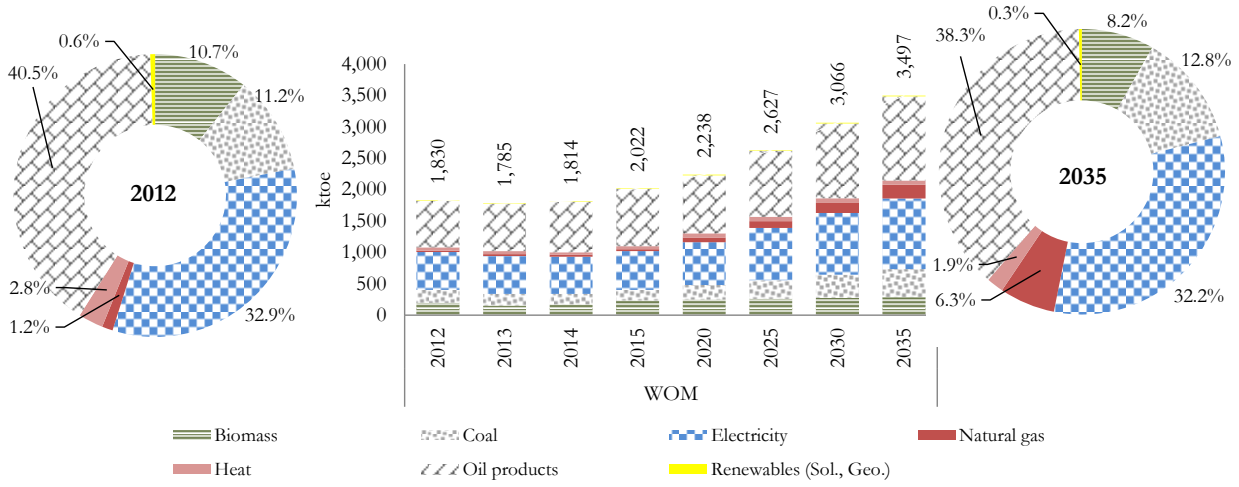


Figure 11. Final energy consumption by fuels (in ktoe)

On the other side, from the analysis of the results by sector, the following can be concluded:

- **Highest share** in 2012 (**31.7%**) and in 2035 (**32.5%**) has the sector Manufacturing Industries and Construction (Figure 12);
- **Second** in 2035 is the Residential sector, incrementing its share from **24.3%** in 2012 to **27.1%** in 2035.
- **Third** in 2035 is the sector Transport, decrementing its share from **29.9%** in 2012 to **26.7%** in 2035.

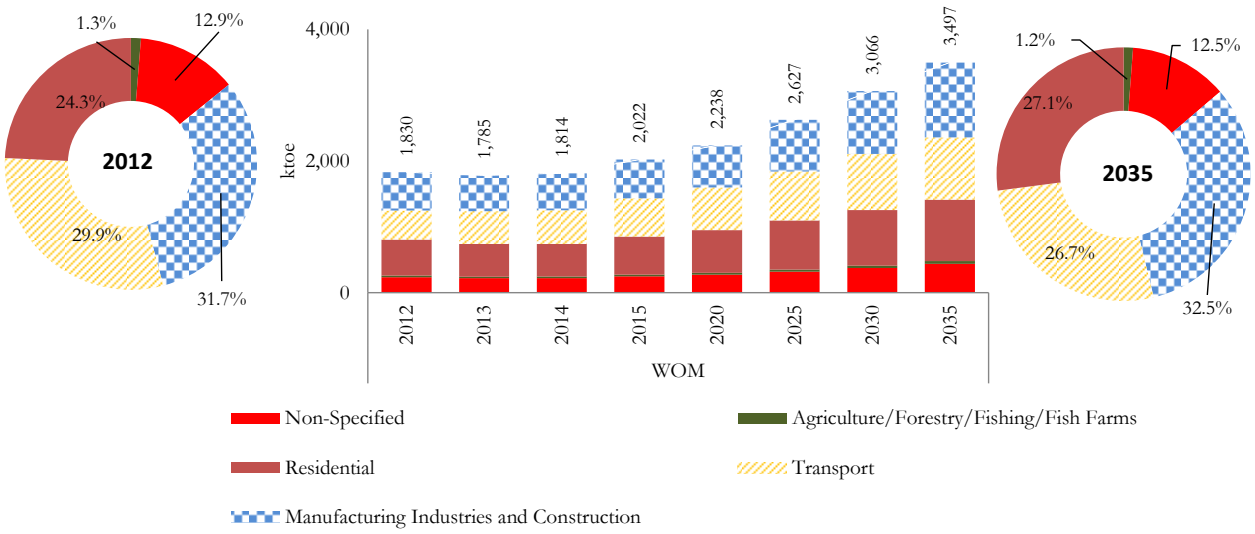


Figure 12. Final energy consumption by sectors (in ktoe)

Electricity production

Electricity is of special importance because it is one of the few fuels produced in Macedonia, and therefore special attention is payed. On the other hand, it is mainly produced in coal power plants that have a major impact on GHG emissions, making the Energy sector a sector with the largest share in GHG emissions in Macedonia. The Reference scenario envisages:

- **Increase of the electricity consumption by 84%** in 2035 (8,301 GWh) relative to 2012 (15,261 GWh) (Figure 13);
- **Maximum exploitation of the existing pipeline capacity** that will lead to **increase** of the share in electricity production from gas-fired **TPP and CHP** (**15.5%)**;
- **Decrease** of the share of the **HPP** from **12.4%** (2012) to **11.7%** (2035) since construction of new HPP is not foreseen;
- **Covering of the remaining part** of electricity from **coal-fired TPP**, which continue being predominant (**63%,** 2035);
- **Significant decrease of the import of electricity** with a share of **8.6%** in 2035 (**32.4%** in 2012).

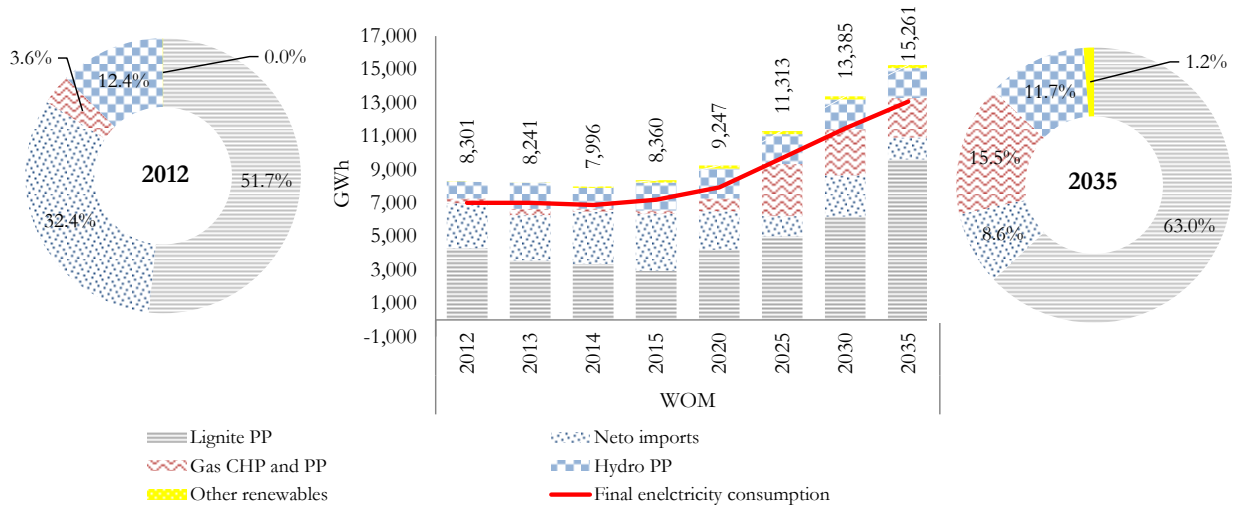


Figure 13. Electricity generation (in GWh)

With regard to the installed capacity, and so as to meet the electricity demand, the results obtained with the MARKAL model indicate an increase of 43%, i.e. an average annual growth of 1.6% (Figure 14). In order to achieve these numbers, it is foreseen:

- Phasing out of TPP Oslomej, its complete reconstruction and re-commissioning in 2021;
- Construction of a gas-fired TPP with capacity of 350 MW in the period 2020-2025, which together with the existing gas-fired CHP will utilize the capacity of the pipeline to the highest extent;
- Construction of a TPP running on (domestic) coal with capacity of 300 MW in the period 2025-2030;
- Construction of a coal-fired TPP with capacity of 60 MW (domestic), 300 MW (imported) and 600 MW (imported) in the period 2030-2035.

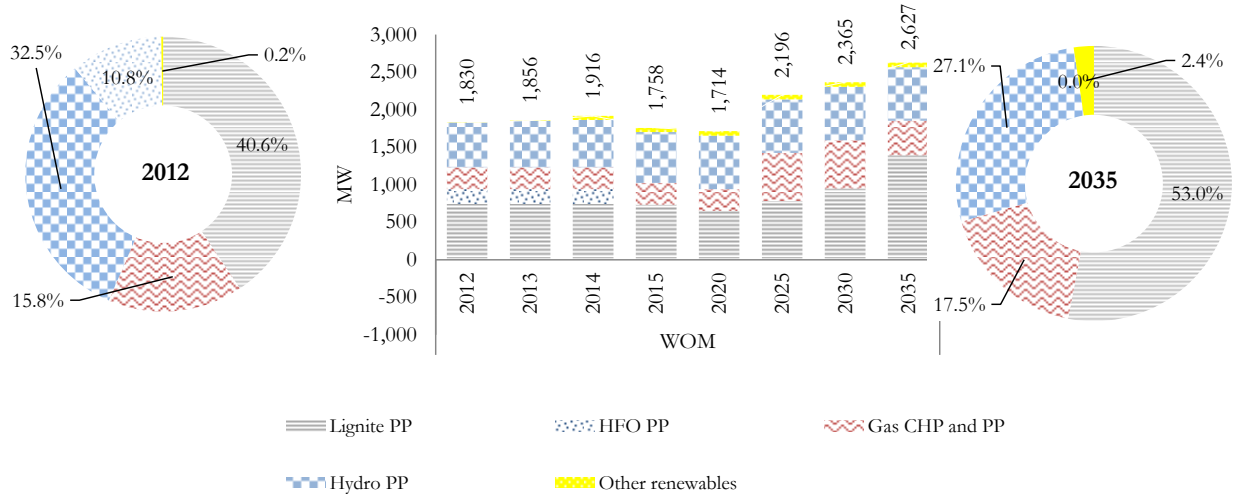


Figure 14. Total installed capacity for electricity generation (in MW)

Gross inland consumption

In order to determine the GHG emissions in Macedonia, it is necessary to know the amount of the gross inland consumption. Summing up the final energy consumption and the transformation input (electricity and heat production), the amount of the gross inland consumption is obtained. According to the analyses based on least-cost of the entire energy system, for the gross inland consumption, it is envisaged:

- Increase by 125%, from 2,924 ktoe in 2012 to 6,572 ktoe in 2035 (Figure 15);
- Increase of the share of coal to 60.8% in 2035 (49.6%, 2012);
- Increase of the share of natural gas to 9.9% in 2035 (3.9%, 2012), making it the fastest growing energy source.

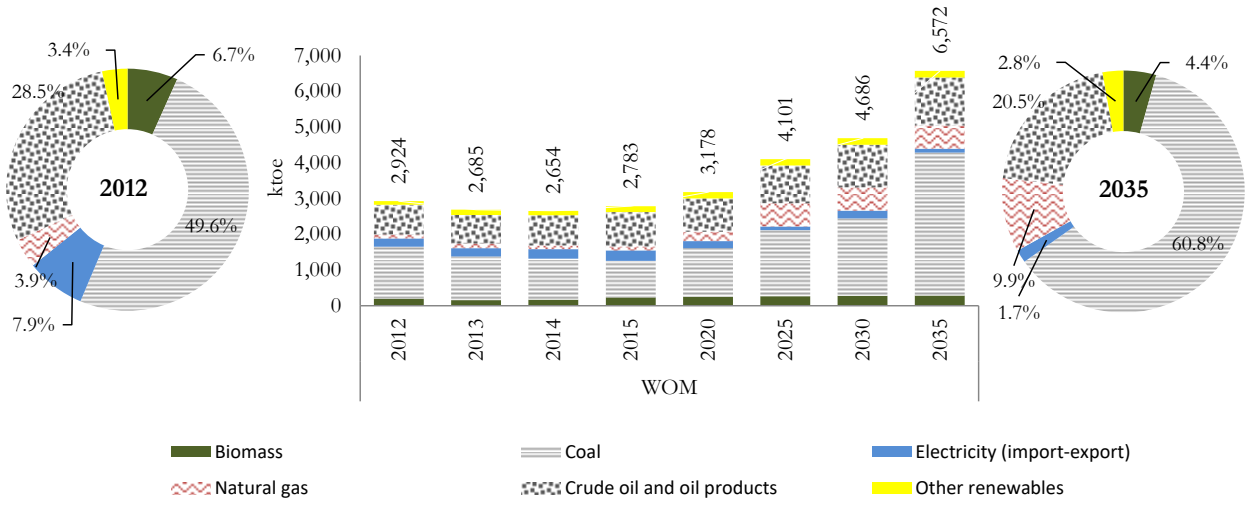


Figure 15. Gross inland consumption (in ktoe)

GHG emissions

The increase of the gross inland consumption, especially the increased electricity production from coal and gas contributes to an increase of CO_2 emissions by 58% in 2035 compared to 2012. The Reference scenario envisages:

- Increase in emissions from 10,864 Gg CO_2-eq in 2012 to 17,203 Gg CO_2-eq in 2035 (Figure 16);
- Transport category will increase its share from 12.1% in 2012 to 15.8% in 2035;
- The share of Manufacturing Industries and Construction category will increase to 15.9% in 2035 (12.6%, 2012);
- Minimum increase of the Energy Industries share from 55.6% in 2012 to 56% in 2035;
- Decrease of the imported electricity share to 6.4 % in 2035 (15.4%, 2012).

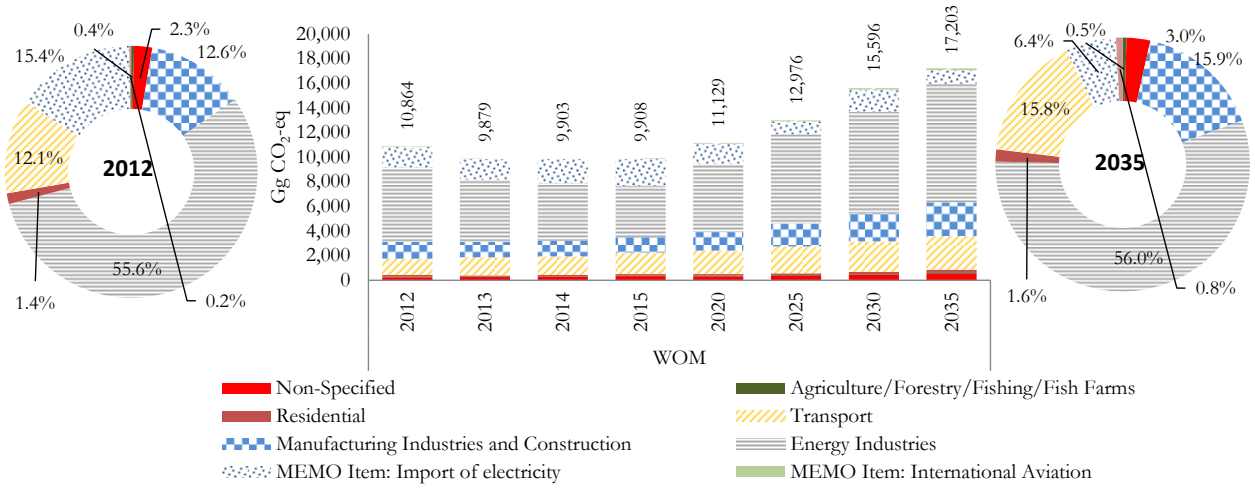


Figure 16. CO_2 emissions in Energy sector by categories (in Gg CO_2-eq)

The amount of CH_4 emissions in the Energy sector mostly depends on the category Fugitive emissions from fuels. Almost 99% of this category emissions depend on coal excavation. Because in 2035, a part of the coal for TPP is envisaged to be imported, which will lead to reduction of the excavation of coal, one can state that:

- The amount of Fugitive emissions will be reduced from 165 Gg CO_2-eq to 77 Gg CO_2-eq (Figure 17);
- Maximum CH_4 emissions are to be achieved in 2030 and they account for 427 Gg CO_2-eq;
- Increase of the share of Residential category from 13.6% in 2012 to 30.1% in 2035.

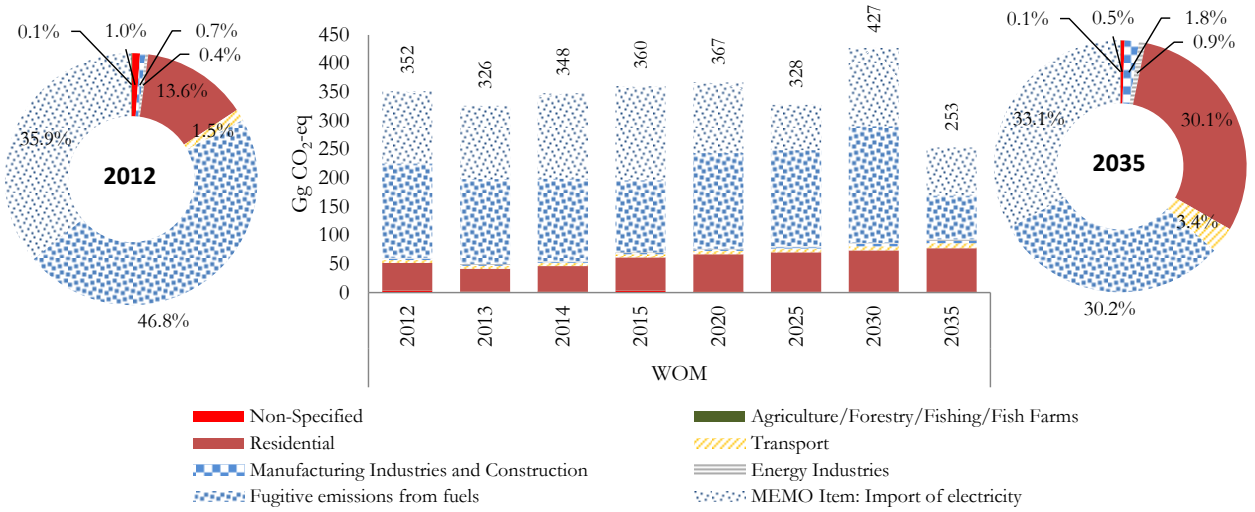


Figure 17. CH_4 emissions in Energy sector by categories (in Gg CO_2-eq)

In the reference scenario for the N_2O emissions it is envisaged:

- Increase of 55%, i.e. from 80 Gg CO_2-eq in 2012 to 124 Gg CO_2-eq (Figure 18);
- The Transport category will take the primacy of the most intensive sector in 2035 with a share of 35.4% (25.3% in 2012);

- In second place in 2035 is the Energy Industries category with a share of 32.3% (31.1% in 2012).

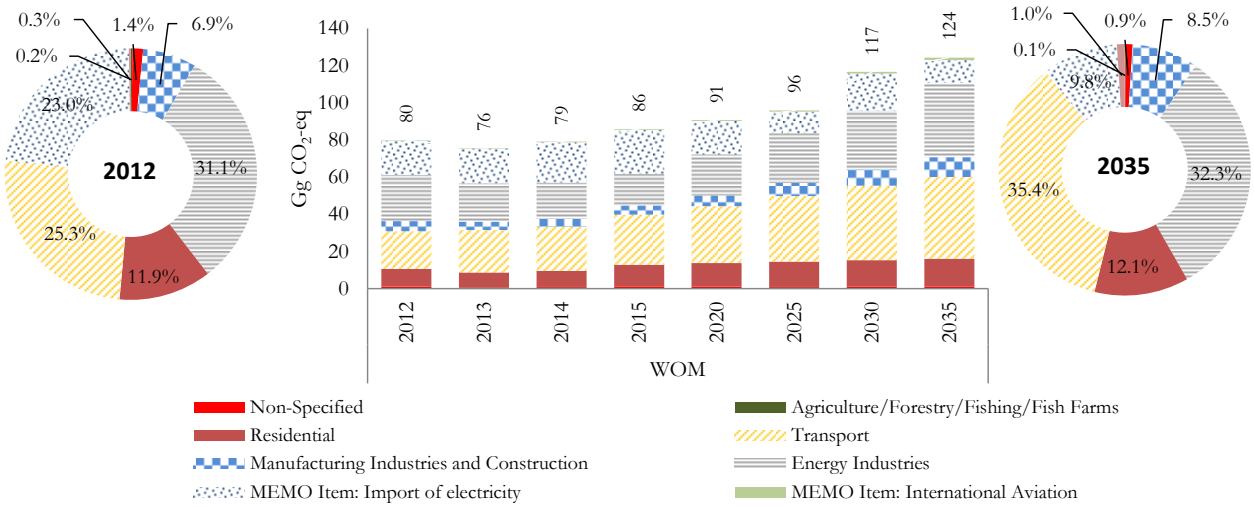


Figure 18. N_2O emissions in Energy sector by categories (in Gg CO_2-eq)

Analyses of the total GHG emissions in the sector Energy illustrate:

- permanent growth from 2020 to 2035
- 56% increase in 2035 compared to 2012
- total 17,580 Gg CO_2-eq in 2035 (Figure 19)
- CO_2 emissions share of 97.9% in 2035 (96.2% in 2012)
- CH_4 emissions share of 1.4% in 2035 (3.1% in 2012)
- N_2O emissions share of 0.7% in 2035 (0.7% in 2012)

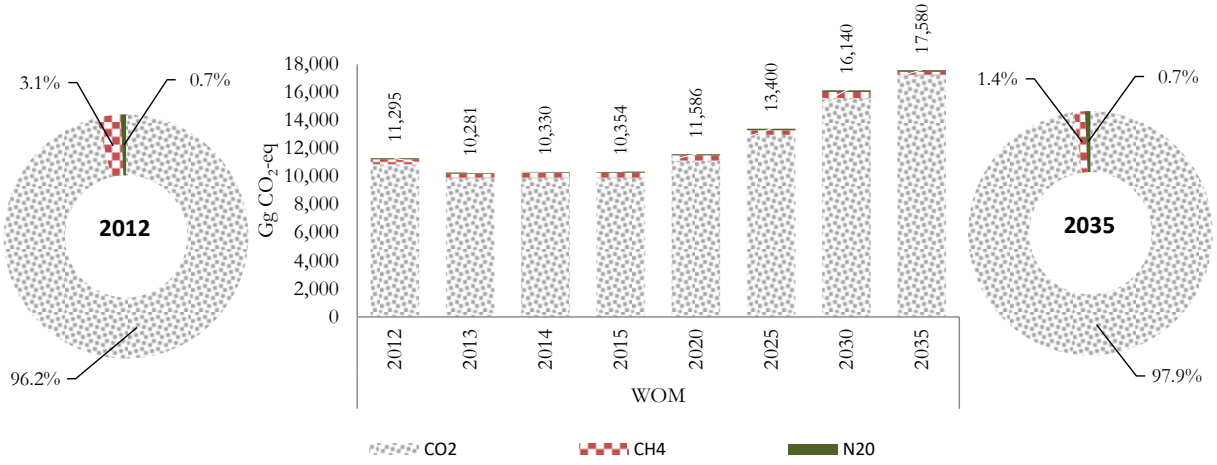


Figure 19. Total GHG emission in Energy sector by gasses (in Gg CO_2-eq)

Total costs in Energy sector

Concerning the total annual costs in the Energy sector, the results obtained from the MARKAL model point out the following:

- Increase by about 3.5 times, and from 1,633 million EUR in 2012 will reach 5,669 million EUR in 2035 (Figure 20). (The increase is mostly due to investments in technologies on demand side and on supply side, in order to meet the energy demand);
- Investment costs on demand side are expected to reach 1,972 million EUR in 2035, which is over 30% of the total costs.

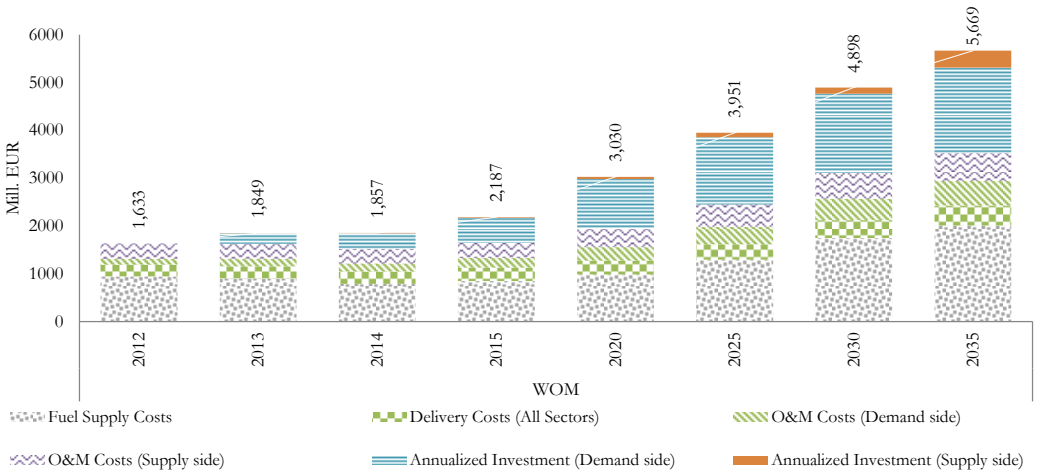


Figure 20. Annual costs in Energy sector (in Mill. EUR)

3.2 Industrial Processes and Production Use

3.2.1 Key assumptions

Based on historical data, in the IPPU sector in Macedonian, emissions are emitted only in the following categories:

- Mineral Industry
- Chemical Industry
- Metal Industry
- Product Uses as Substitutes for ODS

The basic assumption used to plan emissions in these categories is that they are mainly dependent on the increase of the added value in the specific industry. Based on this assumption, an analysis of the correlation between the emissions and the added value in the specific industry was made. However, this assumption does not apply to the category Product Uses as Substitutes for ODS, where the main source of emissions are imported appliances (such as refrigerators and air conditioners). Emissions in this category may be related to the number of refrigerators and air conditioners existing in the country

on an annual basis. However, in calculating the GHG inventory, for this category Level 1 (Tier 1) method was used, which assumes that all imported appliances emit 100% of their emissions in one year, not taking into account in the specific year the existing appliances that have been imported in previous years (since their emissions are calculated in the year they were imported). Therefore, it is assumed that the emissions depend only on the import in the specific year, and it is additionally assumed that the import depends on the GDP growth. The connection of this category with the number of refrigerators and air conditioners is important because when projections are made, the number of refrigerators and air conditioners can be taken from the forecasts made by the MARKAL model and thus gain greater integration of the sectors. Also, it is assumed that in the other categories of this sector, the emissions will remain zero.

3.2.2 Method

A correlation analysis between historical emission and added value data in the specific industry for the Mineral and Metal Industry using the Pearson coefficient is made. The results show a great linear dependence between these pairs of variables and, therefore, again based on historical data, an equation for the dependence of emissions on the added value, in the specific industry, is calculated. These equations, together with historical data on the Mineral and Metal Industry are shown in Figure 21 and Figure 22.

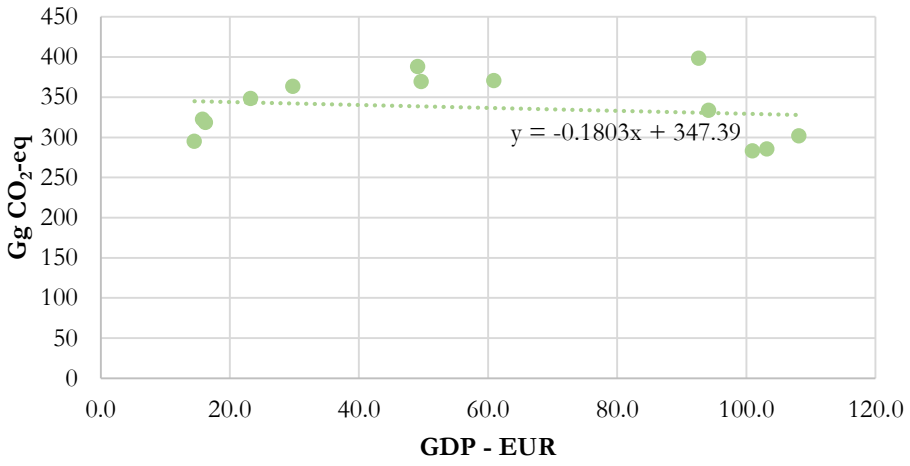


Figure 21. Dependence between GHG emissions and value added in the Mineral industry

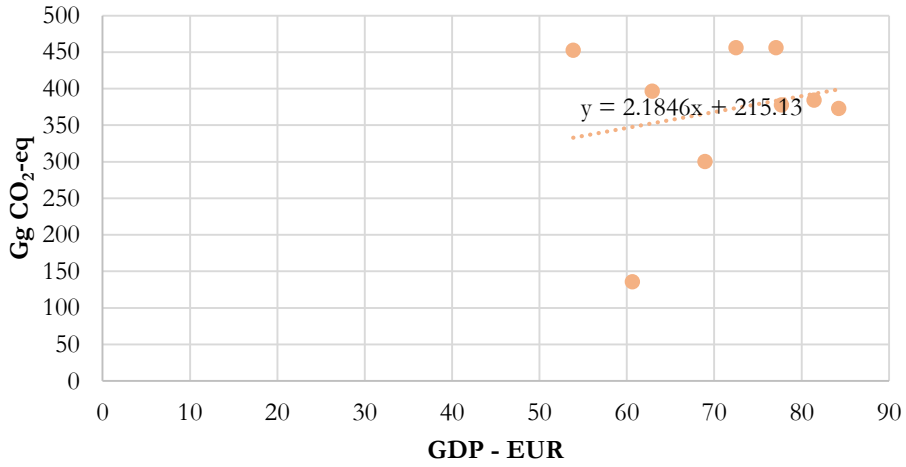


Figure 22. Dependence between GHG emissions and value added in the Metal industry

Historical data show that emissions in the Chemical Industry are at the same level in the last thirteen years. Additionally, their share in total emissions from this sector is less than 0.001% in the previous years. Therefore, it is assumed that this amount of emissions in the coming years will remain at the same level.

As to the emissions from the category Product Uses as Substitutes for ODS, a correlation with the total GDP in Macedonia was made. Since the results show high correlation, the equation for the linear dependence between the GDP and the emissions in this category is calculated (Figure 23).

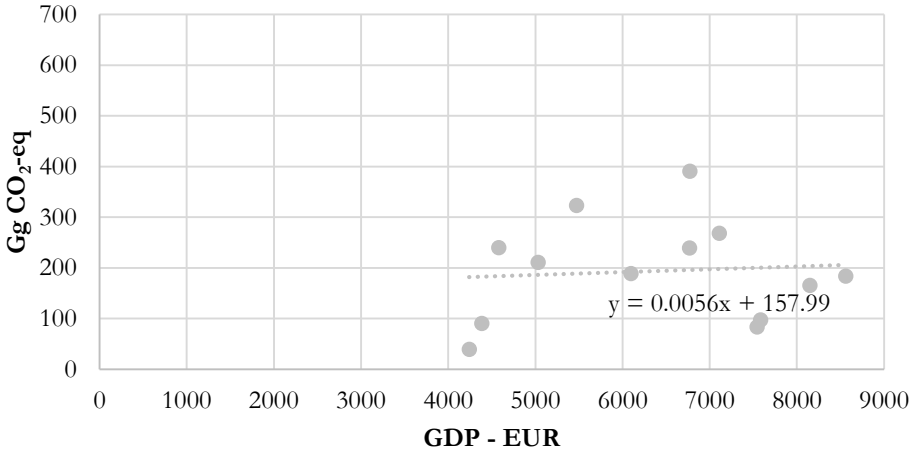


Figure 23. Dependence between GHG emissions in the category Product Uses as Substitutes for Ozone Depleting Substances and total GDP

3.2.3 Results

Based on the GDP growth (shown in the section on macroeconomic drivers) and the equations derived from historical data, emissions for the IPPU sector in the period up to 2035 were calculated.

As can be noticed, in the **Mineral Industry** there is a decreasing trend of emissions, that up to 2035 will **decrease by 12%** relative to 2012 and will account for 250 Gg CO_2-eq (Figure 24).

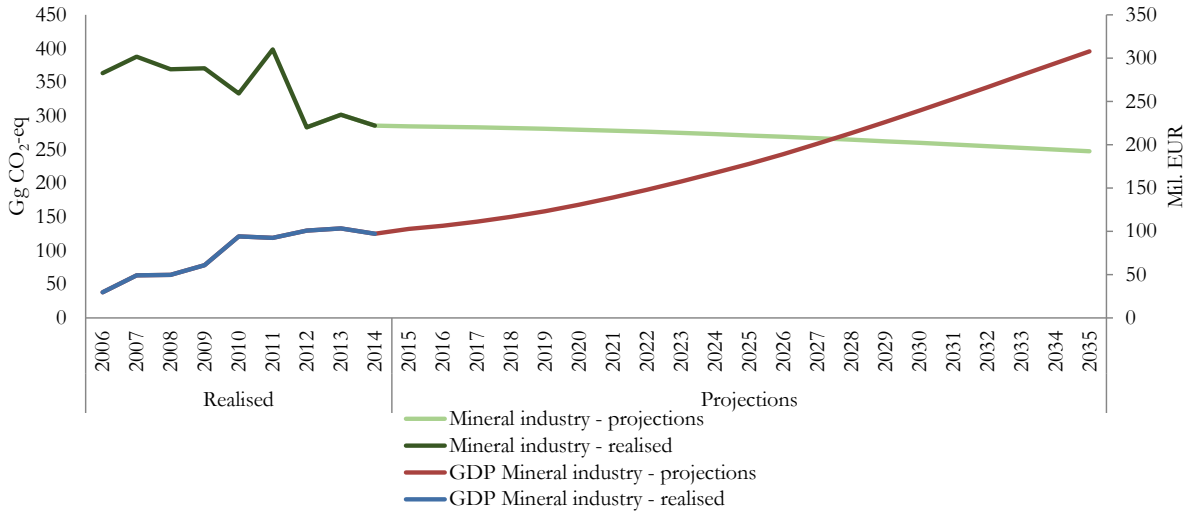


Figure 24. Realised and projected GHG emissions and value added in the Mineral industry (in Gg CO_2-eq)

Because there are no large emissions in the **Chemical Industry**, it is predicted that emissions will remain **at the same level** and in 2035 they will amount to 0.01 Gg CO_2-eq.

Concerning the emissions in the **Metal Industry**, it can be noted that they grow together with the growth of the added value in the Metal Industry. Accordingly, emissions in 2035 amount to about 690 Gg CO_2-eq, and in 2012 they were about 400 Gg CO_2-eq, which means an **increase of about 73%** is predicted (Figure 25).

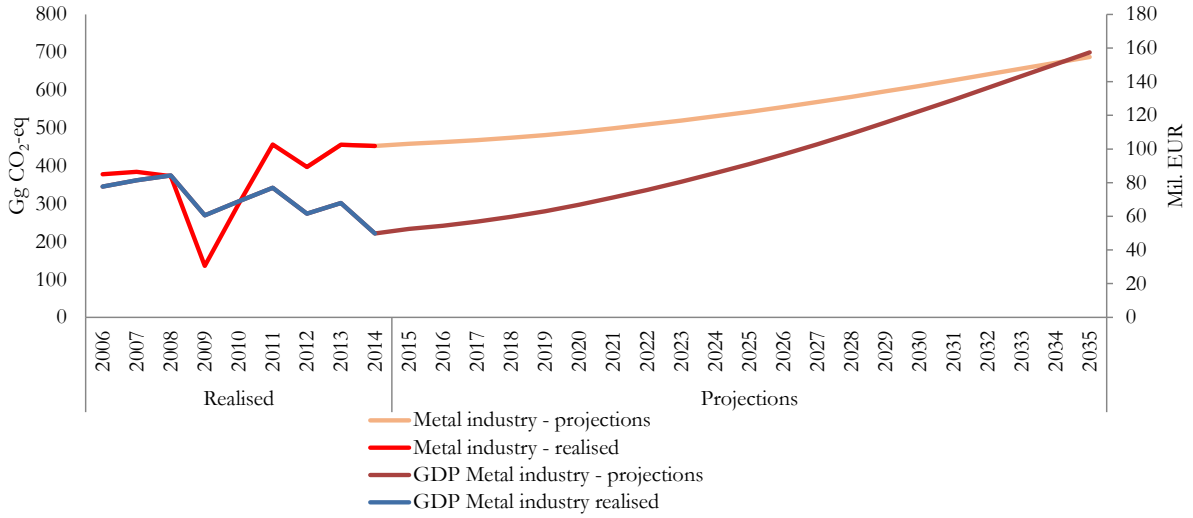


Figure 25. Realised and projected GHG emissions and value added in the Metal industry (in Gg CO_2-eq)

The emissions in the category **Product Uses as Substitutes for ODS** follow the growth of the GDP in Macedonia, and according to the equation for their interdependence, in 2035 they **increase by about 180%** compared to 2012, and amount to about 270 Gg CO_2-eq (Figure 26).

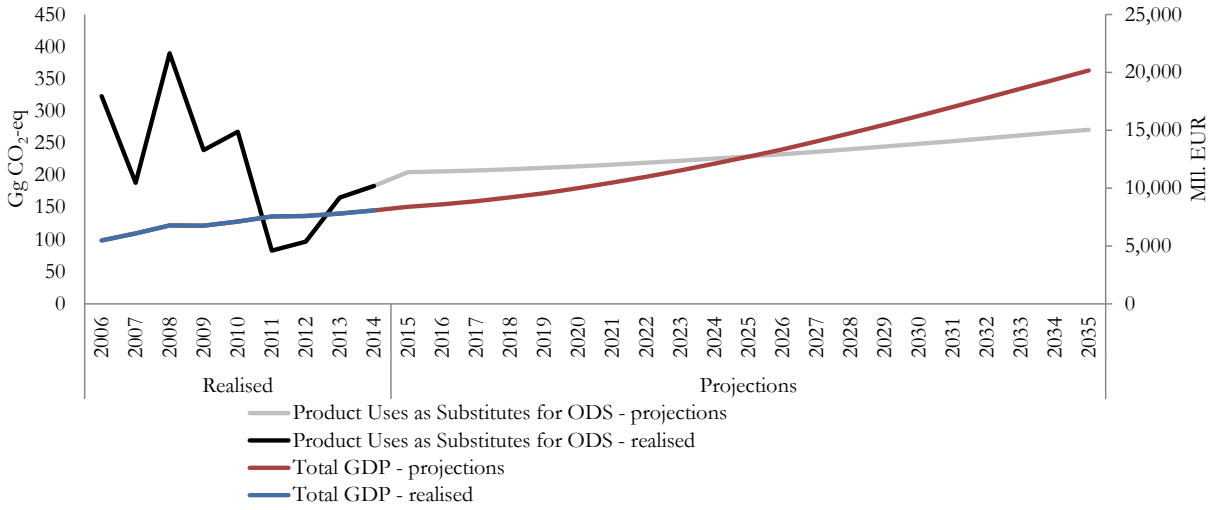


Figure 26. Realised and projected GHG emissions in the category Product Uses as Substitutes for Ozone Depleting Substances and GDP (in Gg CO_2-eq)

When all these projections of emissions in the **IPPU** sector are summarized, Figure 27 shows that **emissions in 2035 increase by about 55%** compared to 2012. This means that emissions from the IPPU sector will reach 1,206 Gg CO_2-eq in 2035. The **Metal Industry** will remain as **the most dominant** category with an emission share of 57% in 2035 (51.1% in 2012). The Chemical Industry will significantly reduce its share and from 36.5% in 2012, in 2035 will participate with 20.5%. As a result of the decrease in the share of the Chemical Industry, the category Product Uses as Substitutes for ODS will account for 22.5% in 2035 (12.5% in 2012).

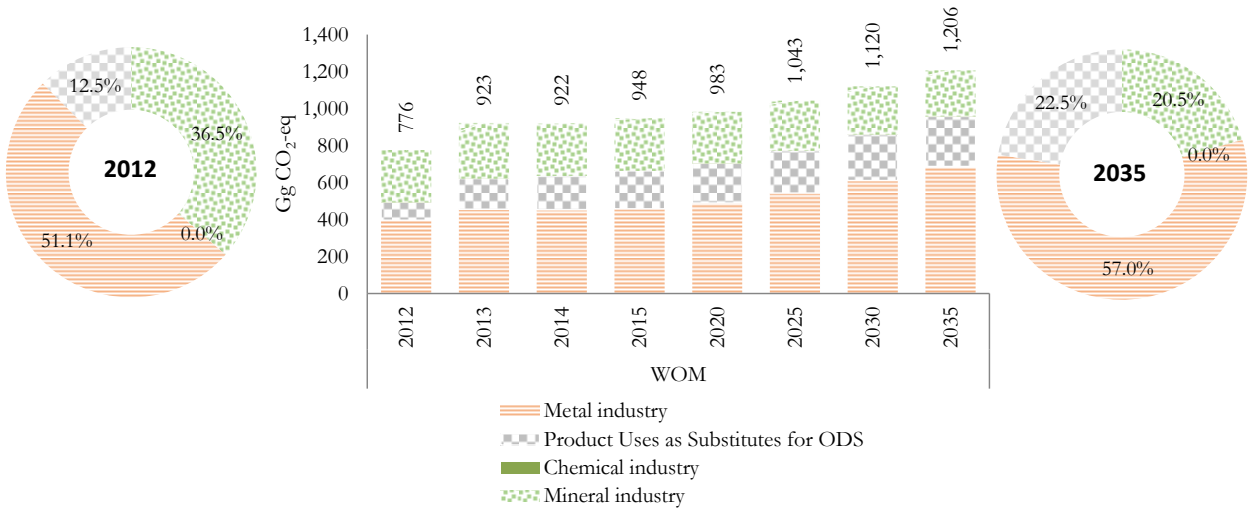


Figure 27. Total GHG emissions in Industrial processes and product use sector by categories (in Gg CO_2-eq)

3.3 Agriculture, Forestry and Other Land Use

3.3.1 Key assumptions

Livestock

During the activities related to livestock production, greenhouse gases are emitted, mainly as a result of enteric fermentation and manure management. It is forecasted that the trend of GHG emissions in Livestock will be descending. In addition, it is expected that the emissions will decrease by 10% in the next 20 years, primarily due to the reduction of domestic animals population as well as the changes in the productivity of livestock production. However, despite the negative trends in GHG emissions from livestock production, three scenarios are elaborated, so as to further reduce them.

Forestry

In the Reference scenario for the Forestry sector, it is assumed that with regard to afforestation there will be very little or almost no changes in forest land. It is also assumed that there will be annual losses of forests caused by fires that are equal to the average of the last fifteen years. The same assumption is taken into account for the forest-cutting activities, i.e. the annual harvest is equal to the average of the last fifteen years.

Agriculture and Land Use

GHG emissions from plant production are a consequence of several major sources, such as inadequate and excessive fertilization with mineral fertilizers, which in the long run cause severe reduction of organic matter in soils and significant CO_2 emissions; Rare and inadequate use of manure on surfaces; Conversion of the land use from extensive to intensive plant production system; Inadequate management of arable land and improper management of fertilization.

3.3.2 Method

Livestock

In order to anticipate future GHG emissions from the activities related to livestock production, a Reference scenario is prepared initially without application of mitigation measures. The projection is based on: a) Trends in the number of heads; B) Forecasts of changes in production systems for each species of domestic animals, and c) Changes in the level of productivity in each production system and for each species of domestic animals, separately. In the Reference scenario, the current state of productivity and management method of the farms was taken as a starting point. In general, the size of the population of domestic animals is expected to be reduced. This decrease began in the early 90's of the last century. It strikes the most the cattle, sheep, goats and horses. In contrast, in pig breeding and poultry, the reduction in the number is not so pronounced, primarily because of the specific mode of production, which is usually intense.

The data used in the forecasts for future GHG emissions emitted as a result of activities related to livestock production are taken from different sources for each type and production system separately. For ruminants and horses, official statistics for the period 1990-2014 were used. With these data, extrapolation equations for the number of heads were derived. However, for the number of pigs and poultry, the predictions about the size of population are based on expert opinion. For all types of domestic animals in the Reference Scenario, in 2015 the official statistics for 2015 are used.

In cattle breeding milk cows and other cattle are contained. The presence of organized farms with more than 50 milk cows is very low (about 1-2%). However, from an economic, productive point of view, and from the aspect of efficiency in the work, it is realistic to expect that many of the small farms (farms with fewer than 10-15 heads) will disappear in the future, against the increase in the number of organized dairy farms with more heads. The projection assumes that the participation of organized farms with more than 50 dairy cows will be 5% of the total dairy farms in 2020. In each 5 years subsequently, an additional 5% of dairy farms will be transformed into organized, thus in 2035 their share is expected to be 25% of the total number of dairy farms. On these farms advanced techniques of nutrition and improved management and treatment of manure would be implemented. In this way, even the current descending trend of dairy cows population to remain (drop of about 15% by 2035), milk production is expected to increase, primarily due to increased production per head. Other cattle are also expected to experience a moderate decrease in the population, primarily due to cross-breeding of the local with more productive breeds, but it is also expected that some of the very extensive farms in the remote mountain regions will completely disappear.

Production systems in sheep and goat breeding are under strong pressure due to a lack of skilled labor, but also because of low productivity. Most of the sheep breeders are older family members. Unless some rapid demographic changes occur, the reduction in the sheep and goat population will continue. If the current trend (1990-2014) continues, then it is realistic to expect a decrease in the population by an additional 25% by 2035 (Table 4).

The population of ungulates (horses and donkeys) counts nearly 20,000 heads. This population contributes insignificantly to the GHG emissions and is expected to remain stable in the coming period.

The number of pigs in the coming period is expected to remain stable, due primarily to the specific intensive system. At the same time, it is expected that the productivity and structure of the herds will change as well as the number of farms that will use modern breeding technologies. Therefore, the projection is that by 2035 the population of pigs will decrease (from 23,511 in 2014 to 20,000 in 2035), but at the same time, the number of pigs for fattening will increase from 141,542 (2014) to 160,000 (2035).

Poultry is also expected to follow the trend as pig breeding, where the total population would be slightly reduced, while the number of intensive farms for laying hens, broilers and turkeys would increase.

Table 4. Statistical (2013, 2014 u 2015) and foreseen data on the number of domestic animals used in forecasting GHG emissions in Livestock

Types and categories	2013	2014	2015	2020	2025	2030	2035
Dairy cows	154,487	155,432	156,699	144,814	140,534	136,381	132,350
Other cattle	83,846	86,175	96,743	93,671	92,405	91,318	90,367
Sheep	572,961	575,833	619,839	480,725	461,817	442,910	424,002
Sheep up to 1 year	158,867	164,624	113,671	120,756	116,096	112,043	108,457
Goats	75,028	81,346	88,064	44,462	36,559	28,655	20,752
Horses	20,682	19,371	18,784	19,921	19,926	19,931	19,936
Swine	26,724	23,511	20,857	22,000	21,000	20,000	20,000
Fattening pigs	140,768	165,053	174,586	165,000	168,000	170,000	180,000
Poultry	1,737,505	1,911,811	1,495,915	1,820,645	1,910,712	2,005,922	2,106,577
Laying hens	1623,130	1,884,289	1,423,841	1,790,075	1,879,578	1,973,557	2,072,235
Broilers	90,184	4,355	51,256	6,532	7,839	9,406	11,288
Turkeys	3,491	3,690	2,910	5,535	6,642	7,971	9,565
Other poultry	20,700	19,477	17,908	18,503	16,653	14,988	13,489

Forestry

In the preparation of this scenario, it was assumed that in the future, except for forest fires, there will be no other losses on forest land. In doing so, the forest land in 2013 was taken and the average annual losses from fires for the period 1999-2015 and their share in the balance of carbon from forests were calculated.

Agriculture and Land Use

In defining the WOM scenario for the AFOLU sector, the hypothesis that the rate of conversion of the land for the period 2000-2014 will keep the same trend by 2035. The assessment of the values for the period 2013-2035 was prepared by means of simple extrapolation method. Still, it is very difficult to make forecasts for the land use trends and change in land use for such a long period of time. However, CO_2 emissions are calculated according to the basic dynamics of the past changes in land use. In addition, in this scenario, it was assumed that no mitigation measures will be applied, i.e. the usual practice in land use will be continued.

3.3.3 Results

Dairy cows and other cattle are the main emitters of greenhouse gases in livestock production, while other the species (sheep, goats, horses, pigs and poultry) participate considerably less. Enteric fermentation will remain the main source of methane emissions. However, it is projected that methane emissions would be reduced by about 6.3%, primarily due to the reduction of population in ruminant animals. The emissions of methane from manure management will be reduced by 8.6%. The reduction of N_2O emissions from manure management in the period from 2014 to 2035 is projected to decrease by 11.3%. The total emissions of methane in CO_2-eq in 2014 was 633.14 Gg (Table 5). It is predicted

that in 2035 these emissions will be 567.21 Gg CO_2-eq. The emissions of nitric oxide would drop from 41 Gg CO_2-eq (2014) to 36 Gg CO_2-eq in 2035. The total GHG emissions from activities related to livestock production in CO2-eq in 2014 were 673.65 Gg and it is projected to continuously decrease in the next years to the level of 603.15 Gg in 2035.

Table 5. Estimated total emissions for the period 2012-2035 in the AFOLU sector

	2012	2013	2014	2015	2020	2025	2030	2035
	Gg $CO_{2\text{-eq}}$							
Livestock	692.6	666.4	673.6	695.7	630.4	617.2	604.5	603.1
Land	1,936.5	-1,814.8	-3,181.1	-203.2	111.6	426.4	741.2	1,056.0
Forest land	1,665.0	-2,097.0	-3,471.2	-505.5	-243.8	18.0	279.8	541.5
Cropland	114.9	120.6	123.8	128.6	150.8	172.9	195.0	217.1
Grassland	125.9	130.0	134.9	139.3	162.0	184.7	207.4	230.1
Settlements	24.2	25.0	25.9	26.7	31.1	35.5	39.8	44.2
Other land	6.5	6.6	5.5	7.6	11.5	15.4	19.3	23.2
Aggregate sources and non-CO_2 emissions sources on land	326.7	322.8	328.2	328.9	337.4	345.9	354.4	363.0
Urea application	5.7	5.7	5.7	5.9	6.4	6.9	7.5	8.0
Direct N_2O emissions from managed soils	198.2	196.0	197.7	198.2	200.6	203.0	205.3	207.7
Indirect N_2O emissions from managed soils	72.0	71.3	72.0	72.1	72.7	73.4	74.0	74.7
Indirect N_2O emissions from manure	27.9	26.8	27.3	27.6	27.3	27.0	26.6	26.3
Rice cultivations	22.9	22.9	25.4	25.1	30.4	35.7	41.0	46.4
Other	-21.6	-22.2	0.0	-22.2	-22.2	-22.2	-22.2	-22.2

The emissions from the AFOLU sector in the WOM scenario in 2035 were 32% lower than the emissions in 2012 (the year in which a non-standard large forest area was burned, and as a result, instead of absorption - negative emissions, there were positive emissions from the forest land). It is estimated that the total emissions from this sector in 2035 will be equal to 2,000 Gg CO_2-eq. After 2020 it is projected that the amount of CO_2 emitted from the wood mass of forests will be higher than the amount of CO_2 that the forests will absorb. This means that the forests will be unsustainable, i.e. there will be more harvesting of wood than the annual growth of wood.

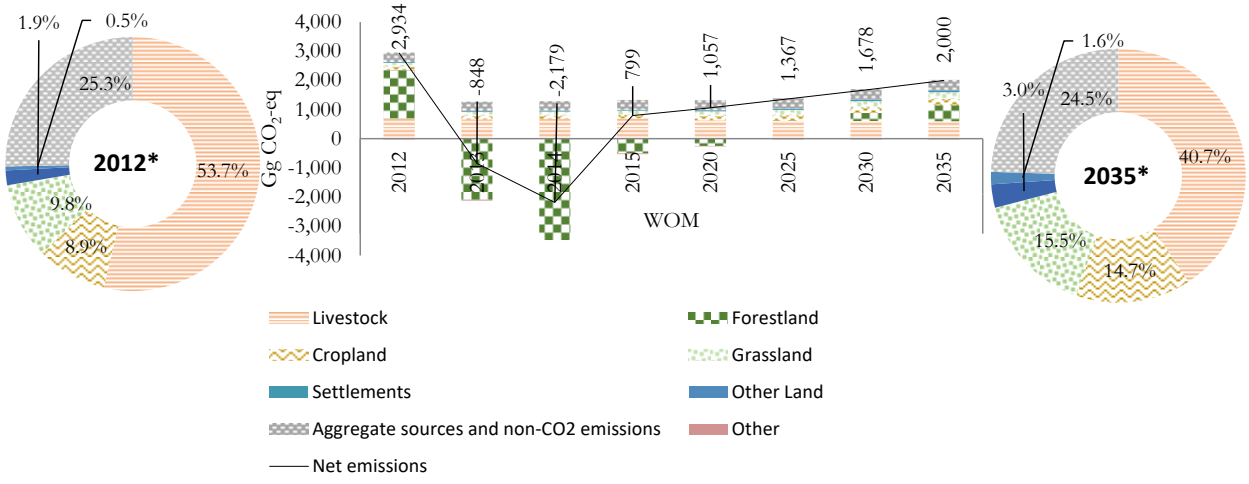


Figure 28. Total GHG emissions in AFOLU sector by subcategories (in Gg CO_2-eq)

3.4 Waste

3.4.1 Key assumptions

The connection of the Waste sector with the sectors Energy and IPPU is in the same key drivers used, i.e. GDP and population (explained in the section on macroeconomic drivers). In addition to these two parameters, in this sector, the **amount of waste per capita** is additionally used. For this purpose, a comparison of the amount of waste per capita in Macedonia with the countries in the nearby region as well as with the European Union 28 (EU28) was made, and it can be concluded that its value in 2014 in Macedonia was 23% lower than the one in EU28. In Europe, there is obviously a downward trend in the amount of waste per capita, while in Macedonia there is generally a trend of growth. The assumption is that these trends will continue and in 2035 Macedonia will have the same level of waste per capita as the EU28 (Figure 29). The estimated amount of waste per capita corresponds to the amount of waste that Bulgaria and Croatia had in 2014.

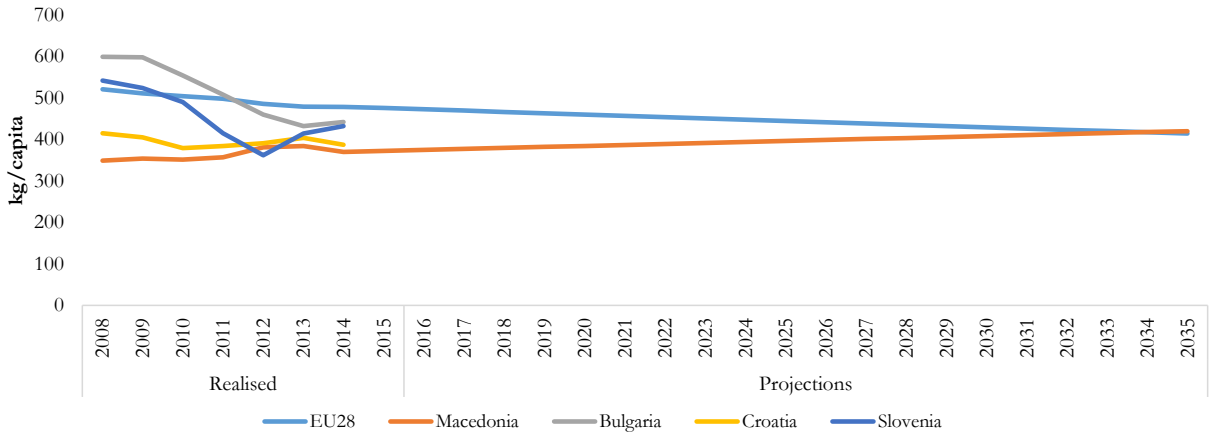


Figure 29. Quantity of municipal waste per capita in the Republic of Macedonia, EU28 and countries in the SEE region (in kg/capita)

3.4.2 Method

A completely new model in Excel has been developed to calculate emissions from the Waste sector, which is based on the methodology implemented in the **IPCC software** and thus covering all subcategories of the Waste sector. With the help of this software and the assumptions made, the emissions for the period until 2035 are calculated.

3.4.3 Results

Based on the input data for the Waste sector, the calculations show that:

- The total GHG emissions will increase by 97% in 2035 (4,944 Gg CO_2-eq) compared to 2012 (Figure 30);
- The largest emissions remain in the subcategory Solid Waste Disposal with a share of 97.4% in 2035 (94.3% in 2012);

- Each of the other subcategories participates with less than 1%;
- Observed by emissions, the most common is CH_4 with a share of almost 99% in 2035 (97.3% in 2012) (Figure 31).

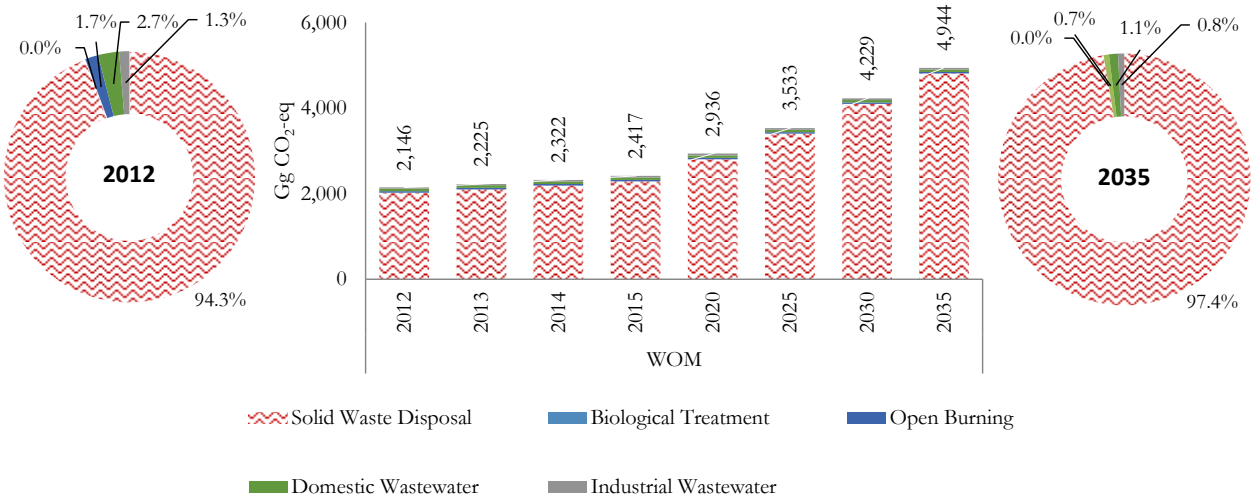


Figure 30. Total GHG emissions in Waste sector by subcategories (in Gg CO_2-eq)

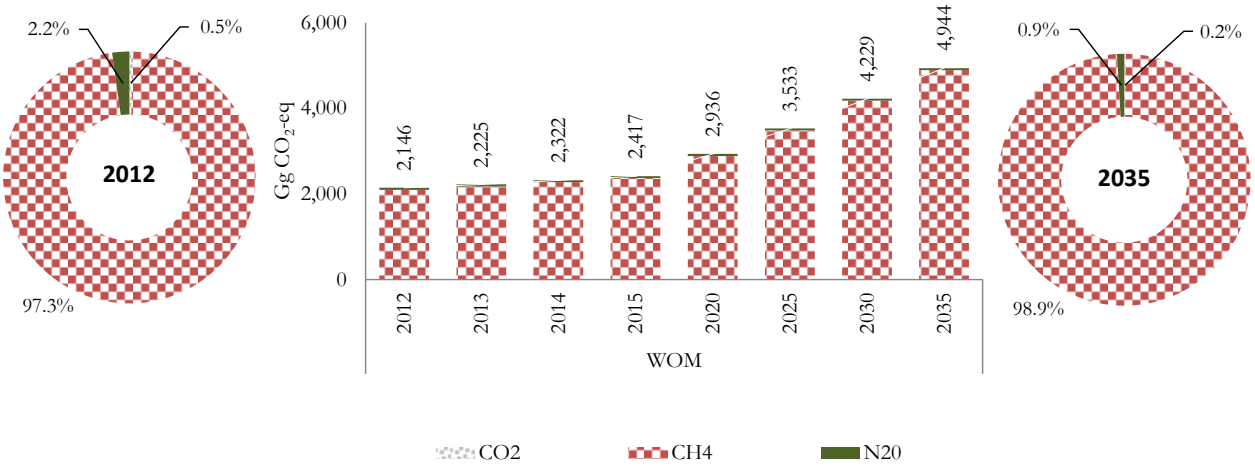


Figure 31. Total GHG emissions in Waste sector by gasses (in Gg CO_2-eq)

3.5 Total emissions

When summarizing the results from all sectors (Figure 32), the following conclusions are obtained:

- Continuous increase in GHG emissions from 2015 to 2032

- Increase of GHG emissions by 49% in 2035 compared to 2012
- The year with the highest emissions is 2035 with 25,585 Gg CO_2-eq
- The Energy sector is the sector with the largest share of 68% in 2035 (66% in 2012)
- Waste is the sector with the highest growth of 130% in the period 2012-2035
- Instead of absorbing CO_2 emissions (negative), the Forestry category as of 2019 starts to emit (positive), which is a major indicator that the use of biomass in Macedonia becomes unsustainable.

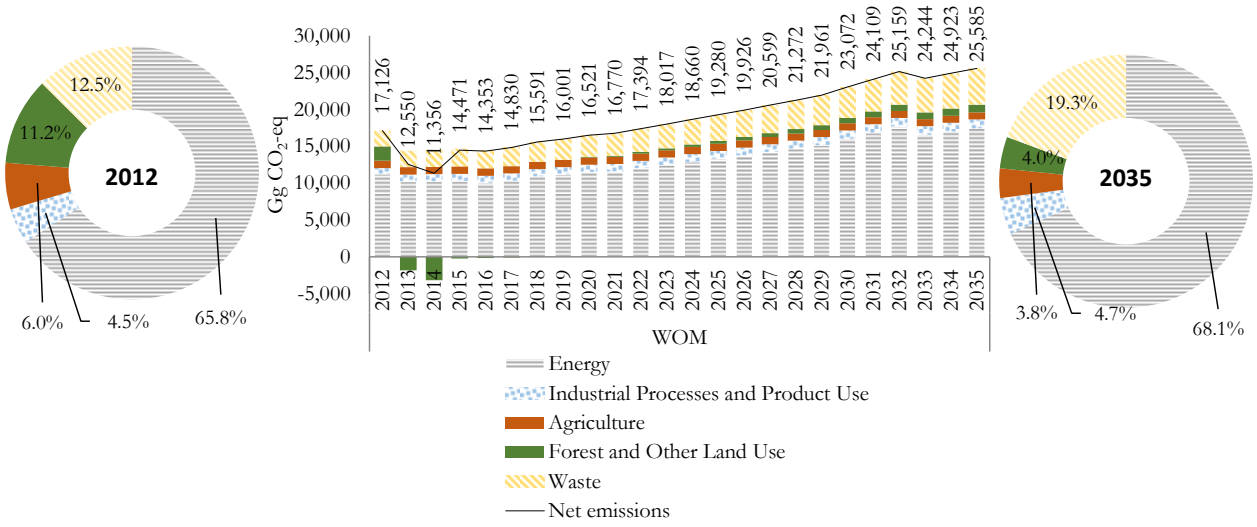


Figure 32. Total GHG emissions by sectors - WOM scenario (in Gg CO_2-eq)

Mitigation measures and their individual effect

4 Mitigation measures and their individual effect

The mitigation measures were selected with a broad participatory approach, at the workshop organized for the key stakeholders, followed by additional consultations, which was a step further to the process of development of mitigation scenarios. All measures/policies (Table 62) used in the climate change mitigation scenarios (WEM and WAM) are presented in this chapter and their individual effect is evaluated relative to the Reference scenario.

4.1 Energy

In the Energy sector, a total of 35 measures are analyzed, divided in the following categories: Energy industries, Residential, Non-specified (Commercial and Service sector), Manufacturing Industries and Construction and Transport.

4.1.1 Energy industries

In the Energy industries subcategory 11 measures in total are modelled and analyzed. The most relevant information for these measures/policies is given from Table 6 to Table 15.

Table 6. Reduction of distribution losses

Mitigation action: ***Reduction of distribution losses***			
Main objective: ***Reduction of losses in electricity and heat distribution networks***			
Description: ***Operating and constructive measures necessary for losses reduction, implemented by distribution networks operators. Energy suppliers and distribution companies have obligation to achieve a certain amount of annual energy savings at end-user level.***			
Information	**Type**		Technical
	Sector		Energy – Energy industries
	Relevant planning documents, legal and regulatory acts		► Strategy for Energy Development in the Republic of Macedonia ► Development plan of EVN Macedonia, AD ► Development plan of Balkan Energy Group (BEG)
	Gases		CO_2, CH_4, N_2O
	Methodology		Technical interventions on the distribution network. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
	Assumptions		Technical interventions will reduce the losses from 17% to 11%
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► A General investment plan in electricity distribution network is developed for the next 20 years. ► Implementing measures for operation improvement and losses reduction in the heat distribution system.
		Steps envisaged	► Replacement old electric transformer with new transformers at 20 kV voltage level ► Reduction of the reactive power in the power network ► Rehabilitation of the hot water distribution network, replacement of the existing pumps in the heating substations with new energy efficient pumps and other measures for energy efficiency improvement. ► Installation of modern equipment for regulation and monitoring in the heating substations for control and reduction of the consumed heat.

	Results achieved and estimated outcomes	Achieved energy savings: ► 3.40 ktoe in 2015 Estimated energy savings: ► 56 ktoe (652 GWh) in 2025 ► 61 ktoe (707 GWh) in 2030 ► 66 ktoe (768 GWh) in 2035
	Estimated emission reductions	► 438 Gg CO_2-eq in 2025 ► 619 Gg CO_2-eq in 2030 ► 509 Gg CO_2-eq in 2035
	Timeframe	2017 – 2035
	Costs (in 2030)	Costs for the Reference scenario: ► 1,332.4 M€ Costs in the scenarios with implemented measure ► 1,322.1 M€ Specific costs: ► -16.6 €/t CO_2-eq
	Implementing entity	► Electricity distribution companies ► Heat distribution companies ► Energy Agency of the Republic of Macedonia, Ministry of Economy
Progress indicators:		► Energy savings (ktoe/GWh) ► Emissions reductions (Gg CO_2-eq)

Table 7. Large hydro power plants

Mitigation action: ***Large hydro power plants***
Main objective: ***Increase of the domestic generation capacity from renewable energy sources***
Description: ***Construction of new large hydro power plants***

Information	**Type**		Technical
	Sector		Energy – Energy industries
	Relevant planning documents, legal and regulatory acts		► Strategy for Energy Development in the Republic of Macedonia ► Strategy for utilization of renewable energy sources in the Republic of Macedonia ► Development plan of ELEM AD (JSC Macedonian Power Plants).
	Gases		CO_2, CH_4, N_2O
	Methodology		Large hydro power plants construction. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		It is envisaged construction of large hydro power plants according to the following dynamics: ► Boshkov most – 2022 ► Lukovo pole – 2022 ► Shpilje, upgrade and revitalization – 2023 ► Tunnel Vardar – Kozjak– 2025 ► Globochica II – 2026 ► Veles – 2027 ► Chebren – 2033 ► Gradec – 2033
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► Feasibility/pre-feasibility studies developed ► Call for tender for Chebren opened
		Steps envisaged	Invitation for tenders for construction of the others hydro power plants, selection of the best bidder and commencement of the construction.
	Results achieved and estimated outcomes		Expected installed capacity and electricity generation: ► 113 MW and 372 GWh in 2025 ► 235 MW and 710 GWh in 2030 ► 623 MW and 1240 GWh in 2035
	Estimated emission reductions		► 244 Gg CO_2-eq in 2025 ► 514 Gg CO_2-eq in 2030 ► 753 Gg CO_2-eq in 2035
	Timeframe		2018 – 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,329.5 M€ Specific costs: ► -5.7 €/t CO_2-eq
	Implementing entity		► ELEM AD (JSC Macedonian Power Plants). ► Ministry of Environment and Physical Planning ► Energy Agency of the Republic of Macedonia, Ministry of Economy
Progress indicators:			► Increase in installed capacity (MW) ► Increase in electricity generation (GWh) ► Emissions reductions (Gg CO_2-eq)

Table 8. Small hydro power plants

Mitigation action: ***Small hydro power plants***
Main objective: ***Increase of the domestic generation capacity from renewable energy sources***
Description: ***Construction of new small hydro power plants and introduction of flexible feed-in premium tariffs to stimulate the construction***

Information	**Type**		Technical
	Sector		Energy – Energy industries
	Relevant planning documents, legal and regulatory acts		► Strategy for Energy Development in the Republic of Macedonia ► Strategy for Utilization of Renewable Energy Sources in the Republic of Macedonia ► Renewable Energy Action Plan ► Law on Energy
	Gases		CO_2, CH_4, N_2O
	Methodology		Small hydro power plants construction and preparation of regulation on feed-in premium tariffs. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		Through stimulation with feed-in premium tariffs, it is envisaged that by 2035 additional capacity of 85 MW in small hydro power plants will be constructed, compared to the Reference scenario (or total capacity of 147 MW).
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	Regulation on feed-in tariffs adopted (17.04.2013)
		Steps envisaged	► Construction of all small hydro power plants with a provisional status of a privileged producer ► Announcement of a new tender for allocation of construction locations for new small hydro power plants ► Modification of the Regulation on feed-in tariffs to introduce flexible feed-in premium tariffs
	Results achieved and estimated outcomes		Achieved installed capacity and average annual electricity generation: ► 67 MW and 237 GWh by 15.05.2017 Expected installed capacity and electricity generation: ► 51 MW and 171 GWh in 2025 ► 73 MW and 246 GWh in 2030 ► 85 MW and 287 GWh in 2035
	Estimated emission reductions		► 113 Gg CO_2-eq in 2025 ► 229 Gg CO_2-eq in 2030 ► 189 Gg CO_2-eq in 2035
	Timeframe		2017 – 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,330.7 M€ Specific costs: ► -7.4 €/t CO_2-eq
	Implementing entity		► Government of the Republic of Macedonia ► Energy Regulatory Commission ► Ministry of Environment and Physical Planning ► Ministry of Economy, Energy Agency of the Republic of Macedonia ► Private investors
Progress indicators:			► Increase in installed capacity (MW) ► Increase in electricity generation (GWh) ► Emissions reduction (Gg CO_2-eq)

Table 9. Solar power plants

Mitigation action: ***Solar power plants***
Main objective: ***Increase of the domestic generation capacity from renewable energy sources***
Description: ***Construction of solar power plants (larger than 10 kW) and introduction of flexible feed-in premium tariffs to stimulate the construction***

Information	**Type**		Technical, regulatory
	Sector		Energy – Energy industries
	Relevant planning documents, legal and regulatory acts		► Strategy for Energy Development in the Republic of Macedonia ► Strategy for Utilization of Renewable Energy Sources in the Republic of Macedonia ► Renewable Energy Action Plan ► Law on Energy
	Gases		CO_2, CH_4, N_2O
	Methodology		Solar power plants construction and preparation of regulation on feed-in premium tariffs. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		Through stimulation with feed-in premium tariffs, it is envisaged that by 2035 additional capacity of 100 MW in solar power plants will be constructed, compared to the Reference scenario (or total capacity of 118 MW).
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	Regulation on feed-in tariffs adopted (17.04.2013).
		Steps envisaged	Modification of the Regulation on feed-in tariffs to introduce flexible feed-in premium tariffs.
	Results achieved and estimated outcomes		Achieved installed capacity and average annual electricity generation: ► 16.7 MW and 21.4 GWh by 15.5.2017 Expected installed capacity and electricity generation: ► 17 MW and 23 GWh in 2025 ► 60 MW and 84 GWh in 2030 ► 100 MW and 140 GWh in 2035
	Estimated emission reductions		► 15 Gg CO_2-eq in 2025 ► 84 Gg CO_2-eq in 2030 ► 90 Gg CO_2-eq in 2035
	Timeframe		2017 – 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1.332,4 M€ Costs for the Scenario with implemented measure: ► 1.332,3 M€ Specific costs: ► -1,4 €/t CO_2-eq
	Implementing entity		► Government of the Republic of Macedonia ► Energy Regulatory Commission ► Ministry of Economy, Energy Agency of the Republic of Macedonia ► Private investors
Progress indicators:			► Increase in installed capacity (MW) ► Increase in electricity generation (GWh) ► Emissions reduction (Gg CO_2-eq)

Table 10. Solar rooftop power plants

Mitigation action: ***Solar rooftop power plants*** *Main objective:* ***Increase of the domestic generation capacity from renewable energy sources*** *Description:* ***Construction of solar rooftop power plant and introduction of "net metering"***			
Information	**Type**		Technical, regulatory
	Sector		Energy – Energy industries
	Relevant planning documents, legal and regulatory acts		► Strategy for Energy Development in the Republic of Macedonia ► Renewable Energy Action Plan ► Law on Energy
	Gases		CO_2, CH_4, N_2O
	Methodology		Solar rooftop power plants construction. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology..
	Assumptions		A construction of 80 MW of solar rooftop power plants is envisaged by 2035.
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	Analyzes performed and public debates conducted for the introduction of "net measurement", organized by the Macedonian Energy Association within the Macedonian Chamber of Commerce, in the framework of the Forum for Renewable Energy Sources.
		Steps envisaged	Introduction of "net metering" system
	Results achieved and estimated outcomes		Expected installed capacity and electricity generation: ► 18 MW and 25 GWh in 2025 ► 55 MW and 77 GWh in 2030 ► 80 MW and 111 GWh in 2035
	Estimated emission reductions		► 19 Gg CO_2-eq in 2025 ► 88 Gg CO_2-eq in 2030 ► 86 Gg CO_2-eq in 2035
	Timeframe		2017 – 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,331.2 M€ Specific costs: ► -13.2 €/t CO_2-eq
	Implementing entity		► Government of the Republic of Macedonia ► Energy Regulatory Commission ► Ministry of Economy, Energy Agency of the Republic of Macedonia ► EVN AD Macedonia (Distribution company) ► End-users of electricity
Progress indicators:			► Increase in installed capacity (MW) ► Increase in electricity generation (GWh) ► Emissions reduction (Gg CO_2-eq)

Table 11. Wind power plants

Mitigation action: ***Wind power plants***
Main objective: ***Increase of the domestic generation capacity from renewable energy sources***
Description: ***Construction of wind power plants and introduction of flexible feed-in premium tariffs to stimulate the construction***

Information	**Type**		Technical, regulatory
	Sector		Energy – Energy industries
	Relevant planning documents, legal and regulatory acts		► Strategy for Energy Development in the Republic of Macedonia ► Strategy for Utilization of Renewable Energy Sources in the Republic of Macedonia ► Renewable Energy Action Plan ► Law on Energy
	Gases		CO_2, CH_4, N_2O
	Methodology		Wind power plants construction and preparation of regulation on feed-in premium tariffs. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		It is envisaged that by 2035 additional capacity of 263 MW in wind power plants will be constructed, compared to the Reference scenario (or total capacity of 300 MW)
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► Regulation on feed-in tariffs adopted (17.04.2013). ► Credit line for realization of the second phase of Wind park - Bogdanci approved
		Steps envisaged	Modification of the Regulation on feed-in tariffs to introduce flexible feed-in premium tariffs.
	Results achieved and estimated outcomes		Achieved installed capacity and average annual electricity generation: ► 36.8 MW и 110 GWh by 15.05.2017 Expected installed capacity and electricity generation: ► 113 MW and 237 GWh in 2025 ► 263 MW and 534 GWh in 2030 ► 263 MW and 534 GWh in 2035
	Estimated emission reductions		► 154 Gg CO_2-eq in 2025 ► 456 Gg CO_2-eq in 2030 ► 314 Gg CO_2-eq in 2035
	Timeframe		2017 – 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,332.4 M€ Specific costs: ► 0 €/t CO_2-eq
	Implementing entity		► Government of the Republic of Macedonia ► Energy Regulatory Commission ► Ministry of Economy, Energy Agency of the Republic of Macedonia ► JSC Macedonian Power Plants (ELEM AD) ► Private investors
Progress indicators:			► Increase in installed capacity (MW) ► Increase in electricity generation (GWh) ► Emissions reduction (Gg CO_2-eq)

Table 12. Biogas power plants

Mitigation action: ***Biogas power plants***
Main objective: ***Increase of the domestic generation capacity from renewable energy sources***
Description: ***Construction of biogas power plants and introduction of flexible feed-in premium tariffs to stimulate the construction***

Information	**Type**		Technical, regulatory
	Sector		Energy – Energy industries
	Relevant planning documents, legal and regulatory acts		► Strategy for Energy Development in the Republic of Macedonia ► Strategy for Utilization of Renewable Energy Sources in the Republic of Macedonia ► Renewable Energy Action Plan ► Law on Energy
	Gases		CO_2, CH_4, N_2O
	Methodology		Biogas power plants construction and preparation of regulation on feed-in premium tariffs. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		Through stimulation with feed-in premium tariffs, it is envisaged that by 2035 additional capacity of 15 MW in biogas power plants will be constructed, compared to the Reference scenario (or total capacity of 22 MW)
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	Regulation on feed-in tariffs adopted (17.04.2013).
		Steps envisaged	Modification of the Regulation on feed-in tariffs to introduce flexible feed-in premium tariffs.
	Results achieved and estimated outcomes		Achieved installed capacity and average annual electricity generation: ► 6 MW and 50.2 GWh by 15.05.2017 Expected installed capacity and electricity generation: ► 5 MW and 35 GWh in 2025 ► 10 MW and 70 GWh in 2030 ► 15 MW and 105 GWh in 2035
	Estimated emission reductions		► 23 Gg CO_2-eq in 2025 ► 65 Gg CO_2-eq in 2030 ► 71 Gg CO_2-eq in 2035
	Timeframe		2017 – 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332. M€ Costs for the Scenario with implemented measure: ► 1,332.3 M€ Specific costs: ► -0.9 €/t CO_2-eq
	Implementing entity		► Government of the Republic of Macedonia ► Energy Regulatory Commission ► Ministry of Economy, Energy Agency of the Republic of Macedonia ► Private investors
Progress indicators:			► Increase in installed capacity (MW) ► Increase in electricity generation (GWh) ► Emissions reduction (Gg CO_2-eq)

Table 13. Biomass power plants (CHP optional)

Mitigation action: ***Biomass power plants (CHP optional)*** *Main objective:* ***Increase of the domestic generation capacity from renewable energy sources*** *Description:* ***Construction of biomass power plants (CHP optional) and introduction of flexible feed-in premium tariffs to stimulate the construction***			
Information	**Type**		Technical, regulatory
	Sector		Energy – Energy industries
	Relevant planning documents, legal and regulatory acts		► Strategy for Energy Development in the Republic of Macedonia ► Strategy for Utilization of Renewable Energy Sources in the Republic of Macedonia ► Renewable Energy Action Plan ► Law on Energy
	Gases		CO_2, CH_4, N_2O
	Methodology		Biomass power plants construction and preparation of regulation on feed-in premium tariffs. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		Through stimulation with feed-in premium tariffs, it is envisaged that by 2035 a capacity of 15 MW in biomass power plants will be constructed.
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	Regulation on feed-in tariffs adopted (17.04.2013).
		Steps envisaged	Modification of the Regulation on feed-in tariffs to introduce flexible feed-in premium tariffs.
	Results achieved and estimated outcomes		Achieved result: Currently (end of June 2017) the following capacity is installed and the average annual electricity generation is expected to be: ► 2.2 MW and 12.8 GWh Expected installed capacity and electricity generation: ► 10 MW and 40 GWh in 2025 ► 12,5 MW and 50 GWh in 2030 ► 15 MW and 60 GWh in 2035
	Estimated emission reductions		► 55 Gg CO_2-eq in 2025 ► 90 Gg CO_2-eq in 2030 ► 85 Gg CO_2-eq in 2035
	Timeframe		2020 – 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,332.9 M€ Specific costs: ► 5 €/t CO_2-eq
	Implementing entity		► Government of the Republic of Macedonia ► Energy Regulatory Commission ► Ministry of Economy, Energy Agency of the Republic of Macedonia ► Private investors
Progress indicators:			► Increase in installed capacity (MW) ► Increase in electricity generation (GWh) ► Emissions reduction (Gg CO_2-eq)

Table 14. Central heating of Bitola

Mitigation action: ***Central heating of Bitola***			
Main objective: ***Utilization of the waste heat from TPP Bitola***			
Description: ***Construction of central heating system in Bitola and utilization of the waste heat from TPP Bitola***			
Information	**Type**		Technical
	Sector		Energy – Energy industries
	Relevant planning documents, legal and regulatory acts		► Strategy for Energy Development in the Republic of Macedonia ► Development plan of JSC Macedonian Power Plants (ELEM AD)
	Gases		CO_2, CH_4, N_2O
	Methodology		Central heating system construction. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		A construction of a central heating system that will use the waste heat from TPP Bitola is envisaged
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► A decision for construction adopted ► A loan from KfW Bank is provided
		Steps envisaged	Opening a call for tender and commencement of construction
	Results achieved and estimated outcomes		Expected installed capacity and heat generation: ► 100 MW and 60 GWh in 2025
	Estimated emission reductions		► 25 Gg CO_2-eq in 2025 ► 36 Gg CO_2-eq in 2030 ► 25 Gg CO_2-eq in 2035
	Timeframe		2015-2019
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,333.1 M€ Specific costs: ► 20 €/t CO_2-eq
	Implementing entity		► Government of the Republic of Macedonia ► JSC Macedonian Power Plants (ELEM AD) ► Ministry of Economy, Energy Agency of the Republic of Macedonia
Progress indicators:			► Increase in installed capacity (MW) ► Increase in heat generation (GWh) ► Emissions reduction (Gg CO_2-eq)

Table 15. Natural gas power plants (CHP)

Mitigation action: ***Natural gas power plants (CHP)***			
Main objective: ***Reduction of import dependency and greater utilization of the gas pipeline system***			
Description: ***Construction of natural gas power plants (CHP)***			
Information	**Type**		Technical
	Sector		Energy – Energy industries
	Relevant planning documents, legal and regulatory acts		► Strategy for Energy Development in the Republic of Macedonia ► Development plan of JSC Macedonian Power Plants (ELEM AD) ► Development plan of TE-TO AD Skopje ► Study for gasification of the Republic of Macedonia
	Gases		CO_2, CH_4, N_2O
	Methodology		Natural gas power plants construction. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		It is envisaged that by 2035 additional capacity of 520 MW in natural gas power plants will be constructed, compared to the Reference scenario (or total capacity of 1120 MW).
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► Analysis conducted - Study for optimization of the plant and the technological process of "Energetika" - ELEM. ► Development plans of private companies (TE-TO AD Skopje) developed
		Steps envisaged	
	Results achieved and estimated outcomes		Expected installed capacity and electricity generation: ► 240 MW and 1,844 GWh in 2030 ► 520 MW and 2,880 GWh in 2035
	Estimated emission reductions		► 947 Gg CO_2-eq in 2030 ► 1,247 Gg CO_2-eq in 2035
	Timeframe		2025-2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,329.8 M€ Specific costs: ► -3 €/t CO_2-eq
	Implementing entity		► Ministry of Economy, Energy Agency of the Republic of Macedonia ► JSC Macedonian Power Plants (ELEM AD) ► TE-TO AD Skopje ► Other private investors
Progress indicators:			► Increase in installed capacity (MW) ► Increase in electricity generation (GWh) ► Emissions reduction (Gg CO_2-eq)

4.1.2 Residential and Non-specified (Commercial and Service sector)

In the Residential and Non-specified subcategories 15 measures in total are modelled and analyzed. The most relevant information for these measures/policies is given from Table 16 to Table 30.

Table 16. Solar thermal collectors

Mitigation action: ***Solar thermal collectors*** *Main objective:* ***Meeting the targets set in the Energy Efficiency Action Plan and the Renewable Energy Sources Action Plan*** *Description:* ***Installation of solar thermal collectors for hot water***			
Information	**Type**		Technical
	Sector		Energy – Residential, non-specified (Commercial and service sector)
	Relevant planning documents, legal and regulatory acts		► Strategy for Energy Development in the Republic of Macedonia ► Strategy for Utilization of Renewable Energy Sources in the Republic of Macedonia
	Gases		CO_2, CH_4, N_2O
	Methodology		Installation of solar thermal collectors. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
	Assumptions		It is envisaged that by 2035: ► 40% of hot water demand in urban houses, ► 16% of hot water demand in urban apartments and ► 50% of hot water demand in rural areas to be provide by solar thermal collectors
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	Reimbursement of part of the costs for purchased and installed solar thermal collectors in the amount of 30%, but not more than 300 €, realized by the Ministry of Economy. From 2007 to 2016, 14,785 requests were submitted, out of which 4,237 were reimbursed.
		Steps envisaged	Continuation of the incentive measures for solar thermal collectors installation
	Results achieved and estimated outcomes		Achieved annual energy savings: ► 4.9 ktoe (57 GWh) in 2015 (together with heat pumps) Expected annual energy savings: ► 6.9 ktoe (80 GWh) in 2025 ► 11.3 ktoe (132 GWh) in 2030 ► 15.9 ktoe (185 GWh) in 2035
	Estimated emission reductions		► 15 Gg CO_2-eq in 2025 ► 83 Gg CO_2-eq in 2030 ► 90 Gg CO_2-eq in 2035
	Timeframe		2017 – 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,329.5 M€ Specific costs: ► -29 €/t CO_2-eq
	Implementing entity		► Ministry of Economy, Energy Agency of the Republic of Macedonia ► End-users of heat
Progress indicators:			► Energy savings (ktoe/GWh) ► Emissions reduction (Gg CO_2-eq)

Table 17. Labeling of electric appliances and equipment

Mitigation action: ***Labeling of electric appliances and equipment***
Main objective: ***Penetration of appliances with higher efficiency (class A++, A+, A, B) and meeting the target set in the Energy Efficiency Action Plan***
Description: ***Labeling of electric appliances and equipment to provide relevant information on the energy consumption of the products. The application of the labeling and eco-design of the products is necessary to ensure that the products sold in Macedonia are in compliance with the EU regulations.***

Information	**Type**		Regulatory
	Sector		Energy – Residential, non-specified (Commercial and service sector)
	Relevant planning documents, legal and regulatory acts		► Third Energy Efficiency Action Plan ► Rulebook on labelling consumption of energy and other resources on devices using energy. ► Regulation on eco-design of products
	Gases		CO_2, CH_4, N_2O
	Methodology		Labeling of electric appliances and equipment. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		As a result of this measure it is expected that by 2035 the share of energy efficient technologies will be 2.5%.
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► New Rulebook on labelling consumption of energy and other resources on devices using energy adopted in September 2016 by the Ministry of Economy ► Draft version of the new Regulation on eco-design of products developed
		Steps envisaged	Adoption of the new Regulation on eco-design of products developed
	Results achieved and estimated outcomes		Achieved annual energy savings: ► 0.7 ktoe (8.1 GWh) in 2015 Expected annual energy savings: ► 8.9 ktoe (103 GWh) in 2025 ► 15.4 ktoe (178 GWh) in 2030 ► 22.6 ktoe (262 GWh) in 2035
	Estimated emission reductions		► 104 Gg CO_2-eq in 2025 ► 202 Gg CO_2-eq in 2030 ► 240 Gg CO_2-eq in 2035
	Timeframe		2017 - 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1.332,4 M€ Costs for the Scenario with implemented measure: ► 1.325,8 M€ Specific costs: ► -33 €/t CO_2-eq
	Implementing entity		► Ministry of Economy, Energy Agency of the Republic of Macedonia ► Producers and suppliers of electrical equipment and household appliances ► End-users
Progress indicators:			► Energy savings (ktoe/GWh) ► Emissions reduction (Gg CO_2-eq)

Table 18. Phasing out of resistive heating devices and inclusion of more heat pumps

Mitigation action: ***Phasing out of resistive heating devices and inclusion of more heat pumps***			
Main objective: ***More efficient use of electricity to meet the target set in the Energy Efficiency Action Plan***			
Description: ***Phasing out heating devices with resistive heaters and their replacement with heat pumps in compliance with EU Climate and Energy Policy***			
Information	**Type**		Regulatory, policy
	Sector		Energy – Residential, non-specified (Commercial and service sector)
	Relevant planning documents, legal and regulatory acts		► Third Energy Efficiency Action Plan ► EU Climate and Energy Policy
	Gases		CO_2, CH_4, N_2O
	Methodology		Adopting a Decision that will prevent the sale of heating devices with resistive heaters. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
	Assumptions		A Decision should be adopted in 2018, prohibiting the sale of resistive heating devices. It is assumed that heating devices with resistive heaters will be gradually replaced with heat pumps. The transition period would be about 15 years.
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	/
		Steps envisaged	Adopting a Decision to ban the sale of heating devices with resistive heaters.
	Results achieved and estimated outcomes		Achieved annual energy savings: ► 4.9 ktoe (57 GWh) in 2015 (together with solar thermal collectors) Expected annual energy savings: ► 79 ktoe (918 GWh) in 2025 ► 128 ktoe (1,486 GWh) in 2030 ► 196 ktoe (2,283 GWh) in 2035
	Estimated emission reductions		► 718 Gg CO_2-eq in 2025 ► 1,465 Gg CO_2-eq in 2030 ► 1,350 Gg CO_2-eq in 2035
	Timeframe		2017 - 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,289.0 M€ Specific costs: ► -30 €/t CO_2-eq
	Implementing entity		► Ministry of Economy, Energy Agency of the Republic of Macedonia ► End-users
Progress indicators:			► Energy savings (ktoe/GWh) ► Emissions reduction (Gg CO_2-eq)

Table 19. Public awareness campaigns and network of energy efficiency (EE) info centers

Mitigation action: ***Public awareness campaigns and network of EE info centers*** *Main objective:* ***Raising public awareness about the importance and benefits from buying and using appliances with higher efficiency class in order to meet the target set in the Energy Efficiency Action Plan*** *Description:* ***Establishment of EE info centers in the local self-governments or Centers of the planning regions, in which energy advisors will operate, will share free advice to the interested citizens about the possibilities of saving energy and saving money in their homes***			
Information	**Type**		Information
	Sector		Energy – Residential, non-specified (Commercial and service sector)
	Relevant planning documents, legal and regulatory acts		Third Energy Efficiency Action Plan
	Gases		CO_2, CH_4, N_2O
	Methodology		Conducting information campaigns and opening information centers for energy efficiency. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		Investment in public awareness rising campaigns that will increase the share of more efficient appliances (with higher class of efficacy) to 105 by 2035.
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► Platform for energy efficiency, for education of the population and journalists and experience sharing of the private sector for successfully implemented EE measures implemented. ► Info Center for Energy of the City of Skopje opened. ► Free advices to the customers for reasonable consumption of electricity enabled by EVN's Customer Service Centre
		Steps envisaged	► Broadcasting of TV spots, announcements, campaigns and documentary films ► Extension of the Platform for energy efficiency ► Continuous work of the existing and opening new information centers.
	Results achieved and estimated outcomes		Achieved annual energy savings: ► 2.7 ktoe (31 GWh) in 2015 Expected annual energy savings: ► 38 ktoe (447 GWh) in 2025 ► 63 ktoe (735 GWh) in 2030 ► 94 ktoe (1.100 GWh) in 2035
	Estimated emission reductions		► 410 Gg CO_2-eq in 2025 ► 893 Gg CO_2-eq in 2030 ► 884 Gg CO_2-eq in 2035
	Timeframe		2017 – 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,306.7 M€ Specific costs: ► -29 €/t CO_2-eq
	Implementing entity		► Ministry of Economy, Energy Agency of the Republic of Macedonia ► Energy suppliers ► End-users
Progress indicators:			► Energy savings (ktoe/GWh) ► Emissions reduction (Gg CO_2-eq)

Table 20. Retrofitting of existing residential buildings

Mitigation action: ***Retrofitting of existing residential buildings*** *Main objective:* ***Retrofitting of existing residential buildings with aim to meet the target set in the Energy Efficiency Action Plan*** *Description:* ***Reconstructions of residential buildings including windows replacement, initiated by the owners and/or supported by commercial banks and funds which exist in the Republic of Macedonia This measure will provide issuing of certificates for energy performance of buildings, as a prerequisite for putting the reconstructions into operation.***			
Information	**Type**		Technical, regulatory
	Sector		Energy – Residential
	Relevant planning documents, legal and regulatory acts		► Third Energy Efficiency Action Plan ► Rulebook on energy performance of buildings. ► Rulebook on Energy Audit
	Gases		CO_2, CH_4, N_2O
	Methodology		Retrofitting of existing residential buildings. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		Annual renovation rate of 1% for the existing residential buildings, while meeting the standard for at least C class (90 kWh/m²)
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► 31 buildings for collective housing were renovated (EE measures implemented) under the USAID/Habitat Project for residential energy efficiency. ► Financial support for rehabilitation of buildings for collective housing with implementation of EE measures provided by some municipalities ► Call for applications for reimbursement of 50% of the costs for windows replacement and installation of PVC and aluminum windows, but not more than 500 €, provided by the Ministry of Economy ► The process of drafting the Law on Energy Efficiency started (a working group established)
		Steps envisaged	► Adoption of the Law on Energy Efficiency ► National Building Renovation Strategy ► Establishment of an Energy Efficiency Fund
	Results achieved and estimated outcomes		Achieved annual energy savings: ► 5.6 ktoe (65 GWh) in 2015 Expected annual energy savings: ► 18 ktoe (212 GWh) in 2025 ► 27 ktoe (318 GWh) in 2030 ► 37 ktoe (426 GWh) in 2035
	Estimated emission reductions		► 161 Gg CO_2-eq in 2025 ► 284 Gg CO_2-eq in 2030 ► 292 Gg CO_2-eq in 2035
	Timeframe		2017 – 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,333.1 M€ Specific costs: ► 2 €/t CO_2-eq
	Implementing entity		► Ministry of Economy, Energy Agency of the Republic of Macedonia ► Donors and financial institutions ► Households
Progress indicators:			► Energy savings (ktoe/GWh) ► Emissions reduction (Gg CO_2-eq)

Table 21. Retrofitting of existing public buildings

Mitigation action: ***Retrofitting of existing public buildings***
Main objective: ***Retrofitting of existing public buildings with aim to meet the target set in the Energy Efficiency Action Plan***
Description: ***Reconstuction including windows replacement of existing public buildings under jurisdiction of the central government or local self-government. This measure will provide issuing of certificates for energy performance of buildings, as a prerequisite for putting the reconstructions into operation.***

Information	**Type**		Technical, regulatory
	Sector		Energy – Residential, non-specified (Commercial and service sector)
	Relevant planning documents, legal and regulatory acts		► Third Energy Efficiency Action Plan ► Rulebook on energy performance of buildings ► Rulebook on Energy Audit
	Gases		CO_2, CH_4, N_2O
	Methodology		Retrofitting of existing public buildings. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		Annual renovation rate of 1% for the existing public buildings
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► Draft National Program for energy efficiency in public buildings in the Republic of Macedonia (Phase I) was developed under the GEF Sustainable Energy Project ► "Resilient Skopje" – Climate Change Strategy for the City of Skopje developed. ► The process of drafting the Law on Energy Efficiency started (a working group established).
		Steps envisaged	► Adoption of the Law on Energy Efficiency ► National Building Renovation Strategy ► Establishment of an Energy Efficiency Fund
	Results achieved and estimated outcomes		Achieved annual energy savings: ► 6 ktoe (70 GWh) in 2015 Expected annual energy savings: ► 15.6 ktoe (181 GWh) in 2025 ► 30 ktoe (349 GWh) in 2030 ► 47.3 ktoe (550 GWh) in 2035
	Estimated emission reductions		► 135 Gg CO_2-eq in 2025 ► 296 Gg CO_2-eq in 2030 ► 346 Gg CO_2-eq in 2035
	Timeframe		2017 – 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,331.8 M€ Specific costs: ► -2 €/t CO_2-eq
	Implementing entity		► Ministry of Economy, Energy Agency of the Republic of Macedonia ► Ministry of Finance ► Local self-government ► Municipal public enterprises ► Donors and financial institutions
Progress indicators:			► Energy savings (ktoe/GWh) ► Emissions reduction (Gg CO_2-eq)

Table 22. Retrofitting of existing commercial buildings

Mitigation action: ***Retrofitting of existing commercial buildings*** *Main objective:* ***Retrofitting of existing commercial buildings with aim to meet the target set in the Energy Efficiency Action Plan*** *Description:* ***Reconstructions of existing commercial buildings including windows replacement, initiated by the owners and/or supported by commercial banks and funds which exist in the Republic of Macedonia This measure will provide issuing of certificates for energy performance of buildings, as a prerequisite for putting the reconstructions into operation.***			
Information	**Type**		Technical, regulatory
	Sector		Energy – Non-specified (Commercial and service sector)
	Relevant planning documents, legal and regulatory acts		► Third Energy Efficiency Action Plan ► Rulebook on energy performance of buildings ► Rulebook on Energy Audit
	Gases		CO_2, CH_4, N_2O
	Methodology		Retrofitting of existing commercial buildings. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
	Assumptions		Annual renovation rate of 1% for the existing commercial buildings
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► The process of drafting the Law on Energy Efficiency started (a working group established).
		Steps envisaged	► Adoption of the Law on Energy Efficiency ► National Building Renovation Strategy ► Establishment of an Energy Efficiency Fund
	Results achieved and estimated outcomes		Achieved annual energy savings: ► 2.5 ktoe (29 GWh) in 2015 Expected annual energy savings: ► 3.4 ktoe (39 GWh) in 2025 ► 8.7 ktoe (100 GWh) in 2030 ► 14 ktoe (163 GWh) in 2035
	Estimated emission reductions		► 64 Gg CO_2-eq in 2025 ► 127 Gg CO_2-eq in 2030 ► 148 Gg CO_2-eq in 2035
	Timeframe		2017 - 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,331.9 M€ Specific costs: ► -4 €/t CO_2-eq
	Implementing entity		► Ministry of Economy, Energy Agency of the Republic of Macedonia ► Ministry of Finance ► Commercial building owners
Progress indicators:			► Energy savings (ktoe/GWh) ► Emissions reduction (Gg CO_2-eq)

Table 23. Construction of new buildings

Mitigation action: ***Construction of new buildings*** *Main objective:* ***Construction of new buildings with aim to meet the target set in the Energy Efficiency Action Plan*** *Description:* ***Construction of new buildings in compliance with theRulebook on energy performance of building. This measure will provide issuing of certificates for energy performance of buildings, as a prerequisite for putting the building into operation***			
Information	**Type**		Technical, regulatory
	Sector		Energy – Residential
	Relevant planning documents, legal and regulatory acts		► Third Energy Efficiency Action Plan ► Rulebook on energy performance of buildings ► Rulebook on Energy Audit
	Gases		CO_2, CH_4, N_2O
	Methodology		Construction of new residential buildings. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		Construction of new residential buildings, while meeting the standard for at least C class (90 kWh/m²)
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► Financial support for construction of new buildings at municipality level ► The process of drafting the Law on Energy Efficiency started (a working group established)
		Steps envisaged	► Adoption of the Law on Energy Efficiency ► National Building Renovation Strategy ► Establishment of an Energy Efficiency Fund
	Results achieved and estimated outcomes		Achieved annual energy savings: ► 4.9 ktoe (57 GWh) in 2015 Expected annual energy savings: ► 9.8 ktoe (57 GWh) in 2025 ► 15.1 ktoe (118 GWh) in 2030 ► 21.6 ktoe (193 GWh) in 2035
	Estimated emission reductions		► 43 Gg CO_2-eq in 2025 ► 101 Gg CO_2-eq in 2030 ► 138 Gg CO_2-eq in 2035
	Timeframe		2017 – 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,332.2 M€ Specific costs: ► -2 €/t CO_2-eq
	Implementing entity		► Ministry of Economy, Energy Agency of the Republic of Macedonia ► Donors and financial institutions ► Investors (households)
Progress indicators:			► Energy savings (ktoe/GWh) ► Emissions reduction (Gg CO_2-eq)

Table 24. Construction of passive buildings

Mitigation action: ***Construction of passive buildings*** *Main objective:* ***Meeting the requirement of the EU Directive 2010/31/EU that all buildings constructed after 31.12.2020 should be nearly zero-energy buildings*** *Description:* ***Construction of new passive residential buildings in compliance with the EU Directive 2010/31/EU. This measure will provide issuing of certificates for energy performance of buildings, as a prerequisite for putting the building into operation***			
Information	**Type**		Technical, regulatory
	Sector		Energy – Residential
	Relevant planning documents, legal and regulatory acts		► EU Directive 2010/31/EU ► Rulebook on Energy Audit
	Gases		CO_2, CH_4, N_2O
	Methodology		Construction of passive buildings. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		Construction of new passive buildings, while meeting the standard for at least A^+ class (15 kWh/m^2) starting from 2020 and continuously increasing their number so that in 2035, 85% of new buildings are assumed to be passive.
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► Financial support for construction of new passive buildings at municipality level ► The process of drafting the Law on Energy Efficiency started (a working group established)
		Steps envisaged	► Adoption of the Law on Energy Efficiency ► National Building Renovation Strategy ► Establishment of an Energy Efficiency Fund
	Results achieved and estimated outcomes		Expected annual energy savings: ► 1.7 ktoe (20 GWh) in 2025 ► 6.3 ktoe (73 GWh) in 2030 ► 12.7 ktoe (147 GWh) in 2035
	Estimated emission reductions		► 7 Gg CO_2-eq in 2025 ► 45 Gg CO_2-eq in 2030 ► 103 Gg CO_2-eq in 2035
	Timeframe		2017 – 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,334.5 M€ Specific costs: ► 47 €/t CO_2-eq
	Implementing entity		► Ministry of Economy, Energy Agency of the Republic of Macedonia ► Donors and financial institutions ► Investors (households)
Progress indicators:			► Energy savings (ktoe/GWh) ► Emissions reduction (Gg CO_2-eq)

Table 25. Phasing out of incandescent lights

Mitigation action: ***Phasing out of incandescent lights*** *Main objective:* ***Meeting the target set in the Energy Efficiency Action Plan*** *Description:* ***Replacing incandescent light bulbs with halogen ones (at the beginning) and later with compact fluorescent (CFL) and LED***			
Information	**Type**		Regulatory, policy
	Sector		Energy – Residential, non-specified (Commercial and service sector)
	Relevant planning documents, legal and regulatory acts		► Third Energy Efficiency Action Plan ► Commision Regulation(EC) No 244/2009 implementing Directive 2005/32/EC of the European Parlament and of the Council with regard to ecodesign requirements for non-directional household lamps
	Gases		CO_2, CH_4, N_2O
	Methodology		Introducing a Regulation that will prohibit sales of incandescent light bulbs. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		It is assumed that a Regulation will be adopted on prohibiting sales of incandescent light bulbs, its implementation will start in 2018, and it is assumed that there will be 2-3 years of transition period
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	/
		Steps envisaged	Adoption of a Regulation that will prohibit sales of incandescent light bulbs.
	Results achieved and estimated outcomes		Expected annual energy savings: ► 84 ktoe (981 GWh) in 2025 ► 106 ktoe (1.235 GWh) in 2030 ► 131 ktoe (1.524 GWh) in 2035
	Estimated emission reductions		► 677 Gg CO_2-eq in 2025 ► 1,314 Gg CO_2-eq in 2030 ► 1,131 Gg CO_2-eq in 2035
	Timeframe		2017 - 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,293.5 M€ Specific costs: ► -30 €/t CO_2-eq
	Implementing entity		► Government of the Republic of Macedonia ► Ministry of Economy, Energy Agency of the Republic of Macedonia ► End-users
Progress indicators:			► Energy savings (ktoe/GWh) ► Emissions reduction (Gg CO_2-eq)

Table 26. Improvement of the street lighting in the municipalities

Mitigation action: ***Improvement of the street lighting in the municipalities*** *Main objective:* ***Meeting the target set in the Energy Efficiency Action Plan*** *Description:* ***Replacement of the existing lamps with sodium and LED lamps***			
Information	**Type**		Technical
	Sector		Energy – Non-specified (Commercial and service sector)
	Relevant planning documents, legal and regulatory acts		Third Energy Efficiency Action Plan
	Gases		CO_2, CH_4, N_2O
	Methodology		Replacement of the mercury lamps with sodium and LED lamps. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		It is envisaged that by 2035 60% of the street lights will be LED and the rest 40% will be sodium lamps
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► Street lighting at some location replaced ► Promotional activities for the implementation of public-private partnership (PPP) taken
		Steps envisaged	► Continuing the promotional activities for the implementation of public-private partnership
	Results achieved and estimated outcomes		Achieved annual energy savings: ► 1.7 ktoe (20 GWh) in 2015 Expected annual energy savings: ► 4.6 ktoe (53 GWh) in 2025 ► 7.3 ktoe (85 GWh) in 2030 ► 9.3 ktoe (108 GWh) in 2035
	Estimated emission reductions		► 30 Gg CO_2-eq in 2025 ► 86 Gg CO_2-eq in 2030 ► 86 Gg CO_2-eq in 2035
	Timeframe		2017 - 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,329.6 M€ Specific costs: ► -32 €/t CO_2-eq
	Implementing entity		► Ministry of Economy, Energy Agency of the Republic of Macedonia ► Local self-government
Progress indicators:			► Energy savings (ktoe/GWh) ► Emissions reduction (Gg CO_2-eq)

Table 27. "Green procurements"

Mitigation action: ***"Green procurements"*** *Main objective:* ***Application of energy efficiency criteria ("greening") in public procurement procedures*** *Description:* ***Intensified activities to ensure legal and technical knowledge and skills of public sector entities for inclusion and evaluation of requirements for energy efficiency in public procurement procedures by applying the criteria of most economically advantageous tender.***			
Information	**Type**		Regulatory
	Sector		Energy – Non-specified (Commercial and service sector)
	Relevant planning documents, legal and regulatory acts		► Third Energy Efficiency Action Plan ► Law on Public Procurement ► Law on Energy
	Gases		CO_2, CH_4, N_2O
	Methodology		Implementation of energy efficiency criteria. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		Penetration of efficient appliances to 5% share by 2035
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► Recommendations for amendment/supplementation of the Law on Public Procurement in order to incorporate requirements for EE criteria in the public procurements given by the State Audit Office. ► The process of drafting the Law on Energy Efficiency started (a working group established
		Steps envisaged	► Adoption of the Law on Energy Efficiency ► Amendments/supplementations to the Law on Public Procurement ► Changing the existing guidelines on energy efficiency criteria and providing training for public sector entities for the proper implementation of the guidelines ► Introduction of a method for monitoring the implementation of the measure.
	Results achieved and estimated outcomes		Achieved annual energy savings: ► 0.22 ktoe (2.6 GWh) in 2015 Expected annual energy savings: ► 2.9 ktoe (34 GWh) in 2025 ► 5.1 ktoe (59 GWh) in 2030 ► 7.6 ktoe (88 GWh) in 2035
	Estimated emission reductions		► 16 Gg CO_2-eq in 2025 ► 64 Gg CO_2-eq in 2030 ► 73 Gg CO_2-eq in 2035
	Timeframe		2017 – 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,330.2 M€ Specific costs: ► -34 €/t CO_2-eq
	Implementing entity		► Ministry of Economy, Energy Agency of the Republic of Macedonia ► Public Procurement Bureau ► Local self-government
Progress indicators:			► Energy savings (ktoe/GWh) ► Emissions reduction (Gg CO_2-eq)

Table 28. Gasification (residential and commercial and public sector)

Mitigation action: ***Gasification (residential and commercial and public sector)*** *Main objective:* ***Enabling access to a new fuel type in residential and commercial and public sector*** *Description:* ***Gasification of residential and commercial and public sector through construction of a gasification network***			
Information	**Type**		Technical, policy
	Sector		Energy – Residential, non-specified (Commercial and service sector)
	Relevant planning documents, legal and regulatory acts		► Strategy for Energy Development in the Republic of Macedonia ► Work Program of the Government of the Republic of Macedonia ► Study for gasification of the Republic of Macedonia
	Gases		CO_2, CH_4, N_2O
	Methodology		Construction of gasification network. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		Gradual gasification of the residential and commercial and public sector by 2020, which will be more intensified after 2020
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► Gasification network section Klechovce – Shtip built ► Gasification network sections: Shtip – Negotino, Negotino – Bitola and Tetovo – Skopje in a process of construction
		Steps envisaged	► Finalizing the construction of the started sections ► Call for tenders for public private partnership and construction of a secondary and tertiary gasification network
	Results achieved and estimated outcomes		Achieved share of natural gas in the final energy consumption in residential and non-specified sectors. correspondingly : ► 0.02% and 4.5% in 2015 Expected share of natural gas in the final energy consumption in residential and non-specified sectors. correspondingly : ► 6.2% and 7.7% in 2025 ► 8.5% and 9.6% in 2030 ► 10.7% and 11.2% in 2035
	Estimated emission reductions		► 17 Gg CO_2-eq in 2025 ► 17 Gg CO_2-eq in 2030 ► 58 Gg CO_2-eq in 2035
	Timeframe		2017 - 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,326.5 M€ Specific costs: ► -341 €/t CO_2-eq
	Implementing entity		► Government of the Republic of Macedonia ► Ministry of Economy, Energy Agency of the Republic of Macedonia ► JSC Macedonian Energy Resources ► JSC GAMA ► JSC Strumica Gas ► JSC Kumanovo Gas ► Directorate for Technological Industrial Development Zones ► Private investors
Progress indicators:			► Share of natural gas in final energy consumption in Residential and Non-specified sectors (%) ► Emissions reduction (Gg CO_2-eq)

Table 29. Increased use of central heating systems

Mitigation action: ***Increased use of central heating systems***
Main objective: ***Reduction of local pollution***
Description: ***Increased use of the existing central heating systems through implementation of information campaigns for connecting new consumers, including those who have been disconnected from the system in the past.***

Information	**Type**		Technical, information
	Sector		Energy – Residential, Non-specified (Commercial and service sector)
	Relevant planning documents, legal and regulatory acts		► Strategy for Energy Development in the Republic of Macedonia ► Study for determining the techno-economic optimal and environmentally sustainable structure of heating and implementation of the central supply of sanitary hot water in the City of Skopje
	Gases		CO_2, CH_4, N_2O
	Methodology		Implementation of information campaigns. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		Information campaigns will contribute to connection of the new consumers to the existing central heating system earlier than in the Reference scenario
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► Studies for analysis of the central heating system and implementation of central supply of sanitary hot water developed ► Information campaigns for re-connection of the previously disconnected consumers and attraction of new consumers implemented
		Steps envisaged	► Continuing the implementation of the information campaigns
	Results achieved and estimated outcomes		Expected heat consumption: ► 6.5 ktoe (76 GWh) in 2025 ► 4.7 ktoe (57 GWh) in 2030 ► 14.4 ktoe (167 GWh) in 2035
	Estimated emission reductions		► 10 Gg CO_2-eq in 2025 ► 24 Gg CO_2-eq in 2030 ► 18 Gg CO_2-eq in 2035
	Timeframe		2017 – 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,330.9 M€ Specific costs: ► -62 €/t CO_2-eq
	Implementing entity		► Ministry of Economy, Energy Agency of the Republic of Macedonia ► Balkan energy Dooel Skopje ► JSC Skopje Sever ► "Energetika" –Skopje, subsidiary to JSC Macedonian Power Plants (ELEM AD) ► Private investors
Progress indicators:			► Increase of heat consumption (form central heating systems) (GWh) ► Increase in the number of consumers connected to the central heating system ► Emissions reduction (Gg CO_2-eq)

Table 30. Utilization of the heating system for obtaining sanitary hot water in a combination with solar collectors

Mitigation action: ***Utilization of the heating system for obtaining sanitary hot water in a combination with solar collectors***

Main objective: ***Meeting the target set in the Energy Efficiency Action Plan and Renewable Energy Action Plan***

Description: ***Obtaining sanitary hot water by utilization the heating system in a combination with solar collectors***

Information	**Type**		Technical, information
	Sector		Energy – Residential, Non-specified (Commercial and service sector)
	Relevant planning documents, legal and regulatory acts		► Strategy for Energy Development in the Republic of Macedonia ► Study for determining the techno-economic optimal and environmentally sustainable structure of heating and implementation of the central supply of sanitary hot water in the City of Skopje
	Gases		CO_2, CH_4, N_2O
	Methodology		Implementation of systems for obtaining sanitary hot water from the heating system in a combination with solar collectors. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		It is envisaged that by 2035, 15% of the hot water needs in the urban buildings will be provided through the heating system.
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► Studies for analysis of the central heating system and implementation of central supply of sanitary hot water developed
		Steps envisaged	► Implementation of information campaigns ► Implementation of systems for obtaining sanitary hot water from the heating system in a combination with solar collectors at end-users level
	Results achieved and estimated outcomes		Expected annual energy savings: ► 0.8 ktoe (9 GWh) in 2025 ► 2 ktoe (24 GWh) in 2030 ► 3 ktoe (34 GWh) in 2035
	Estimated emission reductions		► 8 Gg CO_2-eq in 2025 ► 25 Gg CO_2-eq in 2030 ► 30 Gg CO_2-eq in 2035
	Timeframe		2017 - 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,331.7 M€ Specific costs: ► -27 €/t CO_2-eq
	Implementing entity		► Ministry of Economy, Energy Agency of the Republic of Macedonia ► Balkan energy Dooel Skopje ► JSC Skopje Sever ► "Energetika" –Skopje, subsidiary to JSC Macedonian Power Plants (ELEM AD) ► Private investors
Progress indicators:			► Number of connected systems for obtaining sanitary hot water from the heating system in a combination with solar collectors ► Energy savings (ktoe/GWh) ► Emissions reduction (Gg CO_2-eq)

4.1.3 Manufacturing industries and construction

In the subcategory Manufacturing industries and construction two measures are modelled and analyzed. The most relevant information for these measures/policies is given in Table 31 and in Table 32.

Table 31. Energy management in manufacturing industries

Mitigation action: ***Energy management in manufacturing industries*** *Main objective:* ***Efficient management of manufacturing processes in industry aiming to increased production at the same energy consumption and meeting the target set in the Energy Efficiency Action Plan*** *Description:* ***Implementation of obligatory energy audits of manufacturing industries and implementation of ISO 50001 standard***			
Information	**Type**		Regulatory, technical
	Sector		Energy – Manufacturing industries and construction
	Relevant planning documents, legal and regulatory acts		Third Energy Efficiency Action Plan
	Gases		CO_2, CH_4, N_2O
	Methodology		Implementation of the ISO 50001 standard. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		Improvement of the systems efficiency in manufacturing industries at annual rate of 0.15%
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► Promotion of ISO 50001 standards completed ► Training on implementation of energy management in industry organized ► Certificates for energy auditors issued ► USAID project for energy management in industry realized in 17 companies ► Ongoing UNIDO/GEF Project in which one of the activities is Program for energy management in industrial companies according to ISO 50001 standard and the UNIDO Methodology. Initial results achieved in 12 companies and additionally Program for replications of the energy management systems realized in 5 companies.
		Steps envisaged	► Continuation of the implementation of ISO 50001 standard in more industrial companies (manufacturing industries). ► Implementation of obligatory energy audits.
	Results achieved and estimated outcomes		Achieved annual energy saving: ► 3 ktoe (35 GWh) in 2015 Expected annual energy savings: ► 14.6 ktoe (170 GWh) in 2025 ► 24.7 ktoe (288 GWh) in 2030 ► 37.2 ktoe (434 GWh) in 2035
	Estimated emission reductions		► 52 Gg CO_2-eq in 2025 ► 150 Gg CO_2-eq in 2030 ► 199 Gg CO_2-eq in 2035
	Timeframe		2017 – 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,327.6 M€ Specific costs: ► -32 €/t CO_2-eq
	Implementing entity		► Ministry of Economy, Energy Agency of the Republic of Macedonia ► Private companies

Progress indicators:	▶ Energy savings (ktoe/GWh) ▶ Emissions reduction (Gg CO_2-eq)

Table 32. Introduction of efficient electric motors

Mitigation action: ***Introduction of efficient electric motors*** *Main objective:* ***Efficient management of manufacturing processes in industry aiming to increased production at the same energy consumption and meeting the target set in the Energy Efficiency Action Plan*** *Description:* ***Introduction of efficient electric motors in manufacturing industries***			
Information	**Type**		Technical
	Sector		Energy – Manufacturing industries and construction
	Relevant planning documents, legal and regulatory acts		Third Energy Efficiency Action Plan
	Gases		CO_2, CH_4, N_2O
	Methodology		Installation of efficient electric motors. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		It is envisaged that the share of efficient electric motors will be 40% by 2035
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	New efficient electric motors installed in a number of companies.
		Steps envisaged	Replacement of the existing electric motors with more efficient
	Results achieved and estimated outcomes		Achieved annual energy saving: ► 1.4 ktoe (16 GWh) in 2015 Expected annual energy savings: ► 7.3 ktoe (84 GWh) in 2025 ► 10.9 ktoe (127 GWh) in 2030 ► 15.1 ktoe (176 GWh) in 2035
	Estimated emission reductions		► 51 Gg CO_2-eq in 2025 ► 117 Gg CO_2-eq in 2030 ► 134 Gg CO_2-eq in 2035
	Timeframe		2017 – 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,330.2 M€ Specific costs: ► -19 €/t CO_2-eq
	Implementing entity		► Ministry of Economy, Energy Agency of the Republic of Macedonia ► Private companies
Progress indicators:			► Energy savings (ktoe/GWh) ► Emissions reduction (Gg CO_2-eq)

4.1.4 Transport

In the Transport subcategory eight measures in total are modelled and analyzed. The most relevant information for these measures/policies is given from Table 33 to Table 40.

Table 33. Biofuels 5%

Mitigation action: ***Biofuels 5%*** *Main objective:* ***Meeting the targets set in the Renewable Energy Action Plan*** *Description:* ***5% share of biofuels by 2020***			
Information	**Type**		Regulatory
	Sector		Energy – Transport
	Relevant planning documents, legal and regulatory acts		► Strategy for Energy Development in the Republic of Macedonia ► Strategy for Utilization of Renewable Energy Sources in the Republic of Macedonia ► Renewable Energy Action Plan ► Biennial report on the progress of increased utilization of renewable energy sources
	Gases		CO_2, CH_4, N_2O
	Methodology		Adoption of Law and Action Plan on Biofuels. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		It is assumed that the implementation of the Directive for biofuels (2003/30/EC) will be postponed to 2025, or the share of biofuels will be 5% by 2020 and 10% by 2025, remaining at that level till 2035
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► Adoption of Renewable Energy Action plan till 2025 ► Draft version of the Action Plan for Biofuels developed ► Draft version of the Law on Biofuels developed ► The process of drafting the Law on Renewable Energy Sources (RES) started (a working group established)
		Steps envisaged	► Adoption of the Law on Biofuels ► Adoption of the Law on RES ► Adoption of the Action Plan for Biofuels
	Results achieved and estimated outcomes		Expected share of biofuels in the total final energy consumption in transport: ► 5% in 2020 ► 10% in 2025, 2030 and 2035
	Estimated emission reductions		► 206 Gg CO_2-eq in 2025 ► 221 Gg CO_2-eq in 2030 ► 221 Gg CO_2-eq in 2035
	Timeframe		2017-2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,336.7 M€ Specific costs: ► 20 €/t CO_2-eq
	Implementing entity		► Ministry of Economy, Energy Agency of the Republic of Macedonia ► End-users
Progress indicators:			► Share of the biofuels in the total final energy consumption in transport (%) ► Emissions reduction (Gg CO2-eq)

Table 34. Biofuels 1%

Mitigation action: ***Biofuels 10%*** *Main objective:* ***Meeting the targets set in the Renewable Energy Action Plan*** *Description:* ***10% share of biofuels by 2020***			
Information	**Type**		Regulatory
	Sector		Energy – Transport
	Relevant planning documents, legal and regulatory acts		► Strategy for Energy Development in the Republic of Macedonia ► Strategy for Utilization of Renewable Energy Sources in the Republic of Macedonia ► Renewable Energy Action Plan ► Biennial report on the progress of increased utilization of renewable energy sources
	Gases		CO_2, CH_4, N_2O
	Methodology		Adoption of Law and Action Plan on Biofuels. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		It is assumed that the Directive for biofuels (2003/30/EC) will be implemented by 2025, or the share of biofuels will be 10% by 2020, remaining at that level till 2035
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► Adoption of Renewable Energy Action plan till 2025 ► Draft version of the Action Plan for Biofuels developed ► Draft version of the Law on Biofuels developed ► The process of drafting the Law on Renewable Energy Sources (RES) started (a working group established)
		Steps envisaged	► Adoption of the Law on Biofuels ► Adoption of the Law on RES ► Adoption of the Action Plan for Biofuels
	Results achieved and estimated outcomes		Expected share of biofuels in the total final energy consumption in transport: ► 10% in 2020, 2025, 2030 and 2035
	Estimated emission reductions		► 206 Gg CO_2-eq in 2025 ► 221 Gg CO_2-eq in 2030 ► 221 Gg CO_2-eq in 2035
	Timeframe		2017-2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,336.7 M€ Specific costs: ► 20 €/t CO_2-eq
	Implementing entity		► Ministry of Economy, Energy Agency of the Republic of Macedonia ► End-users
Progress indicators:			► Share of the biofuels in the total final energy consumption in transport (%) ► Emissions reduction (Gg CO2-eq)

Table 35. Increased use of the railway

Mitigation action: ***Increased use of the railway*** *Main objective:* ***Meeting the target set in the Energy Efficiency Action Plan*** *Description:* ***Increased use of the railway though awareness rising to use the railway for long-distance traveling and by improving the conditions of the companies***			
Information	**Type**		Technical, information
	Sector		Energy – Transport
	Relevant planning documents, legal and regulatory acts		► Third Energy Efficiency Action Plan ► National Transport Strategy
	Gases		CO_2, CH_4, N_2O
	Methodology		Conducting campaigns and modernization of the railway. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		By 2035 2.1% of the passenger kilometers of cars, 5.7% of passenger kilometers of busses and 3.6% of tonnes kilometers of heavy duty vehicles will be realized by railway transport.
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► 150 freight cars and six compositions consisting of a locomotive and passenger cars ordered by the Government as part of a project with the European Bank for Reconstruction and Development (EBRD). Some of these have already been received and put into use. ► Campaigns for cheaper/free driving of certain categories of passengers (young people, pensioners, etc.) carried out.
		Steps envisaged	► Arrival and putting into use of other commissioned wagons ► Implement promotional campaigns for raising public awareness ► Continuing the campaigns for cheaper/free driving ► Enabling additional conditions for companies
	Results achieved and estimated outcomes		Expected annual energy savings, and increase of passenger and tonnes km, correspondingly: ► 5.8 ktoe (67 GWh), 324 pkm and 755 tkm in 2025 ► 10.3 ktoe (119 GWh), 431 pkm and 1,050 tkm in 2030 ► 15.6 ktoe (182 GWh), 541 pkm and 1,407 tkm in 2035.
	Estimated emission reductions		► 10 Gg CO_2-eq in 2025 ► 20 Gg CO_2-eq in 2030 ► 26 Gg CO_2-eq in 2035
	Timeframe		2017 – 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,325.1 M€ Specific costs: ► -371 €/t CO_2-eq
	Implementing entity		► Government of the Republic of Macedonia ► Ministry of Transport and Communications ► Ministry of Economy, Energy Agency of the Republic of Macedonia ► JSC Macedonian Railway Transport ► End-users ► Private companies
Progress indicators:			► Energy savings (ktoe/GWh) ► Increase of passenger km in railway transport (pkm) ► Increase of tonnes km in railway transport (tkm) ► Emissions reduction (Gg CO_2-eq)

Table 36. Renewing of the national car fleet

Mitigation action: ***Renewing of the national car fleet***
Main objective: ***Reduction of the local air pollution and meeting the target set in the Energy Efficiency Action Plan***
Description: ***This measure consists of successively organized and well-planned steps for faster renewal of the vehicle fleet.***

Information	**Type**		Regulatory, policy, information
	Sector		Energy – Transport
	Relevant planning documents, legal and regulatory acts		► Third Energy Efficiency Action Plan ► National Transport Strategy
	Gases		CO_2, CH_4, N_2O
	Methodology		Introducing a Regulation that will prohibit the purchase of cars with a standard lower than EURO5. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		It is assumed that only new vehicles and vehicles not older than 8 years will be sold, i.e. vehicles that meet EU standards such as CO_2 emissions in 2020 of 95 g CO_2/km, and 70 g CO_2/km by 2025.
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	
		Steps envisaged	► Amendment of the following legislation: Rulebook for identification and/or identification and appreciation of vehicles technical condition, Rulebook for individual authorization of vehicles and Law for vehicles – the part for registration and technical inspection. ► Successive implementation of EURO standards for import of new EE vehicles.
	Results achieved and estimated outcomes		Achieved annual energy savings: ► 6.5 ktoe (76 GWh) in 2015 (together with other road vehicles) Expected annual energy savings: ► 27 ktoe (315 GWh) in 2025 ► 45 ktoe (523 GWh) in 2030 ► 60 ktoe (670 GWh) in 2035
	Estimated emission reductions		► 83 Gg CO_2-eq in 2025 ► 139 Gg CO_2-eq in 2030 ► 185 Gg CO_2-eq in 2035
	Timeframe		2017 – 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,312 M€ Specific costs: ► -147 €/t CO_2-eq
	Implementing entity		► Government of the Republic of Macedonia ► Ministry of Transport and Communications ► Ministry of Economy, Energy Agency of the Republic of Macedonia ► End-users
Progress indicators:			► Energy savings (ktoe/GWh) ► Emissions reduction (Gg CO_2-eq)

Table 37. Renewing of other national road fleet

Mitigation action: ***Renewing of other national road fleet (light duty and heavy goods vehicles and buses)***
Main objective: ***Reduction of the local air pollution and meeting the target set in the Energy Efficiency Action Plan***
Description: ***This measure involves introduction of a regulation that will enable renewal of the vehicle fleet of light duty and heavy goods vehicles and buses***

Information	**Type**		Regulatory, policy
	Sector		Energy – Transport
	Relevant planning documents, legal and regulatory acts		► Third Energy Efficiency Action Plan ► National Transport Strategy
	Gases		CO_2, CH_4, N_2O
	Methodology		Introducing a Regulation that will prohibit the purchase of cars with a standard lower than EURO6. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		It is assumed that only new vehicles (light duty and heavy goods vehicles and buses) that meet EU standards for exhaust fumes.
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	
		Steps envisaged	Successive implementation of EURO standards (EU new standard is a EURO 6, while in Macedonia is EURO 4) for import of new EE vehicles
	Results achieved and estimated outcomes		Achieved annual energy savings: ► 6.5 ktoe (76 GWh) in 2015 (together with passenger cars) Expected annual energy savings: ► 9.5 ktoe (111 GWh) in 2025 ► 24 ktoe (278 GWh) in 2030 ► 39.7 ktoe (462 GWh) in 2035
	Estimated emission reductions		► 27 Gg CO_2-eq in 2025 ► 65 Gg CO_2-eq in 2030 ► 122 Gg CO_2-eq in 2035
	Timeframe		2017 – 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,325.9 M€ Specific costs: ► -100 €/t CO_2-eq
	Implementing entity		► Government of the Republic of Macedonia ► Ministry of Transport and Communications ► Ministry of Interior Affairs ► Ministry of Economy, Energy Agency of the Republic of Macedonia ► Private companies
Progress indicators:			► Energy savings (ktoe/GWh) ► Emissions reduction (Gg CO_2-eq)

Table 38. Increased use of bicycles, walking and introduction of parking policy

Mitigation action: ***Increased use of bicycles, walking and introduction of parking policy***
Main objective: ***Reduction of the local air pollution and meeting the target set in the Energy Efficiency Action Plan***
Description: ***Conducting campaigns/providing subsidies and systems for use of new or rented bicycles, walking, and introduction of parking policies that would reduce the use of cars in the city area***

Information	**Type**		Regulatory, technical, information
	Sector		Energy – Transport
	Relevant planning documents, legal and regulatory acts		► Third Energy Efficiency Action Plan ► Decisions made by municipalities to subsidize buying of new bicycles
	Gases		CO_2, CH_4, N_2O
	Methodology		Implementation of campaigns/subsidies, parking policies. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		► Introduction of an appropriate parking policy which would reduce the use of cars in the city area, and would contribute to increased use of bicycles. ► People, especially in smaller towns where a lot of them use cars for short distances, would increase their use of bicycles or walking
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► Subsidies and campaigns for buying new bicycles implemented ► Systems for bicycles renting implemented ► Bicycles tracks constructed ► Zonal parking implemented ► New multi-level car parks constructed
		Steps envisaged	► Continue the implementation of the campaigns and subsidies for buying new bicycles and renting bicycles ► Continue the construction of new bicycles tracks
	Results achieved and estimated outcomes		Expected annual energy savings: ► 1 ktoe (11 GWh) in 2025 ► 1.3 ktoe (15 GWh) in 2030 ► 1.5 ktoe (18 GWh) in 2035
	Estimated emission reductions		► 3 Gg CO_2-eq in 2025 ► 4 Gg CO_2-eq in 2030 ► 5 Gg CO_2-eq in 2035
	Timeframe		2017 – 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,328.6 M€ Specific costs: ► -970 €/t CO_2-eq
	Implementing entity		► Ministry of Economy, Energy Agency of the Republic of Macedonia ► Local self-government ► End-users
Progress indicators:			► Energy savings (ktoe/GWh) ► Emissions reduction (Gg CO_2-eq)

Table 39. Construction of the railway to Republic of Bulgaria

Mitigation action: ***Construction of the railway to Republic of Bulgaria*** *Main objective:* ***Connecting the Republic of Macedonia with the Republic of Bulgaria and extending the export to external markets, not just in the neighboring countries but in the Southeast Europe and Turkey region, using the railway transport*** *Description:* ***Construction of the railway to Republic of Bulgaria***			
Information	**Type**		Technical, policy
	Sector		Energy – Transport
	Relevant planning documents, legal and regulatory acts		► Work Program of the Government of the Republic of Macedonia ► National Transport Strategy
	Gases		CO_2, CH_4, N_2O
	Methodology		Construction of the railway. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		By 2035 up to 5% of the tonne kilometers (to the Republic of Bulgaria) will cross from heavy goods vehicles to the railroad transport
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	The railway is under construction
		Steps envisaged	Finishing the construction of the railway and putting it into operation
	Results achieved and estimated outcomes		Expected annual energy savings and increase of the tonnes km, correspondingly: ► 9.4 ktoe (110 GWh) and 371 tkm in 2025 ► 13.1 ktoe (152 GWh) and 532 tkm in 2030 ► 16.8 ktoe (196 GWh) and 692 tkm in 2035
	Estimated emission reductions		► 17 Gg CO_2-eq in 2025 ► 26 Gg CO_2-eq in 2030 ► 30 Gg CO_2-eq in 2035
	Timeframe		2017-2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,338.4 M€ Specific costs: ► 229 €/t CO_2-eq
	Implementing entity		► Government of the Republic of Macedonia ► Ministry of Transport and Communications ► Ministry of Economy, Energy Agency of the Republic of Macedonia
Progress indicators:			► Energy savings (ktoe/GWh) ► Increase of the tonnes km in the railway transport (tkm) ► Emissions reduction (Gg CO_2-eq)

Table 40. Electrification of the transport – electric passenger cars

Mitigation action: ***Electrification of the transport***
Main objective: ***Reduction of the local air pollution and meeting the target set in the Energy Efficiency Action Plan***
Description: ***This measure consists of successively organized and well-planned steps for faster renewal of the vehicle fleet, through introduction of electric vehicles***

Information	**Type**		Regulatory, policy, information
	Sector		Energy – Transport
	Relevant planning documents, legal and regulatory acts		Third Energy Efficiency Action Plan
	Gases		CO_2, CH_4, N_2O
	Methodology		Introducing a Regulation that will prohibit the purchase of cars with a standard lower than EURO6. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		It is envisaged that: ► the share of electric vehicles and "plug-in" electric vehicles will be 10% by 2035 ► subsidies of 5000 € for purchasing an electric vehicle and 1000 € purchasing an"plug-in" electric vehicle will be introduced
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► Chargers installed at specific locations in the City of Skopje
		Steps envisaged	► Development of studies for determining the best locations for installation of electric vehicles chargers from the aspect of the power grid. ► Successive implementation of EURO standards (EU new standard is a EURO 6, while in Macedonia is EURO 4) for import of new EE vehicles
	Results achieved and estimated outcomes		Expected annual energy savings: ► 5.6 ktoe (66 GWh) in 2025 ► 17.5 ktoe (204 GWh) in 2030 ► 21.8 ktoe (254 GWh) in 2035
	Estimated emission reductions		► 13.3 Gg CO_2-eq in 2025 ► 20.4 Gg CO_2-eq in 2030 ► 0 Gg CO_2-eq in 2035*
	Timeframe		2017-2035
	Costs (in 2030)		Costs for the Reference scenario: ► 1,332.4 M€ Costs for the Scenario with implemented measure: ► 1,334.0 M€ Specific costs: ► 76 €/t CO_2-eq
	Implementing entity		► Government of the Republic of Macedonia ► Ministry of Transport and Communications
Progress indicators:			► Energy savings (ktoe/GWh) ► Emissions reduction (Gg CO_2-eq)

*Although these vehicles are more efficient than fossil fuel vehicles, the emissions from this measure may increase, considering that the electricity in the power system is mainly produced from fossil fuels, therefore this measure should be implemented in parallel with the measures for electricity generation from RES.

4.2 Agriculture, forestry and other land use

In the Agriculture, forestry and other land use sector eight measures in total are modelled and analyzed, divided in the following categories Livestock, Forestry and Land use.

4.2.1 Livestock

In the Livestock category three measures are modelled and analyzed. The most relevant information for these measures/policies is given from Table 41 to Table 43.

Table 41. Enteric fermentation in dairy cows

Mitigation action: ***Enteric fermentation in dairy cows***			
Main objective: ***Decrease level of CH_4 emission from enteric fermentation in highly productive dairy cows***			
Description: ***By modification of the feed composition and nutrition practice in dairy cows, the emission of CH_4 due to enteric fermentation can be reduced by 20%. It is foreseen that the number of dairy cows under intensive farming system will be increased form present 1% to 25% in 2035. Because of highly productive cows involved the CH_4 emission will also increase. But, with modification of feed content (adding carbohydrates, high quality forages and tannins) into TMR, the CH_4 emission will be decreased by 20%. The mitigation measure can be easily applied on dairy farms, by nutrition management. It is also cost effective; do not require additional subsidies or incentives. Practical training and demonstration for farmers will be sufficient***			
Information	**Type**		Livestock, enteric fermentation in dairy cow
	Sector		AFLOU – Livestock
	Relevant planning documents, legal and regulatory acts		Law on nature protection (Environmental impact assessment). The IPARD Program contains the provisions
	Gases		CH_4
	Methodology		Feed composition and nutrition management in up to 25% of dairy cows. IPCC Methodology.
	Assumptions		► Increased number of highly productive dairy cows under intensive farming, ► Introduced modified TMR (Total Mixed Ration) and nutrition management
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	TMR with partly modified feed composition in already used on two intensive farms that account about 1% of the dairy cow population.
		Steps envisaged	► Development advisory package for TMR modified feed and nutrition management for the intensive dairy farms with more than 50 cows ► Incentives for dissemination of the advisory package to target farmers ► Monitoring of the effect of TMR modified feed and nutrition management, and further improvements
	Results achieved and estimated outcomes		25% from population of dairy cows have been applied TMR modified feed and nutrition management up to 2035.
	Estimated emission reductions		► 3 Gg CO_2-eq in 2025 ► 5.7 Gg CO_2-eq in 2030 ► 8.3 Gg CO_2-eq in 2035
	Timeframe		2017-2035
	Costs (in 2030)*		Costs for the Reference scenario: ► 0 M€ Costs for the Scenario with implemented measure: ► 0.01 M€ Specific costs: ► 1.8 €/t CO_2-eq
	Implementing entity		Ministry of Agriculture, Forestry and Water Economy
Progress indicators:			Farms (dairy cows as a percentage of the total population) used TMR modified feed and nutrition management on biannual base.

* Costs refer only to the investments

Table 42. Manure management in dairy cows

Mitigation action: ***Manure management in dairy cows***
Main objective: ***Decrease level of NO_2 emission from manure management in highly productive dairy cows***
Description: ***By modification of the manure management in dairy cows, the emission of NO_2 can be reduced up to 30%. It is foreseen that the number of dairy cows under intensive farming system with more than 50 heads will be increased form present 1% to 25% in 2035. All those farms will need to apply improved manure management in order to reduce N loss, and N_xO emissions. Therefore, on farm manure management system needs to modify. The mitigation measure, consider on farm adaption on existing farms and moderate investments on newly established farms. It will require subsidies for adapting and incentives in farm design and construction***

Information	**Type**		Livestock, enteric fermentation in dairy cow
	Sector		AFLOU – Livestock
	Relevant planning documents, legal and regulatory acts		Law on nature protection (Environmental impact assessment). The IPARD Program contains the provisions
	Gases		N_2O
	Methodology		Modified manure management in up to 25% of dairy cows. IPCC Methodology.
	Assumptions		► Increased number of highly productive dairy cows under intensive farming, ► On farm modified manure management.
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	The process of modified manure management started on the existing large dairy farms, as a result of the implementation of the studies for environmental impact assessment (Permit A for alignment with the operational plan).
		Steps envisaged	► Adaption in manure management on intensive dairy farms with more than 50 cows, ► Design and construction of intensive dairy farms with more than 50 cows, ► Monitoring of the effect modified manure management in the intensive dairy farms with more than 50 cows.
	Results achieved and estimated outcomes		25% from population of dairy cows, belonging to intensive dairy farms with more than 50 cows have been applied modified manure management up to 2035.
	Estimated emission reductions		► 1.4 Gg CO_2-eq in 2025 ► 2.1 Gg CO_2-eq in 2030 ► 3.9 Gg CO_2-eq in 2035
	Timeframe		2017 – 2035
	Costs (in 2030)*		Costs for the Reference scenario: ► 0 M€ Costs for the Scenario with implemented measure: ► 0.05 M€ Specific costs: ► 25.1 €/t CO_2-eq
	Implementing entity		Ministry of Agriculture, Forestry and Water Economy
Progress indicators:			Farms (dairy cows as a percentage of the total population) used modified manure management on 2-5 years base.

*Costs refer only to the investments

Table 43. Manure management in swine farms

Mitigation action: ***Manure management in swine farms***
Main objective: ***Decrease level of NO_2 emission from manure management in highly productive swine farms***
Description: ***By modification of the manure management in swine farms, the emission of NO_2 can be reduced up to 50%. It is foreseen that number of fatteners and number of fatteners per sow will increase, while the total number of sows will remain stable over period. Number of swine farms with more than 1,000 fatteners and/or 350 sows will also increase and they need to adapt improved manure management system, in order to reduce N loss. In 2035 is expected that 90% of fatteners will be produced on those farms, accounting for 75% of sow in the country. The mitigation measure, consider on farm adaption on existing farms and moderate investments on newly established farms. It will require subsidies for adapting and incentives in farm design and construction.***

Information	**Type**		Livestock, manure management in swine farms
	Sector		AFLOU – Livestock
	Relevant planning documents, legal and regulatory acts		Law on nature protection (Environmental impact assessment). The IPARD Program contains the provisions
	Gases		N_2O
	Methodology		Modified manure management in swine farms with more than 1,000 fatteners and/or 350 sows. IPCC Methodology.
	Assumptions		► Increased number of highly productive swine farms with more than 1,000 fatteners and/or 350 sows, ► On farm modified manure management.
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	The process of modified manure management started on the existing large swine farms, as a result of the implementation of the studies for environmental impact assessment (Permit A for alignment with the operational plan).
		Steps envisaged	► Adaption in manure management on intensive swine farms with more than 1,000 fatteners and/or 350 sows, ► Design and construction of intensive swine farms with more than 1000 fatteners and/or 350 sows, ► Monitoring of the effect modified manure management in the intensive swine farms with more than 1000 fatteners and/or 350 sows.
	Results achieved and estimated outcomes		Up to 2035, 90% of fatteners and 75% of sow will be kept on farms more than 1000 fatteners and/or 350 sows.
	Estimated emission reductions		► 0.3 Gg CO_2-eq in 2025 ► 0.4 Gg CO_2-eq in 2030 ► 0.4 Gg CO_2-eq in 2035
	Timeframe		2017 – 2035
	Costs (in 2030)*		Costs for the Reference scenario: ► 0 M€ Costs for the Scenario with implemented measure: ► 0.05 M€ Specific costs: ► 131.6 €/t CO_2-eq
	Implementing entity		Ministry of Agriculture, Forestry and Water Economy
Progress indicators:			Farms (fatteners and sows as a percentage of the total population) used modified manure management on 2-5 years base.

*Costs refer only to the investments

4.2.2 Forestry

In the Forestry category two measures are modelled and analyzed. The most relevant information for these measures/policies is given in Table 44 and in Table 45.

Table 44. Decreasing the number and damaged area by forest fires

Mitigation action: ***Decreasing the number and damaged area by forest fires*** *Main objective:* ***Decreasing the damaged area by forest fires*** *Description:* ***Protection of the forest area by preventing the forest fires and the damages resulting from forest fires***			
Information	**Type**		Regulatory, information
	Sector		AFOLU – Forestry
	Relevant planning documents, legal and regulatory acts		► Forestry Management Plans ► Forest information system (UKIM - Faculty of Forestry, MAFWE) ► Study on development of the forest road network in the Republic of Macedonia (UKIM - Faculty of Forestry, MAFWE)
	Gases		CO_2
	Methodology		Conducting information campaigns and implementing legal measures. IPCC Methodology.
	Assumptions		Reduce the area affected by forest fires averaging 1,000 ha/year
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	A communication system between PE "Macedonian Forests" and the Forest Police for timely information on the occurrence of fires established (built and equipped).
		Steps envisaged	► System control, upgrading the software and training staff for its operation ► Conducting promotional campaigns and procurement of fire-fighting equipment ► Activation of the centers for intensive capacity building, training of personnel and certification of products ► Providing permanent funding sources
	Results achieved and estimated outcomes		Decrease the damaged area by forest fires ► 11,000 ha in 2025 ► 16,000 ha in 2030 ► 21,000 ha in 2035
	Estimated increase of emissions absorption		► 1,154 Gg CO_2-eq in 2025 ► 1,189 Gg CO_2-eq in 2030 ► 1,223 Gg CO_2-eq in 2035
	Timeframe		2017 – 2035
	Costs (in 2030)*		Costs for the Reference scenario: ► 0 M€ Costs for the Scenario with implemented measure: ► 1 M€ Specific costs: ► 0.8 €/t CO_2-eq
	Implementing entity		► PE "Makedonski shumi" ► Ministry of Environment and Physical Planning ► Ministry of Agriculture, Forestry and Water Economy ► National parks ► Association of private forest owners
Progress indicators:			► Decrease of a damaged area by forest fires (ha/year) ► Increase of emissions absorption (Gg CO_2-eq)

*Costs refer only to the investments

Table 45. Change of quality of forests by afforestation of transitive forest land

Mitigation action: ***Change of quality of forests by afforestation of transitive forest land*** *Main objective:* ***Improve the quality of the forests Change of quality of forests by afforestation of transitive forest land*** *Description:* ***Improve the quality of forests by afforestation of transitive forest land with higher quality tree species: coniferous, deciduous and mixed forests***			
Information	**Type**		Regulatory, information
	Sector		AFOLU – Forestry
	Relevant planning documents, legal and regulatory acts		► Forestry Management Plans ► Forest information system (UKIM - Faculty of Forestry, MAFWE) ► Study on development of the forest road network in the Republic of Macedonia (UKIM - Faculty of Forestry, MAFWE)
	Gases		CO_2
	Methodology		Conducting information campaigns and implementing legal measures. IPCC Methodology.
	Assumptions		Change of the cat transitive forest land into coniferous, deciduous and mixed forests, 2,500 ha/year on the average. The share of coniferous, deciduous and mixed forests is based on their average shares in the last three years
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	Three breeding centers for production of forest seedlings developed and equipped
		Steps envisaged	► Activation of the centers for intensive capacity building, training of personnel and certification of products ► Providing permanent funding sources
	Results achieved and estimated outcomes		Increase of coniferous, deciduous and mixed forest area: ► 27,500 ha in 2025 ► 40,000 ha in 2030 ► 52,500 ha in 2035
	Estimated increase of emissions absorption		► 115 Gg CO_2-eq in 2025 ► 167 Gg CO_2-eq in 2030 ► 220 Gg CO_2-eq in 2035
	Timeframe		2017 – 2035
	Costs (in 2030)*		Costs for the Reference scenario: ► 0 M€ Costs for the Scenario with implemented measure: ► 2.5 M€ Specific costs: ► 14.9 €/t CO_2-eq
	Implementing entity		► PE "Makedonski shumi" ► Ministry of Environment and Physical Planning ► Ministry of Agriculture, Forestry and Water Economy ► National parks ► Association of private forest owners
Progress indicators:			► Increase of coniferous, deciduous and mixed forest area (ha/year) ► Increase of emissions absorption (Gg CO_2-eq)

*Costs refer only to the investments

4.2.3 Land use

In the Land use category three measures are modelled and analyzed. The most relevant information for these measures/policies is given from Table 46 to Table 48.

Table 46. Conversion of land use of field crops above 15% inclination

Mitigation action: ***Conversion of land use of field crops above 15% inclination***			
Main objective: ***To reduce the intensity of soil erosion and loss of soil organic matter***			
Description: ***Cultivation of land on inclined terrain causes intensive processes of soil erosion and mineralization of sol organic matter. This processes leads to intensive decomposition of soil organic matter and emission of soil carbon into atmosphere. Conversion of such areas into perennial grassland (pastures, meadows) will significantly decrease intensity of soil organic matter depletion and emission of soil carbon, and will lead to carbon sink. Areas above 15% inclination by law should not be cultivated and are not considered as agricultural land.***			
Information	**Type**		Land management and land use change in the category of cropland
	Sector		AFOLU – Land
	Relevant planning documents, legal and regulatory acts		► Law on Agricultural Land ► Strategy for Agriculture and Rural Development ► Strategy for Consolidation of the Agricultural Land in the Republic of Macedonia ► National Action Plan for Combating Desertification in the Republic of Macedonia (draft version)
	Gases		CO_2
	Methodology		Land use change through conversion of almost 3000 ha of arable land that has been identified on inclined terrain above 15%, to grassland. IPCC Methodology.
	Assumptions		The conversion of land use, should: ► Stop the intensive process of erosion of the top soil layer which leads to loss of soil organic matter and its intensive ex-city mineralization, ► Stop on site mineralization of soil organic matter due to intensive processes of cultivation, ► Intensify carbon sink through accumulation of soil organic matter.
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	The effects of conversion of crop land to grass land has been monitored on two experimental fields in the past four years. Land Parcel Identification System has been established and will serve as a tool for control of the process of conversion.
		Steps envisaged	► Establishment of system for systematic control of land use and land use change on national level, ► Institutional support to primary producers with subsiding the process of conversion of crop fields into grassland, ► System for monitoring of influence of land use change on soil carbon sink.
	Results achieved and estimated outcomes		All 2,957 ha of field crops on inclined terrains above 15% slope, converted to grassland up to 2035.
	Estimated emission reductions		► 3.2 Gg CO_2-eq in 2025 ► 5.8 Gg CO_2-eq in 2030 ► 6.2 Gg CO_2-eq in 2035
	Timeframe		2017-2035
	Costs (in 2030)*		Costs for the Reference scenario: ► 0 M€ Costs for the Scenario with implemented measure: ► 0.08 M€ Specific costs: ► 13.7 €/t CO_2-eq
	Implementing entity		Ministry of Agriculture, Forestry and Water Economy
Progress indicators:			► Area converted on yearly base,

	► Percentage of soil organic matter increase and carbon sink per ha

*Costs refer only to the investments

Table 47. Contour cultivation of cropland on inclined terrains (5-15%)

Mitigation action: ***Contour cultivation of cropland on inclined terrains (5-15%)***
Main objective: ***To reduce erosion of top soil and conservation of soil organic mater***
Description: ***Downslope cultivation of cropland usually causes intensive processes of soil erosion. Field experiments showed that the quantity of eroded sediment is multiply higher if compared to contour cultivation. This eroded sediment is reach with SOM which in such circumstances is rapidly mineralized, due to what significant quantity of soil carbon is released into atmosphere. Contour cultivation means that all agro-technical operations should be across the slope. This measure is easy to be implemented, since it does not requires any special technical capacities and know-how. In practice, farmers usually are not aware of its importance and influence of the overall soil fertility. With a systematic campaign for increasing the awareness of the farmers this measure can be widely adopted.***

Information	**Type**		Land management and land use change in the category of cropland
	Sector		AFOLU – Land
	Relevant planning documents, legal and regulatory acts		► Law on Agricultural Land ► Strategy for Agriculture and Rural Development ► Strategy for Consolidation of the Agricultural Land in the Republic of Macedonia ► National Action Plan for Combating Desertification in the Republic of Macedonia (draft version)
	Gases		CO_2
	Methodology		Land cultivation system change from downslope to contour cultivation on 14,000 ha of arable land on inclined terrains (>5%). IPCC Methodology.
	Assumptions		Main assumptions of implementing contour cultivation are: ► Decreasing of soil erosion processes of the top soil layer and SOM loss with contour ploughing of inclined cropland, ► Increasing of soil carbon with preservation of SOM in the top soil layer,
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► Contour cultivation tested in practice of two experimental sites, ► Contour cultivation promoted among farmers within several national and international Projects
		Steps envisaged	► Incorporation of contour cultivation as a agro-ecological measure into strategic documents, ► Promotion of contour cultivation among farmers, ► Institutional support to primary producers with subsiding the process of adoption of the system of contour cultivation, ► System for monitoring of influence of land use change on soil carbon sink.
	Results achieved and estimated outcomes		Implementing of contour cultivation on 14,000 ha of cropland on inclined terrains up to 2035.
	Estimated emission reductions		► 19.1 Gg CO_2-eq in 2025 ► 28 Gg CO_2-eq in 2030 ► 37 Gg CO_2-eq in 2035
	Timeframe		2017 – 2035
	Costs (in 2030)*		Costs for the Reference scenario: ► 0 M€ Costs for the Scenario with implemented measure: ► 0.05 M€ Specific costs: ► 1.9 €/t CO_2-eq
	Implementing entity		Ministry of Agriculture, Forestry and Water Economy
Progress indicators:			► Area in ha with contour cultivation, ► Percentage of soil organic matter increase and carbon sink per ha ► Quantity of reduced soil sediment loss in t/ha

*Costs refer only to the investments

Table 48. Perennial grass in orchard and vineyards on inclined terrains (>5%)

Mitigation action: ***Perennial grass in orchard and vineyards on inclined terrains (>5%)***
Main objective: ***Reducing of soil erosion and increasing of SOM in vineyards and orchards on inclined terrains (5-15% slope)***
Description: ***In vineyards and orchard on locations where rows are oriented downslope, as a result of intensive classical system of cultivation, a intensive processes of soil erosion and depletion of SOM occurs, which lead to intensive emissions of soil carbon. Simple change of cultivation system with establishment of perennial grass, can significantly mitigate the process of SOm loss and emissions of soil carbon. The measure is easy to be implemented with low initial cost.***

Information	**Type**		Land management and land use change in the category of cropland
	Sector		AFOLU – Land
	Relevant planning documents, legal and regulatory acts		► Law on Agricultural Land ► Strategy for Agriculture and Rural Development ► Strategy for Consolidation of the Agricultural Land in the Republic of Macedonia ► National Action Plan for Combating Desertification in the Republic of Macedonia (draft version)
	Gases		CO_2
	Methodology		Establishing of perennial grass between rows in vineyards and orchards for replacement of classical type of land cultivation system, on a inclined terrains (5-15%). IPCC Methodology.
	Assumptions		Main assumptions of implementing the measure of establishing perennial grass in vineyards and orchards on inclined terrains are: ► Decreasing of soil erosion processes of the top soil layer and SOM loss when classical type of cultivation system with deep plowing is replaced with perennial grass and no-tillage system, ► Increasing of soil carbon with accumulation of SOM in the top soil layer due to mulching of moved biomass and accumulation of biomaterial in the root zone of the perennial grass.
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► Perennial grass in vineyards and orchards as a cover crop tested in practice in two regions, ► Perennial grass in vineyards and orchards as a agro-ecological measure promoted among farmers within several national and international Projects
		Steps envisaged	► To foresee cover crops in perennial plantations (vineyards and orchards) as a agro-ecological measure into strategic documents, ► To promote the effects of cover crops among vine and fruit growers, ► Institutional support to primary producers with subsiding the process of implementing the measure ► System for monitoring of influence of land use change on soil carbon sink,
	Results achieved and estimated outcomes		Implementing of grass land as cover crop on 10,630 ha of vineyards and 1,250 ha of orchards up to 2035
	Estimated emission reductions		► 4.5 Gg CO_2-eq in 2025 ► 8.5 Gg CO_2-eq in 2030 ► 12.2 Gg CO_2-eq in 2035
	Timeframe		2017 – 2035
	Costs (in 2030)*		Costs for the Reference scenario: ► 0 M€ Costs for the Scenario with implemented measure: ► 0.05 M€ Specific costs: ► 6.2 €/t CO_2-eq
	Implementing entity		Ministry of Agriculture, Forestry and Water Economy
Progress indicators:			► Area in ha of vineyards and orchards under perennial grass, ► Percentage of soil organic matter increase and carbon sink per ha ► Quantity of reduced soil sediment loss in t/ha

*Costs refer only to the investments

4.3 Waste

In the Waste sector three measures are modelled and analyzed. The most relevant information for these measures/policies is given from Table 49 to Table 51.

Table 49. Closure of the existing landfills

Mitigation action: ***Closure of the existing landfills*** *Main objective:* ***Environmental protection and meeting the highest European standards*** *Description:* ***Rehabilitation of the existing landfills and illegal ("wild") dumpsites with very high, high and medium risk in each of the five waste management regions. This rehabilitation includes covering on the existing non-compliant landfills, supplemented by gas extraction and flaring.***			
Information	**Type**		Technical
	Sector		Waste – Solid waste disposal
	Relevant planning documents, legal and regulatory acts		► National Waste Management Plan ► Strategy for Waste Management in the Republic of Macedonia ► Regional Waste Management Plans (Northeast, Southeast, Pelagonia, Polog and Skopje region) – final and draft versions
	Gases		CO_2, CH_4
	Methodology		Covering on the existing non-compliant landfills, supplemented by gas extraction and flaring, which will convert the CH_4 emissions into CO_2 emissions. Modelling using the custom-made software tool in excel, performing calculations based on the IPCC Methodology.
	Assumptions		Closing of the landfills by waste management regions in the following order: ► Skopje – 2020 ► East and Northeast – 2020 ► Polog – 2022 ► Southeast – 2024 ► Pelagonia and Southeast – 2024
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► Regional waste management plans developed ► EU funds provided for construction of a regional landfill for the East and Northeast planning region provided, construction of six transfer stations and closing of all non-compliant landfills.
		Steps envisaged	► Obtaining funds for the other regions ► Starting the construction of the new regional landfill for the East and Northeast planning region
	Results achieved and estimated outcomes		Expected annual burned emissions of CH_4: ► 17.2 kt CH_4 in 2025 ► 15.1 kt CH_4 in 2025 ► 13 kt CH_4 in 2025
	Estimated emission reductions		► 316 Gg CO_2-eq in 2025 ► 275 Gg CO_2-eq in 2030 ► 237 Gg CO_2-eq in 2035
	Timeframe		2017 – 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 0 M€ Costs for the Scenario with implemented measure: ► 0.60 M€ Specific costs: ► 2 €/t CO_2-eq
	Implementing entity		► Ministry of Environment and Physical Planning

	▶ Public municipal enterprises for waste management ▶ State Environmental Inspectorate ▶ Inter-Municipal Waste Management Board ▶ Authorized Inspectors of Environment (Municipalities)
Progress indicators:	▶ Burned emissions of CH_4 (kt) ▶ Emissions reduction (Gg CO_2-eq)

Table 50. Mechanical and biological treatment (MBT) in new landfills with composting

Mitigation action: ***Mechanical and biological treatment (MBT) in new landfills with composting*** *Main objective:* ***Environmental protection and meeting the highest European standards*** *Description:* ***Opening of new regional landfills in all waste management regions with installed system for mechanical and biological treatment and composting.***			
Information	**Type**		Technical
	Sector		Waste – Solid waste disposal
	Relevant planning documents, legal and regulatory acts		► National Waste Management Plan ► Strategy for Waste Management in the Republic of Macedonia ► Regional Waste Management Plans (Northeast, Southeast, Pelagonia, Polog and Skopje region) – final and draft versions
	Gases		CO_2, CH_4
	Methodology		Opening of new regional landfills in all planning regions with installed system for mechanical and biological treatment and composting. Modelling using the custom-made software tool in excel, performing calculations based on the IPCC Methodology.
	Assumptions		Opening of the regional landfills in the following order: ► Skopje – 2020 ► East and Northeast – 2020 ► Polog – 2022 ► Southeast – 2024 ► Pelagonia and Southeast – 2024
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► Regional waste management plans developed ► EU funds provided for construction of a regional landfill for the East and Northeast planning region provided, construction of six transfer stations and closing of all non-compliant landfills.
		Steps envisaged	► Obtaining funds for the other regions ► Starting the construction of the new regional landfill for the East and Northeast planning region
	Results achieved and estimated outcomes		Amount of compost: ► 80 kt in 2025 ► 82 kt in 2030 ► 83,5 kt in 2035
	Estimated emission reductions		► 5 Gg CO_2-eq in 2025 ► 52 Gg CO_2-eq in 2030 ► 89 Gg CO_2-eq in 2035
	Timeframe		2017 – 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 0 M€ Costs for the Scenario with implemented measure: ► 2.8 M€* Specific costs: ► 54 €/t CO_2-eq
	Implementing entity		► Ministry of Environment and Physical Planning ► Public municipal enterprises for waste management ► State Environmental Inspectorate ► Inter-Municipal Waste Management Board ► Authorized Inspectors of Environment (Municipalities)
Progress indicators:			► Amount of compost (kt) ► Emissions reduction (Gg CO_2-eq)

*The costs include the profit from the sale of compost

Table 51. Selection of waste - paper

Mitigation action: ***Selection of waste - paper*** *Main objective:* ***Environmental protection and meeting the highest European standards*** *Description:* ***Installation of containers for collection of selected waste, mainly paper***			
Information	**Type**		Technical
	Sector		Waste – Solid waste disposal
	Relevant planning documents, legal and regulatory acts		► National Waste Management Plan ► Strategy for Waste Management in the Republic of Macedonia ► Regional Waste Management Plans (Northeast, Southeast, Pelagonia, Polog and Skopje region) – final and draft versions
	Gases		CO_2, CH_4
	Methodology		Installation of containers for collection of selected waste. Modelling using the custom-made software tool in excel, performing caluculations based on the IPCC Methodology.
	Assumptions		Gradual reduction of the paper share in the total amount of waste from 22% to 12% by 2035.
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► Regional waste management plans developed ► Containers for waste selection installed in several cities in Macedonia, mostly in Skopje. ► Private companies – digitalization of information (bills) realized
		Steps envisaged	► Installation of containers for waste selection in all cities in Macedonia. ► Promoting the reduction of paper consumption and dematerialization of the information using ICT (Information and Communication Technologies)
	Results achieved and estimated outcomes		Expected annual amount of paper waste: ► 110 kt in 2025 ► 93 kt in 2030 ► 76 kt in 2035
	Estimated emission reductions		► 5 Gg CO_2-eq in 2025 ► 19 Gg CO_2-eq in 2030 ► 38 Gg CO_2-eq in 2035
	Timeframe		2017 – 2035
	Costs (in 2030)		Costs for the Reference scenario: ► 0 M€ Costs for the Scenario with implemented measure: ► 0.14 M€ Specific costs: ► 7 €/t CO_2-eq
	Implementing entity		► Ministry of Environment and Physical Planning ► Public municipal enterprises for waste management ► State Environmental Inspectorate ► Inter-Municipal Waste Management Board ► Authorized Inspectors of Environment (Municipalities)
Progress indicators:			► Amount of paper waste (kt) ► Emissions reduction (Gg CO_2-eq)

Assessment of mitigation policies and measures

5 Assessment of mitigation policies and measures

5.1 Economic and environmental aspects

The economic and environmental aspects of the climate change mitigation policies and measures are analyzed through the following two parameters:

- Economic effectiveness or specific cost - shows the amount of investments required in order to reduce 1 t CO_2-eq by applying the specific policy/measure and it is expressed in €/t CO_2-eq.
- Environmental effectiveness or mitigation potential - indicates the extent to which emission reductions are achieved by applying the specific policy/measure and it is expressed in t CO_2-eq.

The combined presentation of these two parameters results in the so-called Marginal Abatement Cost Curve (MAC curve) which serves as a tool for determining priorities in the implementation of mitigation policies and measures.

The MAC curve for the considered mitigation policies and measures for 2030 is shown in Figure 33. Total emission reductions by 2030 that can be achieved by implementing all policies and measures according to the presumed dynamics are more than 10,940 Gg CO_2-eq (for comparison, the total emissions in the WOM Scenario in 2030 are 23,177 Gg CO_2-eq). Almost 80% of these reductions can be achieved with policies and measures that have negative costs or the so-called win-win measures, whose realization, besides emission reductions, also generates financial savings. These are mostly cheap measures that change consumers' behavior, and so, they should have high priority for implementation.

The specific costs of the proposed mitigation policies and measures is more clearly shown in Figure 34, where it can be noted that almost 2/3 of the measures are with negative costs. However, if simultaneously analyzing the reductions that occur by their implementation (Figure 33), significant win-win options can be distinguished, such as: Renewing of the national car fleet, Labeling of electric appliances and equipment , Improvement of the street lighting in the municipalities, inclusion of more heat pumps, Energy management in manufacturing industries, Phasing out of incandescent lights, Public awareness campaigns and network of EE info centers, Solar thermal collectors, Introduction of efficient electric motors, Reduction of distribution losses, Solar rooftop power plants, etc. Some of the policies and measures that have reasonably small costs (for example, Wind power plants, Retrofitting of existing residential buildings, Introduction of biofuels or some of the measures in non-energy sectors such as Enteric fermentation in dairy cows, Change of quality of forests by afforestation of transitive forest land, Conversion of land use of field crops above 15% inclination, etc.) should also be considered for possible realization.

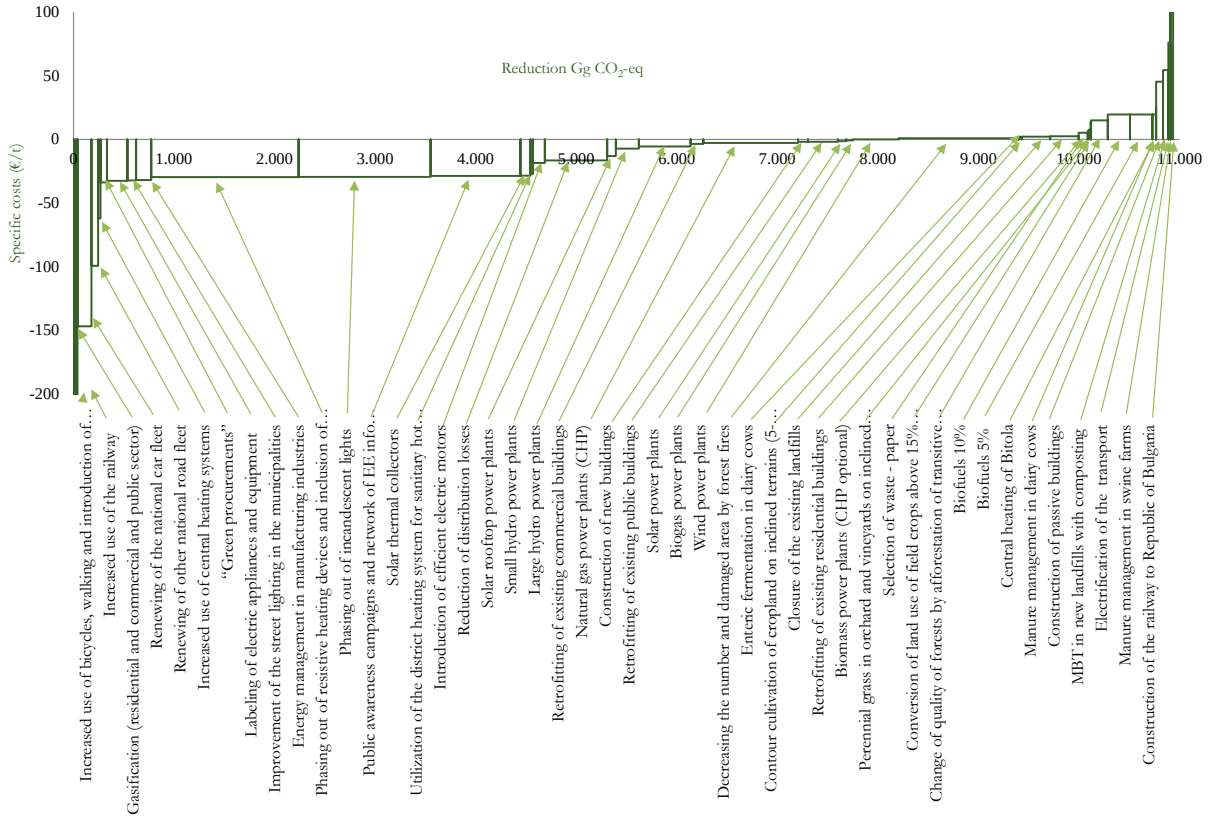


Figure 33. Marginal abatement cost curve for 2030

From the aspect of the calculated mitigation potential (Figure 35), among the top five with the highest potential, the following measures can be outlined: Inclusion of more heat pumps, Phasing out of incandescent lights, Decreasing the number and damaged area by forest fires, Natural gas power plants (CHP), Public awareness campaigns and network of EE info centers, which also have negative (or very low) specific costs.

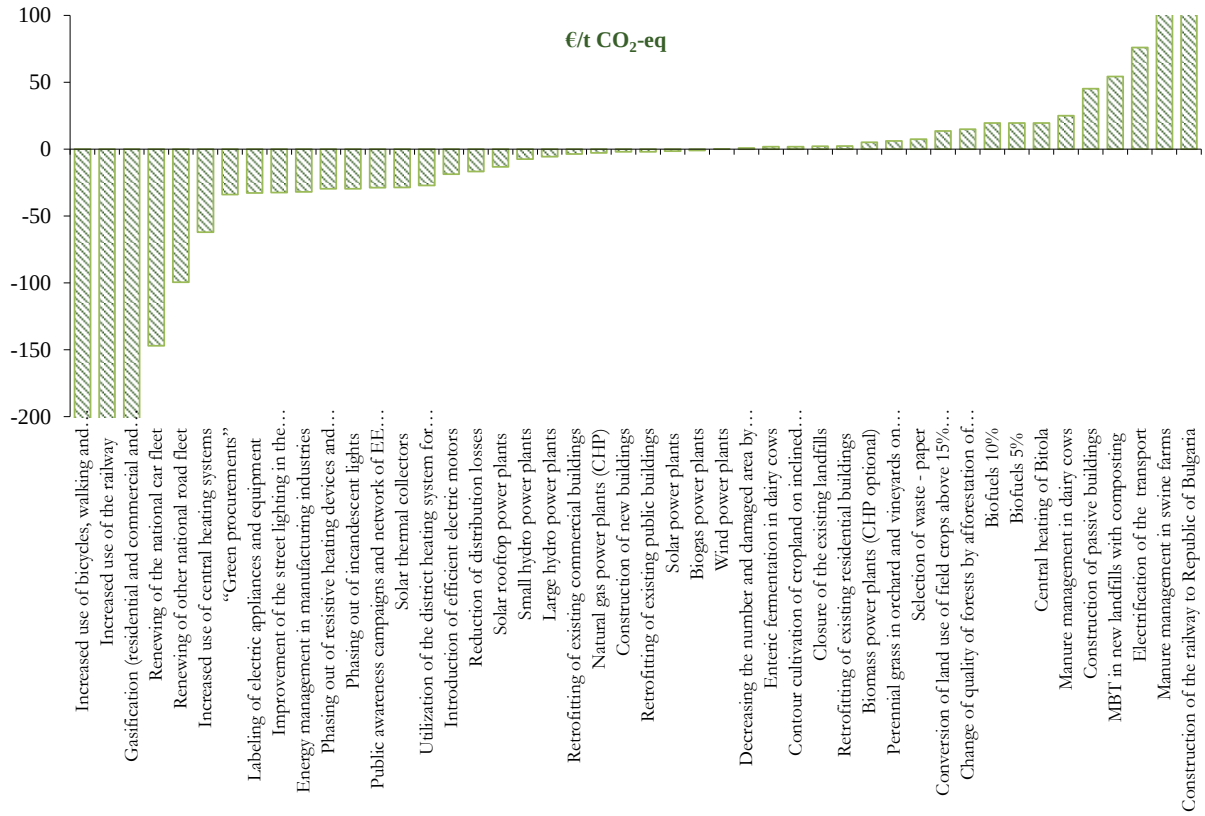


Figure 34. Specific costs for 2030 (in EUR/tCO₂-eq)

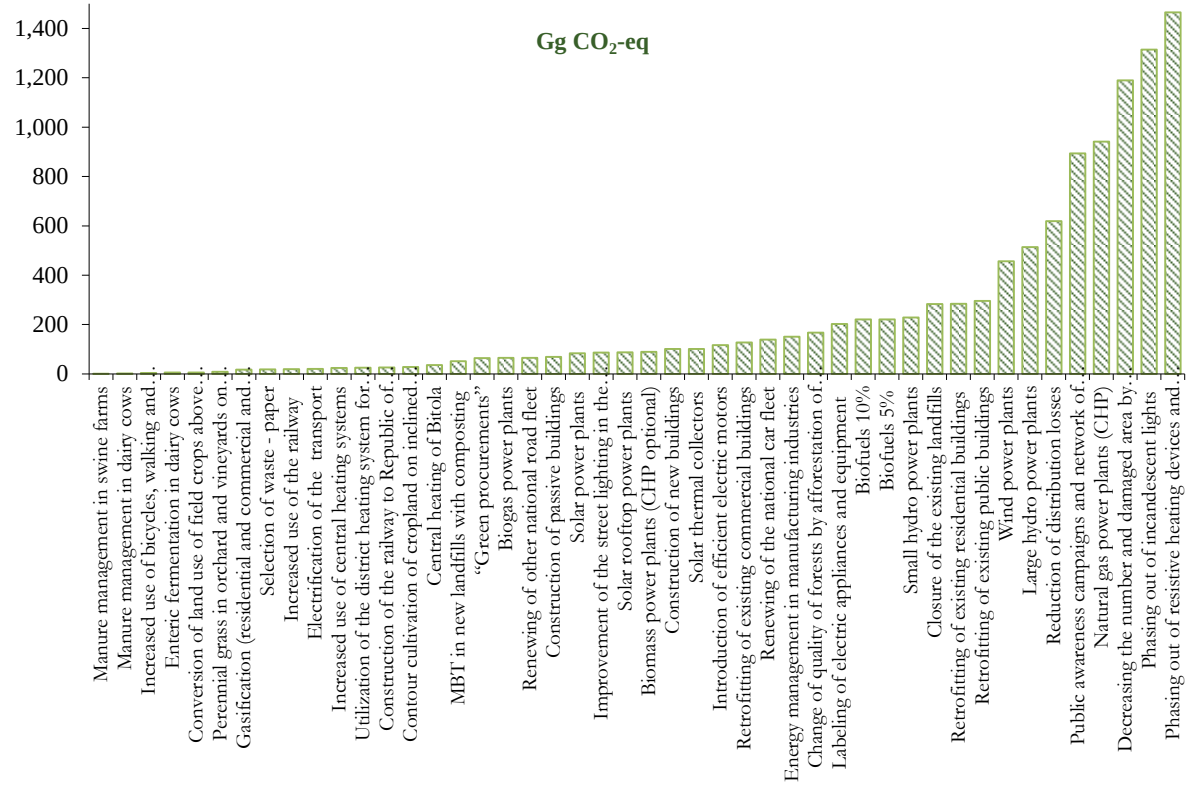


Figure 35. Reduction of CO_2-eq emissions in 2030 (in Gg)

5.2 Social aspects

In order to be able to analyze the overall contribution of the proposed policies and measures towards sustainable development, it is necessary, in addition to the economic and environmental aspects, to address the social aspects. In this study, this was done through an analysis of job creation potential using the same methodological approach (a model for domestic green jobs) developed and implemented for the needs of the Intended Nationally Determined Contributions.

The investments for implementation of the policies and measures, either in energy efficiency or low-carbon energy supply, will mean developing a projects that will positively affect engineering jobs, entrepreneurship, jobs in the financial sector (mainly high-quality jobs - "white-collar jobs "), and then once this phase is completed, the procurement and installation of equipment will be made by installers and engineers ("mixed white and blue-collar jobs"). During the operational phase, jobs will be created related to operation and maintenance, and for some measures jobs will be created related to fuel-handling (production, transport, etc.). There also might be jobs related to billing accounts, as well as other types.

The energy efficiency measures in the building sector have the highest potential for creating jobs, especially home jobs. The most important measures in this group are related to the retrofit of buildings (bringing buildings up to existing standards or to a passive house standard introduced by adopting an improved building directive), which will increase the number of jobs in the construction sector and in the building materials industries (cement, bricks and tiles, insulations, paints, etc.). It is of the utmost importance that the renovation of the buildings is maintained relatively constant, because the renovation of many buildings in one year and very few buildings next year will not bring benefits to the local economy. This is due to the fact that the sectors need time to develop, so large-scale activities in one year would require companies and labor from outside the country to meet the market. In addition, in the years with the low activity, this sector will have to disappear. Accordingly, policies and measures must be designed in a way that ensures sustained or slowly growing investments. Overall, in Macedonia, the construction of new buildings according to a new standard for energy efficiency and the upgrading of old buildings can open over 4,000 new jobs by 2035.

The measure for lighting improvement refers to buildings, but also to public lighting. The transition to LED lighting, which has a much higher added value, will create jobs because new sales channels and innovative installations will be formed. It is estimated that a $ 1 million investment in this sector will create 5.1 direct jobs and 4.2 indirect jobs. Indirect jobs are in industries that supply the specific industry with goods and services. For example, based on the procurement of products from the construction industry, it is possible to estimate the number of direct jobs in the construction industry as a result of those procurements, as well as indirect jobs created in the timber industry, hardware, trucking and more. These jobs will induce an additional 3.7 jobs in other sectors (employees in the direct and indirect industries will spend their earnings in retail, health, food, etc.). By applying this measure, a total of 720 new jobs might be created by 2035.

The measure Inclusion of more heat pumps also has the potential to create jobs in terms of sales, installation and maintenance. It is estimated that, up to 2035 this measure might open up to 120 new jobs.

Jobs related to "more efficient transport" are difficult to evaluate. These jobs will mainly be created in the production of vehicles, which is unlikely to be in Macedonia. On the other hand, if the electrification of the personal vehicles starts, workplaces connected with chargers and smart chargers will be created, which will be installed in the homes, business premises and public parking lots. But some jobs will be lost, such as the services at the gas stations. Workplaces related to the transition to public transport, use of bicycles and hiking and railways are difficult to assess. They should be linked to new investments in alternative modes of transport, as well as the maintenance of the appropriate technologies.

Investments in energy efficiency in industries are also difficult to assess because they are very specific to each industry and each process.

Policies and measures in energy supply include increasing the efficiency of existing power plants, switching to low-carbon fossil fuels and to renewable energy sources for the production of electricity and heat and biofuels for transport.

Increasing the efficiency of existing power plants will create only a small number of new jobs in the reconstruction phase, but in the long run, a higher level of automation is expected, so many new jobs cannot be expected. The partial change from coal-fired electricity production to natural gas fired power plants would create 100 new jobs in 2035.

The use of more renewable energy sources for electricity generation, especially photovoltaic systems, wind, biomass, hydro systems and plants using waste gas will open about 540 jobs in 2035, mainly in the photovoltaic systems sector, which is quite intense in terms of the required workforce, especially if small systems are installed on the roof.

The use of more renewable energy sources for heat production is also a good option, such as solar thermal systems, biomass and heat pumps. The installation of solar thermal collectors can open 710 jobs in 2035.

Greater use of biofuels in transport can be a good option in case biofuels are produced locally. At the moment, it does not appear to be an economic option in Macedonian terms.

As shown in Figure 36, over 6,200 green jobs can be expected in 2035 by implementing energy efficiency measures in buildings and low-carbon energy supply (renewable sources and gas).

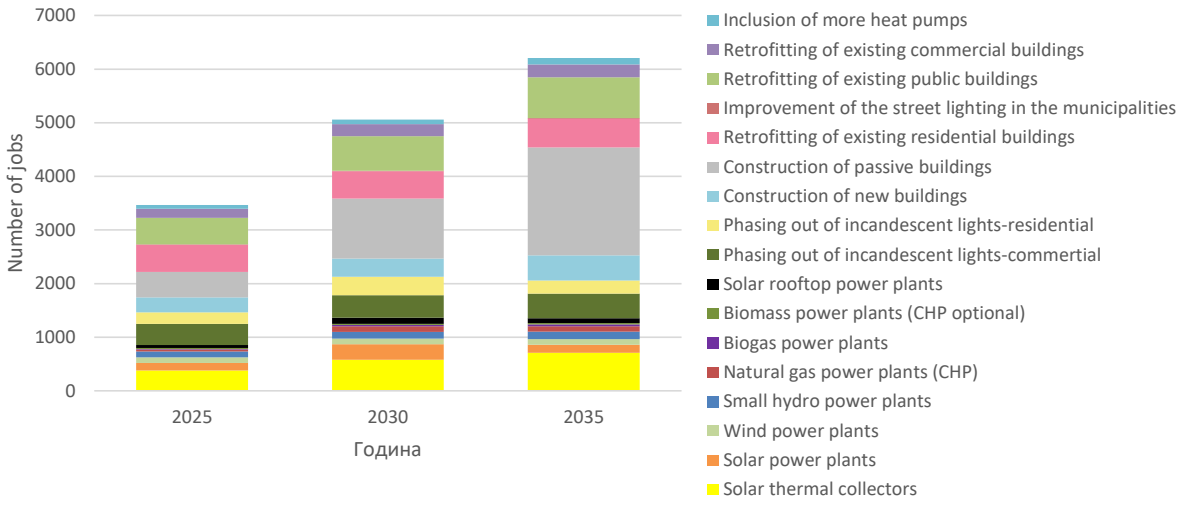
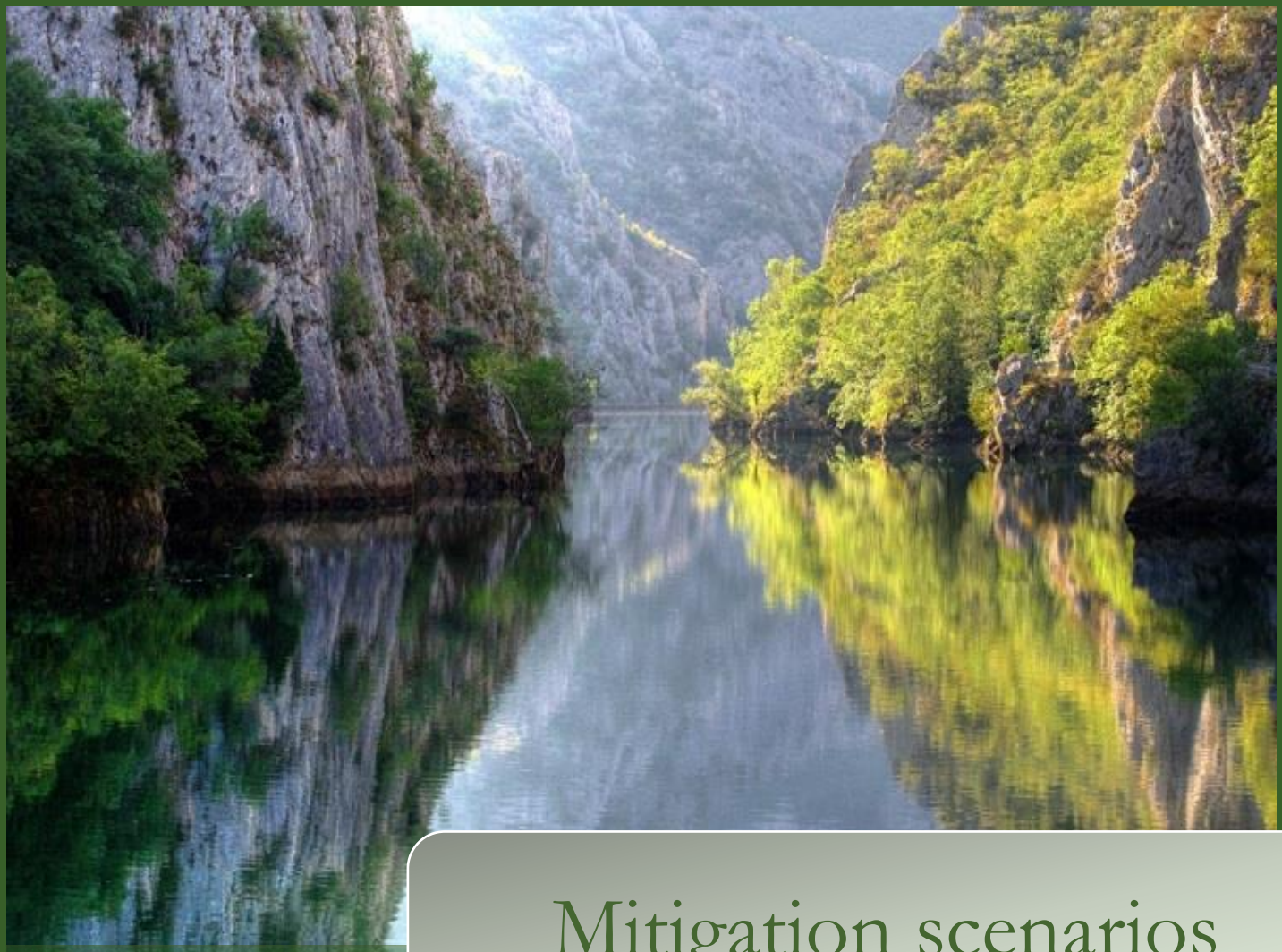


Figure 36. Number of domestic green jobs



Mitigation scenarios

6 Mitigation scenario

6.1 Mitigation scenario (With Existing Measures - WEM)

Compared to the Reference Scenario, the **Mitigation Scenario** includes **35 measures/policies** from the list of measures given in the previous chapter (Assessment of mitigation policies and measures). Measures included in this scenario are called existing measures because they are highly likely to be realized, i.e. they fall into one of the following groups:

- Already started/planned to start in the near future;
- Priority projects/policies in sectoral strategic and planning documents;
- They arise from already adopted laws or laws that will be adopted in the near future.

Therefore, this scenario is also called **"With Existing Measures" (WEM)**, and it can also be called **baseline scenario that is likely to be achieved**. Within this chapter, for each sector individually (Energy, Agriculture, Forestry and Other land use and Waste), and for each measure/policy that is part of this scenario, tabular representation including the following information is given: the competent entities for their realization, the necessary investments, the source of funding and indicative emissions reduction. The results of the mitigation scenario are first shown separately for each sector (due to the specificity of each of the sectors), and eventually the aggregate results are obtained.

6.1.1 Energy

From the Energy sector, in the Mitigation scenario, 24 measures/policies are included, and are represented in Table 52.

Table 52. Review of the measures/policies included in the Mitigation scenario of the Energy sector

#	Policy/measure	Competent entity for realization	Investments (mil. €)	Source of funding	Indicative emissions reduction (Gg CO_2-eq)		
					2025	2030	2035
1	Reduction of distribution losses	► Electricity distribution companies ► Heat distribution companies	220.4	Distribution companies			
2	Large hydro power plants	► JSC ELEM ► Ministry of Environment and Physical Planning ► Ministry of Economy, Energy Agency	1152.6	JSC ELEM, Public Private Partnership	244	514	753
3	Small hydro power plants	► Government of the RM ► Energy Regulatory Commission ► Ministry of Environment and Physical Planning ► Ministry of Economy, Energy Agency ► Private investors	176.5	Private sector	133	229	189

4	Solar power plants	► Government of the RM ► Energy Regulatory Commission ► Ministry of Economy, Energy Agency ► Private investors	86.5	Private sector	15	84	90
5	Solar rooftop power plants	► Government of the RM ► Energy Regulatory Commission ► Ministry of Economy, Energy Agency ► JSC EVN Distribucija ► Electricity end-users	78.7	Private sector	19	88	86
6	Wind power plants	► Government of the RM ► Energy Regulatory Commission ► Ministry of Economy, Energy Agency ► JSC ELEM ► Private investors	332.0	JSC ELEM, Private sector	154	456	314
7	Biogas power plants	► Government of the RM ► Energy Regulatory Commission ► Ministry of Economy, Energy Agency ► Private investors	60.0	Private sector	23	65	71
8	Biomass power plants (CHP optional)	► Government of the RM ► Energy Regulatory Commission ► Ministry of Economy, Energy Agency ► Private investors	24.9	Private sector	55	90	85
9	Central heating of Bitola	► Government of the RM ► JSC ELEM ► Ministry of Economy, Energy Agency	50.0	JSC ELEM	25	36	25
10	Solar thermal collectors	► Ministry of Economy, Energy Agency ► End-users	85.1	Private sector	15	83	90
11	Labeling of electric appliances and equipment	► Ministry of Economy, Energy Agency ► manufacturers and vendors of household appliances and equipment ► End-users	77.5	Private sector	104	202	240
12	Public awareness campaigns and network of EE info centers	► Ministry of Economy, Energy Agency ► Energy suppliers ► End-users	324.8	Budget of the RM	410	893	884
13	Retrofitting of existing residential buildings	► Ministry of Economy, Energy Agency ► Donors and financial institutions ► Households	590.2	Private sector	161	284	292
14	Retrofitting of existing public buildings	► Ministry of Economy, Energy Agency ► Ministry of Finance ► Local self-government ► Public Utilities	633.7	Central government, local self-governments, the city of Skopje	135	296	346

		► Donors and financial institutions					
15	Retrofitting of existing commercial buildings	► Ministry of Economy, Energy Agency ► Ministry of Finance ► Commercial buildings owners	212.3	Private sector	64	127	148
16	Construction of new buildings	► Ministry of Economy, Energy Agency ► Donors and financial institutions ► Investors (households)	284.9	Private sector	43	101	138
17	Improvement of the street lighting in the municipalities	► Local self-government ► Ministry of Economy, Energy Agency	14.6	Budget of the local self-governments	30	86	86
18	Energy management in manufacturing industries	► Ministry of Economy, Energy Agency ► Private companies	/	Private sector	52	150	199
19	Introduction of efficient electric motors	► Private companies ► Ministry of Economy, Energy Agency	113.6	Private sector	51	117	134
20	Biofuels 5%	► Ministry of Economy, Energy Agency ► End-users	/	Private sector	206	221	221
21	Increased use of the railway	► Government of the RM ► Ministry of Transport and Communication ► Ministry of Economy, Energy Agency ► JSC Makedonski zeleznici ► End-users ► Private companies	96.5	Budget of the RM	10	20	26
22	Renewing of the national car fleet	► Government of the RM ► Ministry of Transport and Communication ► Ministry of Economy, Energy Agency ► End-users	10,999.5	Private sector	83	139	185
23	Renewing of other national road fleet	► Government of the RM ► Ministry of Transport and Communication ► Ministry of Interior ► Ministry of Economy, Energy Agency ► Private companies	1,442.6	Private sector	27	65	122
24	Increased use of bicycles, walking and introduction of parking policy	► Ministry of Economy, Energy Agency ► Local self-government ► End-users		Private sector	3	4	5
		Total	17,056.8				

Greenhouse gas emissions reduction are indicative and indicates how much a given measure/policy will contribute to mitigating climate change independently. As a result of the interdependence between the measures/policies, the total reductions of greenhouse gas emissions cannot be calculated as a simple sum of the reductions of each measure/policy individually. Measures with the greatest potential

for reducing greenhouse gas emissions are: Public awareness campaigns and network of EE info centers and Large hydro power plants.

The main indicators, by which the Energy sector in the Mitigation scenario can be described are shown in Table 53 and they indicate that the average annual increase by 2035 is:

- 2.3% of the final energy or a total increase of 68% in 2035 (3,074 ktoe) compared to 2012 (1,830 ktoe);
- 1.6% of electricity consumption or a total increase of 45.1% in 2035 (10,159 GWh) compared to 2012 (7.004 GWh);
- 2.0% of the total installed capacity or an increase of 58.3% in 2035 (2,898 MW) compared to 2012 (1,830 MW);
- 1.8% of the gross inland consumption or a total increase of 49.2% in 2035 compared to 2012;
- 0.1% of greenhouse gas emissions or an increase of 2.4% in 2035 compared to 2012.

Table 53. Indicators for the Mitigation scenario

					Annual increase rate (%)			*Total increase (%)*		
	2012	2025	2030	2035	2012/ 2025	2012/ 2030	2012/ 2035	2012/ 2025	2012/ 2030	2012/ 2035
Final energy (ktoe)	1,830	2,417	2,725	3,074	2.2%	2.2%	2.3%	32.1%	49.0%	68.0%
Electricity consumption (GWh)	7,004	8,326	9,355	10,159	1.3%	1.6%	1.6%	18.9%	33.6%	45.1%
Electricity production (GWh)	8,301	9,653	10,814	11,710	1.2%	1.5%	1.5%	16.3%	30.3%	41.1%
Installed capacity (GW)	1,830	2,364	2,690	2,898	2.0%	2.2%	2.0%	29.2%	47.0%	58.3%
Gross inland consumption (ktoe)	2,924	3,707	4,115	4,361	1.8%	1.9%	1.8%	26.8%	40.7%	49.2%
GHG emissions (Gg CO_2-eq)	10,864	10,870	11,794	11,121	0.0%	0.5%	0.1%	0.1%	8.6%	2.4%

For realization of the mitigation scenario, in the Energy sector, **investments of 17,056.8 mil. €** for the period **2017-2035** are needed or **annually 897.7 mil. € in average**. For comparison, these investments amount to about **6.75%** of the average **annual GDP** for the same period (13,300.0 million €). If the investments from the private sector are exempted, the remaining investments amount to 2.604,2 mil. € or an average of 137.1 mil. € annually, (referring to the budget of the Republic of Macedonia, the local self-governments, the City of Skopje, JSC ELEM). It is **important** to emphasize that these investments contribute to **reducing the total system costs** (€ 37,803 million discounted in 2012) **compared to the reference scenario** costs (€ 39,415 million), which is a reduction **of 4.1%.**

6.1.2 Agriculture, Forestry and Other Land Use

In the Mitigation scenario, 8 measures/policies are included from the Agriculture, Forestry and Other land use sector, from which three are from Livestock, two from Forestry, and three form Agriculture and Other land use (Table 54).

Table 54. Review of the measures/policies included in the Mitigation scenario of the Agriculture, Forestry and Other land use sector

#	Policy/ measure	Competent entity for realization	Investments (mil. €)	Source of funding	Indicative emissions reduction (Gg CO_2-eq)		
					2025	2030	2035
1	Enteric fermentation in dairy cows	► Ministry of Agriculture, Forestry and Water Economy	0.2	Private sector	3	5.7	8.3
2	Manure management in dairy cows	► Ministry of Agriculture, Forestry and Water Economy	1	Private sector	1.4	2.1	3.9
3	Manure management in swine farms	► Ministry of Agriculture, Forestry and Water Economy	1	Private sector	0.3	0.4	0.4
4	Decreasing the number and damaged are by forest fires	► PE "Makedonski sumi" ► Ministry of environment and physical planning ► Ministry of Agriculture, Forestry and Water Economy	19	PE "Makedonski sumi", other forest enterprices	1,154.9	1,189.1	1,223.3
5	Change of quality of forests by afforestation of transitive forest land	► PE "Makedonski sumi" ► Ministry of environment and physical planning ► Ministry of Agriculture, Forestry and Water Economy	47.5	PE "Makedonski sumi", other forest enterprices	115.1	167.3	219.6
6	Conversion of land use of field crops above 15% inclination	► Ministry of Agriculture, Forestry and Water Economy	1.5	Private sector	3.2	5.8	6.2
7	Contour cultivation of cropland on inclined terrains (5-15%)	► Ministry of Agriculture, Forestry and Water Economy	1	Private sector	19.1	28.0	37.0
8	Perennial grass in orchard and vineyards on inclined terrains (>5%)	► Ministry of Agriculture, Forestry and Water Economy	1	Private sector	4.5	8.5	12.2
		Total	72.2		1,301.5	1,407.0	1,511.0

Using the proposed measures in the Agriculture, Forestry and Other land use sector in 2035, a greenhouse gas emissions reduction of 1.511Gg CO_2-eq can be achieved. The measures from the **Forestry category** contribute by far the most to the reduction of greenhouse gas emissions, i.e. they **account for 95.5% of the total emission reduction** from the Agriculture, Forestry and Other Land use sector in 2035. In order to obtain this reduction it is necessary to invest **72.2 € mil. for the period from 2017-2035** or 3.8 mil. € per year. Most of the investments are from PE "Makedonski sumi" and other forest enterprises, which participate with 92.1% in the total foreseen investments.

6.1.3 Waste

From the Waste sector, three measures/policies are included (Table 55).

Table 55. Review of the measures/policies included in the Mitigation scenario of the Waste sector

#	Policy/ measure	Competent entity for realization	Investments (mil. €)	Source of funding	Indicative emissions reduction (Gg CO_2-eq)		
					2025	2030	2035
1	Closure of the existing landfills	► Ministry of environment and physical planning ► Public utilities ► Inter-municipal board for waste management	20.5	Local self-government through Public Utilities, Public Private Partnership, Grants from the EU	316	275	237
2	Mechanical and biological treatment (MBT) in new landfills with composting	► Ministry of environment and physical planning ► Public utilities ► Inter-municipal board for waste management	70.5	Local self-government through Public Utilities, Public Private Partnership, Grants from the EU	5	52	89
3	Selection of waste - paper	► Ministry of environment and physical planning ► Public utilities ► Inter-municipal board for waste management	2	Local self-government through Public Utilities, Public Private Partnership, Grants from the EU	5	19	38
		Total	93		326	346	364

For the implementation of the Mitigation scenario in the Waste sector, investments of **93 mil. €** are needed, for the period from **2017 to 2035** or an average of 4.9 mil. € annually. A measure with the **most significant** potential for greenhouse gas emissions reduction is the **closure of the existing landfills**.

6.1.4 Total emissions

By implementing the measures/policies from the Energy, Agriculture, Forestry and Other Land Use and Waste sectors, and taking into account the emissions from the Industrial Processes and Product Use sector from the Reference Scenario, the following conclusions for the total emissions are drawn (Figure 37**Error! Reference source not found.**):

- Continuous increase in greenhouse gas emissions from 2015 to 2032,
- Increase of greenhouse gas emissions by 2.6% in 2035 compared to 2012,
- The largest emissions are recorded in 2032, amounting to 18,130 Gg CO2-eq,
- The energy sector is the sector with the largest share of 60.9% in 2035,
- During the whole period 2015-2035, the category Forestry has absorption of emissions, which makes this category sustainable.

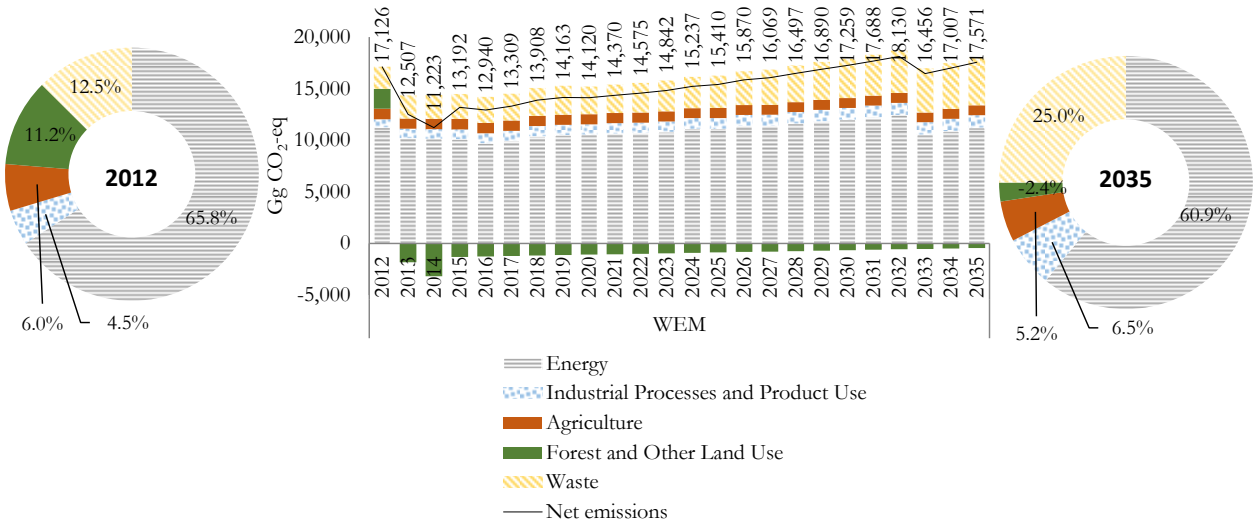


Figure 37. Total GHG emissions by sectors – WEM scenario (in Gg CO_2-eq)

6.2 Higher ambition mitigation scenario (With Additional Measures - WAM)

The higher ambition mitigation scenario includes all the Mitigation scenario measures/policies, but also includes additional measures/policies that are less likely to be realized and therefore they are referred to as the "Additional Measures". None of these measures is in progress, and each of them has a status of planned measure. Exception is only the measure Construction of a railway line to the Republic of Bulgaria for which the funds for realization have been provided.

6.2.1 Energy

In the higher ambition mitigation scenario, 11 additional measures/policies were included in the Energy sector compared to the mitigation scenario (Table 56).

Table 56. Review of the measures/policies included in the Higher ambition mitigation scenario of the Energy sector

#	Policy/ measure	Competent entity for realization	Investments (mil. €)	Source of funding	Indicative emissions reduction (Gg CO_2-eq)		
					2025	2030	2035
1	All the measures from the Mitigation scenario		17,056.8				
2	Natural gas power plants (CHP)	► Ministry of Economy, Energy Agency ► JSC ELEM ► JSC TETO ► Other private investors	1,066.7	JSC ELEM, Public private partnership		947	1247
3	Phasing out of resistive heating devices and inclusion of more heat pumps	► Ministry of Economy, Energy Agency ► Consumers	410.9	Private sector	718	1465	1350
4	Construction of passive buildings	► Ministry of Economy, Energy Agency ► Donors and financial institutions ► Investors (households)	684.5	Private sector	7	45	103
5	Phasing out of incandescent lights	► Government of the RM ► Ministry of Economy, Energy Agency ► Consumers	839.8	Private sector, budget of the RM, budget of the local self-government	677	1314	1131
6	"Green procurements"	► Ministry of Economy, Energy Agency ► Public Procurement Bureau ► Municipal Local Government	42.4	Budget of the RM, budget of the local self-government, the city of Skopje	16	64	73
7	Gasification (residential and	► Government of the RM ► Ministry of Economy, Energy Agency	49.5	Private sector	17	17	58

	commercial and public sector)	► Macedonian energy resources ► JSC GAMA ► JSC Strumica gas ► JSC Kumanovo gas ► Directorate for Technological Industrial Development Zones ► Private investors					
8	Increased use of central heating systems	► Ministry of Economy, Energy Agency ► Distribution of heat BALKAN ENERGY DOOEL ► JSC Skopje sever ► Branch Energetics Skopje ► Private investors	19.6	Private sector	10	24	18
9	Utilization of the district heating system for sanitary hot water combined with solar collectors	► Ministry of Economy, Energy Agency ► Distribution of heat BALKAN ENERGY DOOEL ► JSC Skopje sever ► Branch Energetics Skopje ► Private investors	16.0	Private sector	8	25	30
10	Biofuels 10%	► Ministry of Economy, Energy Agency ► Consumers	/	Private sector	206	221	221
11	Construction of the railway to Republic of Bulgaria	► Government of the RM ► Ministry for Transport and Communications ► Ministry of Economy, Energy Agency	667.3	Budget of the RM	17	26	30
12	Electrification of the transport	► Government of the RM ► Ministry for Transport and Communications	1,784.5	Private sector	13.3	20.4	0
		Total	22,638.0				

The main indicators by which the Higher ambition mitigation scenario is described are shown in Table 57 and they indicate that the average annual increase by 2035 is:

- 2.0% of final energy or a total increase of 57.3% in 2035 (2,879 ktoe) compared to 2012 (1,830 ktoe);
- 1.1%, of electricity consumption or a total increase of 30.1% in 2035 (9,110 GWh) compared to 2012 (7,004 GWh);
- 1.7% of total installed capacity or increase of 46.1% in 2035 (2,674 MW) compared to 2012 (1.830 MW);
- 1.0% of the total energy requirement or a total increase of 25.7% in 2035 compared to 2012;
- -1.2% of GHG emissions or decrease by 24.4% in 2035 compared to 2012.

Table 57. Indicators for the Higher ambition mitigation scenario

					Annual increase rate (%)			Total increase (%)		
	2012	2025	2030	2035	2012/ 2025	2012/ 2030	2012/ 2035	2012/ 2025	2012/ 2030	2012/ 2035
Final energy (ktoe)	1,830	2,296	2,553	2,879	1.8%	1.9%	2.0%	25.5%	39.5%	57.3%
Electricity consumption (GWh)	7,004	7,248	8,213	9,110	0.3%	0.9%	1.1%	3.5%	17.3%	30.1%
Electricity production (GWh)	8,301	8,352	9,436	10,442	0.0%	0.7%	1.0%	0.6%	13.7%	25.8%
Installed capacity (GW)	1,830	2,225	2,486	2,674	1.5%	1.7%	1.7%	21.6%	35.8%	46.1%
Gross inland consumption (ktoe)	2,924	3,388	3,837	3,675	1.1%	1.5%	1.0%	15.9%	31.2%	25.7%
GHG emissions (Gg CO_2-eq)	10,864	10,488	11,542	8,539	-0.6%	0.1%	-1.2%	-7.1%	2.2%	-24.4%

For implementation of the Higher ambition mitigation scenario, **investments of 22,638.0 mil. €** are needed for the period **2017-2035**, or an average of **1,191.5 mil. € annually**. For comparison, these investments amount to about **8.96% of the average annual GDP** for the same period (13,300.0 million €). If the investments from the private sector are exempted, the remaining investments amount to 5,220.4 mil. €, or an average of 274.8 mil. € annually, (referring to the Budget of the Republic of Macedonia, local self-governments, the City of Skopje, JSC ELEM and Public private partnership). It is of great importance to emphasize that these investments **contribute to the reduction of total system costs** (37,045 mil. € discounted in 2012) **compared to the Reference scenario** costs (€ 39,415 million), which is a reduction **of 6%**.

6.2.2 Total emissions

By implementing the measures/policies from the Energy, Agriculture, Forestry and Other Land Use and Waste sectors, and taking into account the emissions from the Industrial Processes and Product Use sector from the Reference Scenario, the following conclusions for the total emissions are drawn (Figure 38):

- Continuous increase in greenhouse gas emissions from 2015 to 2032,
- Decrease of greenhouse gas emissions by 14% in 2035 compared to 2012,
- The largest emissions are recorded in 2032, amounting to 17,510 Gg CO2-eq,
- The energy sector is the sector with the largest share of 53.8% in 2035,
- During the whole period 2015-2035, the category Forestry has absorption of emissions, which makes this category sustainable.

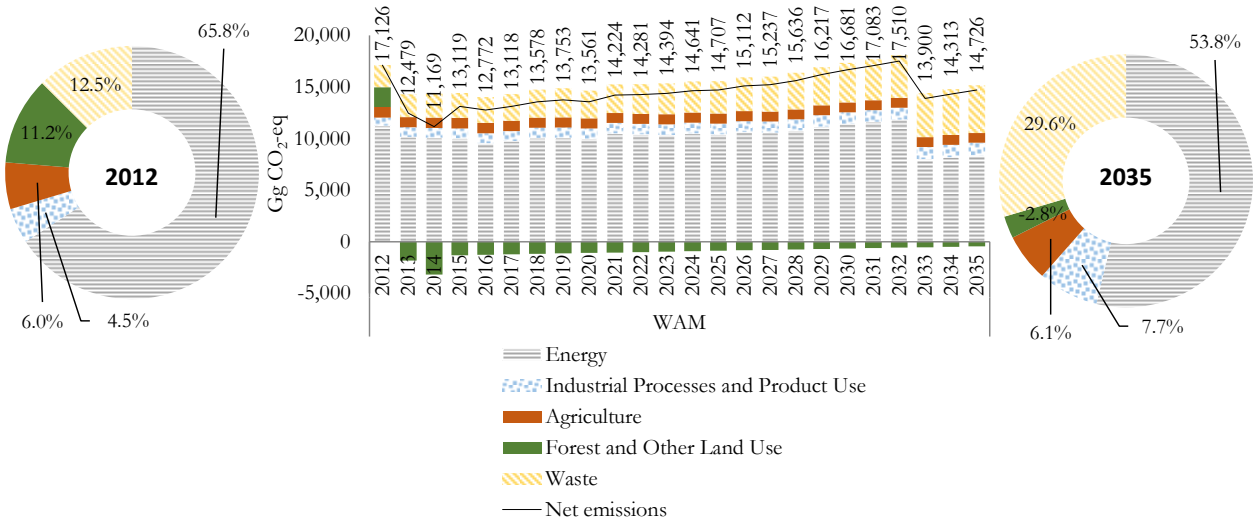


Figure 38. Total GHG emissions by sectors – WAM scenario (in Gg CO_2-eq)

6.3 Comparative analyses of the scenarios

The basic principles of sustainable development are embedded in the two scenarios for climate change mitigation, but in order to perceive the situation with the development of Macedonia in terms of sustainable development, some indicators have been calculated in this study.

The EU Sustainable Development Strategy (EU SDS) recognizes climate change as a threat, and in the part of Climate Change and Energy, through several indicators, expresses the progress of the EU in the short and long term regarding the climate change. On the other hand, the United Nations (UN) have created another set of indicators for sustainable development. Despite the similarity of these two sets of indicators, they differ and therefore in this study the development of Macedonia is perceived through both groups. For the indicators created by the European Union, a comparison was made of Macedonia with the countries of Southeast Europe and the EU28. The comparison with other countries is significant because in that way it can be checked whether the forecasts made are realistic and where would Macedonia be in 2035? These indicators are analyzed only for the Energy Sector, as a sector with the highest share in GHG emissions in Macedonia.

6.3.1 EU indicators for sustainable development - Energy

In this part, a comparison has been made with the countries of the European Union (EU28) and with the countries of Southeast Europe, using the following indicators:

- renewable energy share in the gross final energy consumption
- electricity generated from renewable energy sources
- energy dependence
- share of renewable energy in fuel consumption in transport

- greenhouse gas emissions intensity of energy consumption

Figure 39 shows the **renewable energy share in the gross final energy consumption**, an indicator that expresses how much of the energy needs are provided from wind, solar, biomass and geothermal energy. In Macedonia, this share increased from 15% in 2007 to around 20% in 2016, so Macedonia follows the EU (28) trend, where this indicator from 11% in 2007 rose to 17% in 2015. Compared to the countries in the region, in recent years, Macedonia is almost at the same level as Bulgaria. The highest share was recorded in Montenegro (43% in 2015) and Albania (33%), followed by Croatia (29%) and Romania (25%). Analyzing scenarios for further development of Macedonia, in the WOM scenario, this indicator will decrease during the considered period, as there are almost no new installed capacities from renewable energy sources, and on the other hand the gross final energy consumption is increased. In the mitigation scenarios WEM and WAM, where measures for construction of new RES capacities are foreseen, this indicator will keep the current trend of increase, and after 2025 the share of RES will be expected to range from 24% to 26% in the gross final energy consumption.

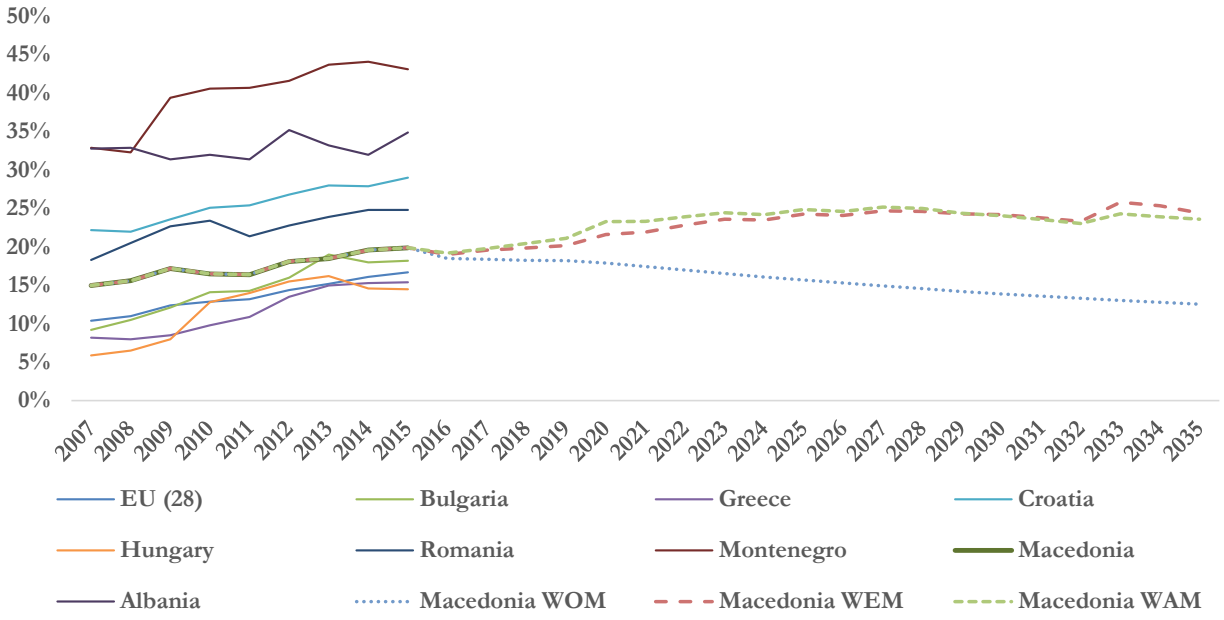


Figure 39. Renewable energy share in the gross final energy consumption (in %)

The increase in the share of RES, especially in electricity production, has been recorded in the Strategy for Sustainable Development and the Directive on the Promotion of the Use of Renewable Energy (Directive 2009/28/EC) as an EU target for reducing Greenhouse gas emissions and energy dependence.

Analyzing the **generation of electricity from RES as a share in the total (gross[5]) electricity generation** (Figure 40), it can be noticed that Macedonia increases the share from 14% in 2007 to 22% in 2015, but it is below the EU(28) average where RES in 2015 participated with 29% in the

[5] Gross production of electricity is a sum of generated electricity from domestic sources and net import (import-export) of electricity.

electricity generation. From the countries in the region, the largest share of electricity generation from RES has Albania (79%), where hydropower plants dominate, followed by Montenegro (50%), Croatia (45%) and Romania (43%). According to the WOM scenario for Macedonia, this indicator has a downward trend after 2020, primarily due to the increased production of electricity from fossil fuels and not building RES capacities. However, using the measures analyzed in the mitigation scenarios, this indicator will continue the growing trend reaching 44% in the WEM scenario and 47% in the WAM scenario (at a level like Montenegro and Croatia in 2015).

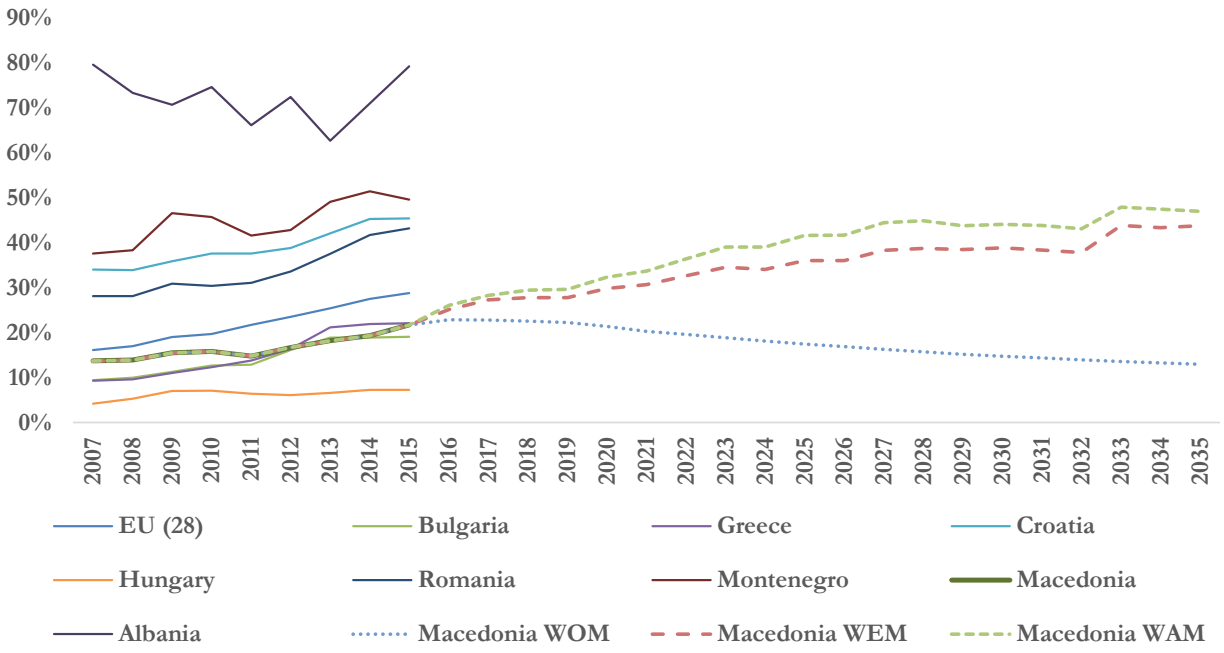


Figure 40. Electricity generated from renewable energy sources (in %)

Another indicator that should be considered is the **energy dependence**, expressed as the ratio between net imports and total energy demand. This indicator actually describes to what extent the economy of a country relies on imports to meet its own energy needs. In recent years, in Macedonia, this indicator ranges from 40% - 50%, reaching 53% in 2015, and it is at the same level as EU (28) and Croatia (Figure 41). Accordingly, it can be concluded that Macedonia is still an import dependent country compared to other countries in the region, where it can be noted a decreasing trend for this indicator. Greece has the highest value for this indicator (about 70%), while in the countries with higher utilization of RES, such as Albania and Montenegro, this indicator is below 20%. In the WOM scenario, energy dependence is expected to increase for almost 10% by 2029, and after 2032, with the closure of larger generation facilities using domestic resources and opening up new facilities that will operate on imported fuels, an increase is expected of additional 20%. In the mitigation scenarios, with the introduction of energy efficiency measures, which reduce the energy demand, as well as the increased share of RES, this indicator will vary in the current range (from 45% - 55%) by 2033, where there is a certain increase of 17 % in the WEM scenario, and 28 % in the WAM scenario, for the same reasons as in the Reference Scenario.

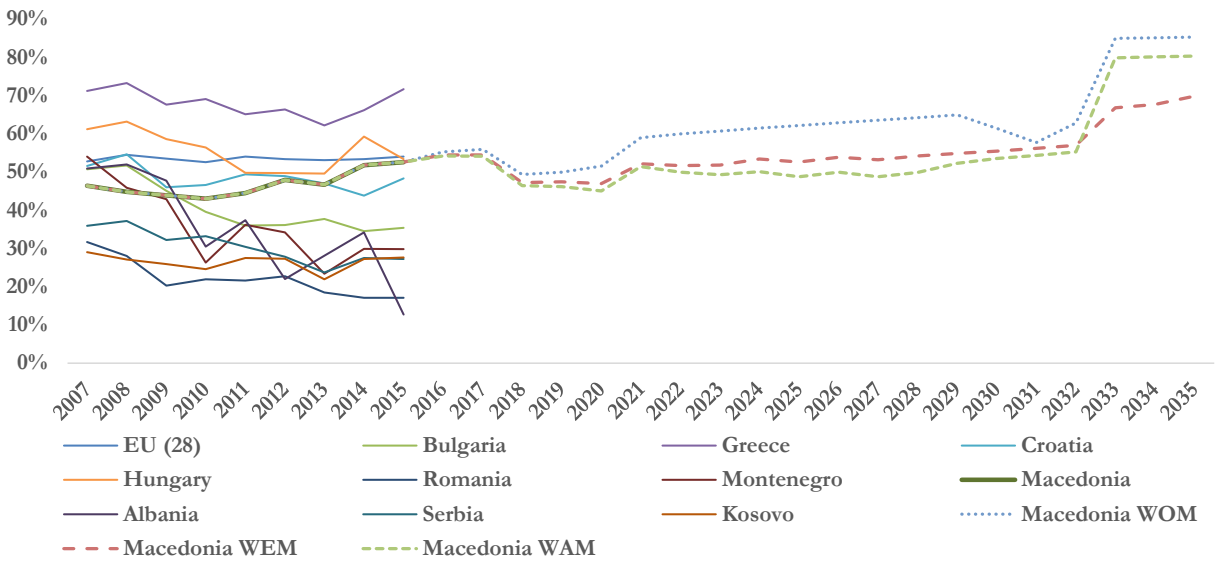


Figure 41. Energy dependence (in %)

The share of renewable energy (such as biofuels and electricity from RES) **in fuel consumption in transport is also one of the EU objectives,** in accordance with the Directive on the promotion of the use of energy from renewable sources (Directive 2009/28/EC), where it has been adopted that the share of RES in the fuel consumption in transport by 2020 should be 10%. The EU Sustainable Development Strategy also takes into account this share as one of the indicators in the field of Climate Change and Energy. This indicator notes a growing trend in the EU (28), as well as in the countries of the region, especially after 2012 (Figure 42). In Macedonia it is at a very low level, below 1%, and in the WOM scenario it is assumed that it will decrease during the considered period. According to the national strategic documents, transposition of the Directive on the promotion of the use of energy from renewable sources (Directive 2009/28/EC) in national legislation is planned. In the WEM scenario, postponement of the Directive by 2025 is assumed, i.e. 5% on biofuels in 2020 and 10% in 2025, a percentage that is retained until 2035. On the other hand, the WAM scenario assumes that the Directive will be implemented by 2020, i.e. a 10% share of biofuels in 2020, a percentage that is retained until 2035. The forecasted growth of the share for Macedonia in the period 2018-2020 is achievable and similar growth has occurred in some of the analyzed countries (such as Bulgaria and Croatia).

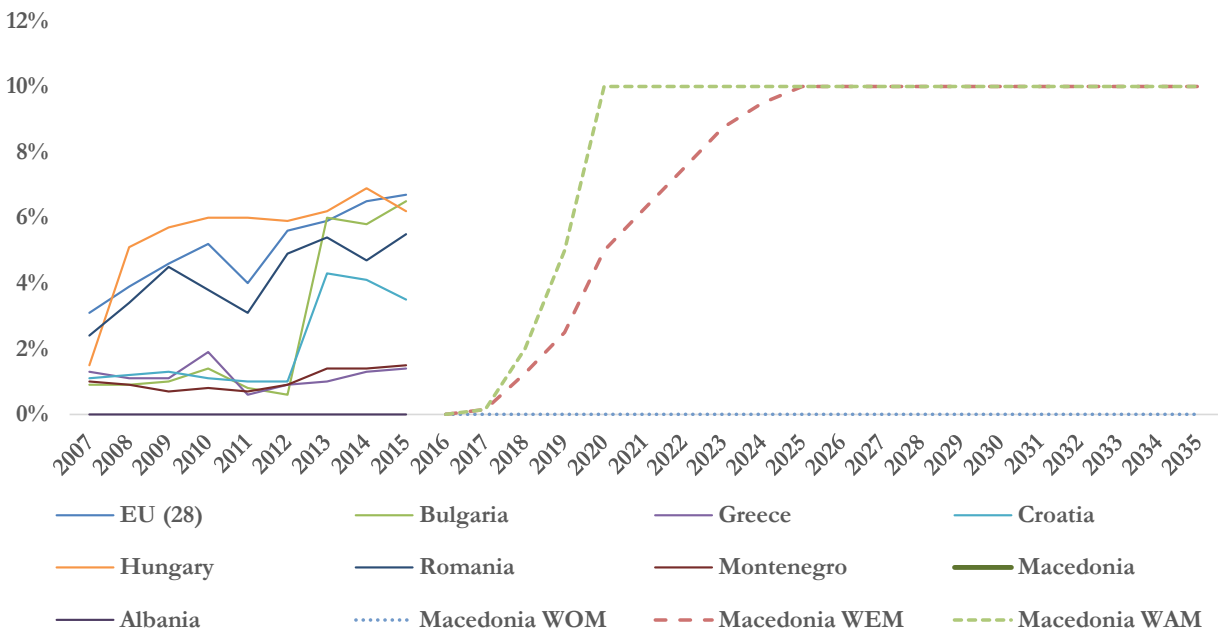


Figure 42. Share of renewable energy in fuel consumption of transport (in %)

From the aspect of climate change, an important indicator is the **greenhouse gas emissions intensity of energy consumption**, which monitors the extent to which low-carbon fuels, such as natural gas and RES, replace high-carbon fuels, such as lignite and other coal, in energy production and consumption. From the comparison with the EU countries and neighboring countries (Figure 43), it can be concluded that Macedonia's greenhouse gases emissions of energy consumption are low. Expressed as an index relative to 2000 (2000 = 100%), the value of this indicator in the past years ranges between 80% - 90%. For EU countries this indicator ranges from 90% -100%. As it can be noted in Figure 43, in 2015, Macedonia has an increase of about 20%. This is due to the fact that from 2015 to 2035 in the greenhouse gases emissions for Macedonia, emission from the import of electricity are also included, for the reasons explained in the chapter "Reference scenario" section "Emission factor of imported electricity". Although there is an increase in energy demand that is largely met by fossil fuels in the WOM scenario, this indicator is expected to decrease and in 2035 it will be 75%, which is 25% lower than the emissions in 2000. In the mitigation scenarios, as a result of energy efficiency measures, the increase in energy consumption is expected to be slighter than in the WOM scenario, and at the same time, with the replacement of lignite with natural gas and the greater utilization of RES, this indicator is expected to reach 65% in the WAM scenario, which means 35% less emissions compared to 2000.

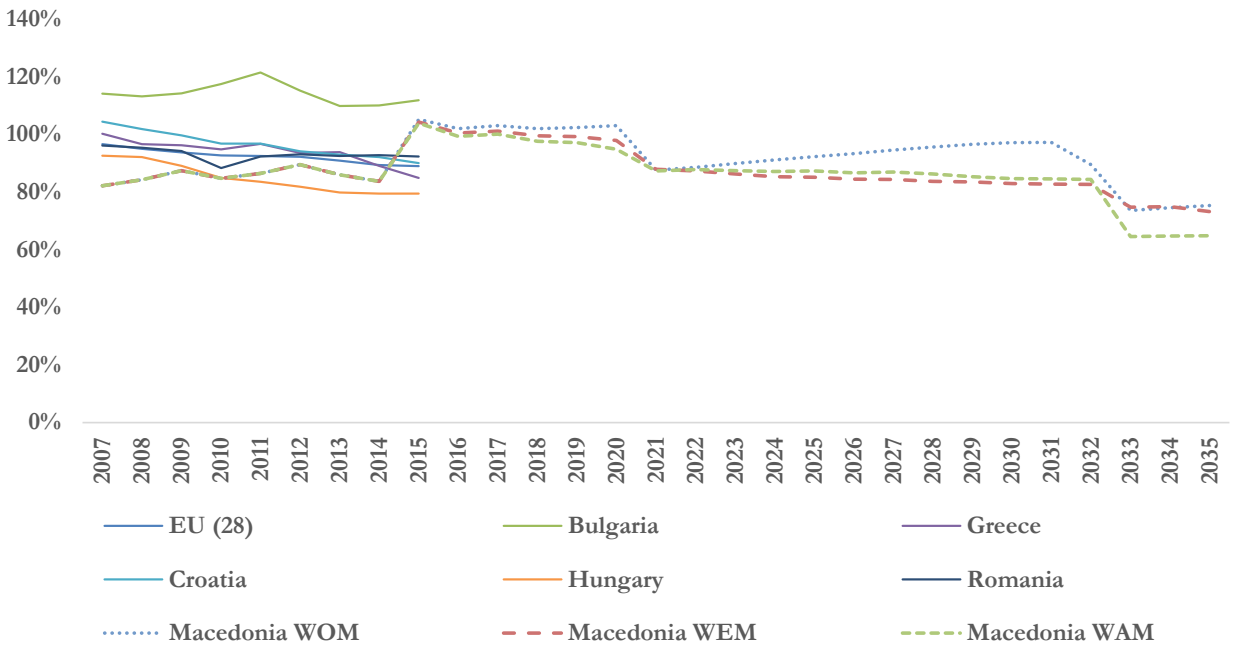


Figure 43. Greenhouse gas emissions intensity of energy consumption, 2000=100 (in %)

When comparing GHG emissions (including emissions from electricity import) for all scenarios, expressed by index in relation to 2000 (Figure 44), in the Reference scenario (WOM), an increase of the emissions is expected of 50% by 2035, primarily due to the use of fossil fuels for energy needs. In the mitigation scenarios the emissions will be at approximately the same level as previously, i.e. within the limits of 87% - 110%. In the Higher ambition scenario the emissions are slightly lower, between 85% - 107%, by 2032, and from 2033 there is a decrease reaching 72%, due to the closure of TPP Bitola and the opening of natural gas fired TPP and CHP, instead of coal fired TPP as is the WOM scenario.

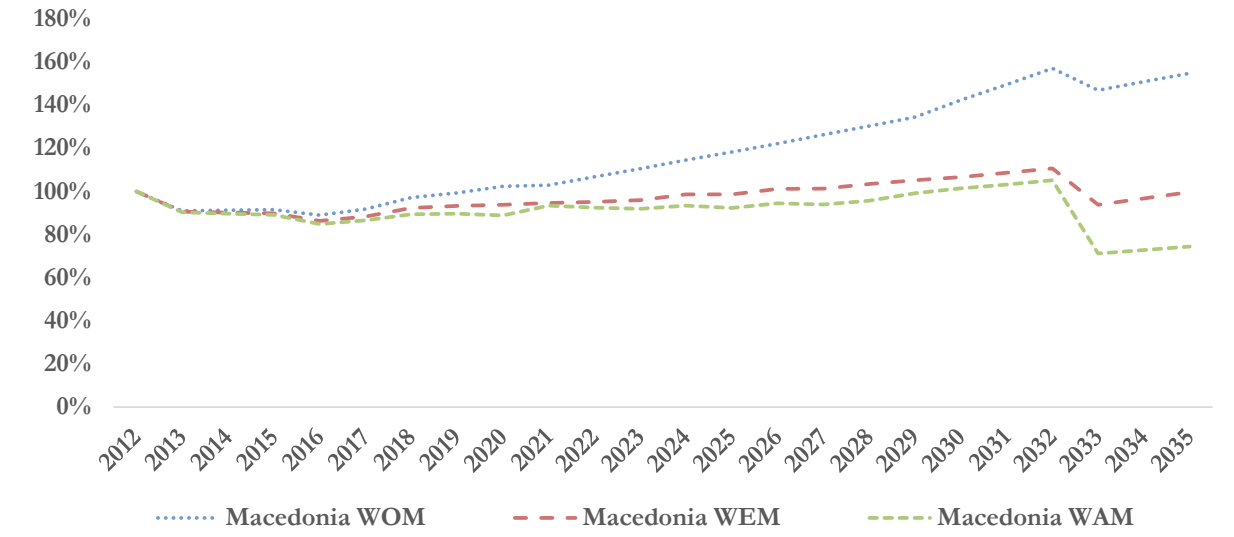


Figure 44. Comparison of GHG emissions in the Reference, Mitigation, and Higher ambition mitigation scenarios, 2012=100 (in %)

6.3.2 UN indicators for sustainable development – Energy sector

Given that the energy sector is the largest source of greenhouse gas emissions, in Table 58 several key indicators for the three analyzed scenarios for this sector are summarized, which are defined under the Sustainable Development Goals (SDG). It can be concluded that in the scenarios for climate change mitigation, most of the final energy (about 23%) will be obtained from renewable sources, unlike the WOM scenario where their share is about 17% in 2025, 15% in 2030 and 13% in 2035. Another indicator is the energy intensity, expressed as the ratio between the total primary energy and GDP, which reflects the degree to which the economy of a country has managed to separate energy consumption from economic growth. Macedonia is a country with high energy intensity (about 0.4 kgoe/€ in 2015), nearly four times the average of the European developed countries (about 0.1 kgoe/€ in 2015). In the WOM scenario, although there is a downward trend in energy intensity, it remains high and in 2035 it is 3 times higher than the EU average in 2015. In the mitigation scenarios there is a decreasing trend of energy intensity and it approaches the EU average. Thus, in the WAM scenario, this indicator reaches a value that is 80% higher than the EU average, i.e. it is at the level of Slovenia in 2013.

Table 58. UN indicators for sustainable development (SDG)

	WOM			*WEM*			*WAM*		
	2025	2030	2035	2025	2030	2035	2025	2030	2035
Proportion of population with access to electricity	100%	100%	100%	100%	100%	100%	100%	100%	100%
Renewable energy share in the total final energy consumption	16.8%	14.8%	13.4%	23.1%	23.1%	23.3%	23.5%	22.8%	22.4 %
Energy intensity measured in terms of primary energy and GDP (kgoe/€)	0.32	0.29	0.33	0.29	0.25	0.22	0.27	0.24	0.18

Figure 45 shows historical overview of GHG emissions from 1990 (from the Energy sector) according to the national inventory, and a comparison of the emission projections according to the three considered scenarios, expressed through an index relative to 1990. As it can be seen in Figure 45, in 2015, Macedonia has an increase of about 25% compared to 2014. This is due to the fact that from 2015 to 2035 in the greenhouse gases emissions for Macedonia emission from electricity import are also included for the reasons explained in the chapter "Reference scenario" section "Emission factor of imported electricity". Additionally, if measures are not taken, according to the WOM scenario, the emissions would increase by as much as 90%. With the implementation of the proposed mitigation measures in the Mitigation scenario, the emission growth will be reduced and compared to 1990, emissions would increase by about 21%. If the measures from the Higher ambition mitigation scenario are implemented, then there is a reduction in greenhouse gas emissions by around 10% in 2035 compared to 1990 greenhouse gas emissions.

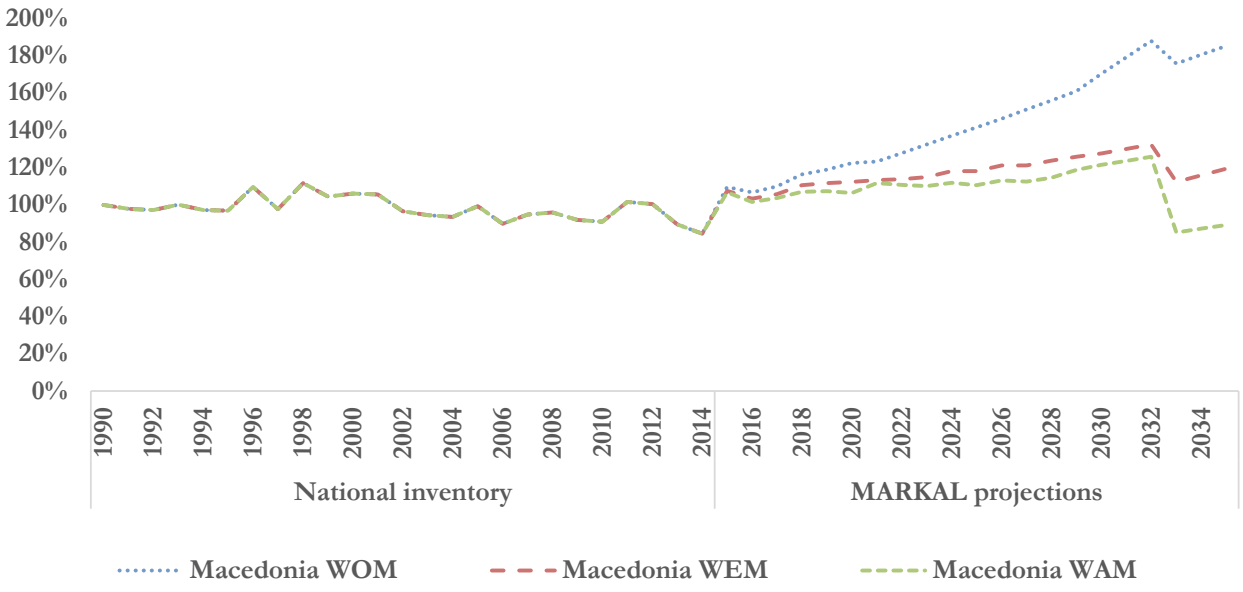


Figure 45. Comparison of the historical GHG emissions and the emission in the Reference, Mitigation and Higher ambition mitigation scenarios, 1990=100 (in %)

Analyzing the GHG emissions from the Energy sector only, in the WOM scenario, the emissions in 2030 would amount to 16,035 Gg CO_2-eq, which means an increase of 70% compared to 1990, i.e. 71% compared to 2005 (Figure 46). According to the WEM scenario, the emissions from the energy sector would be reduced by 25%. If additional measures are applied (WAM scenario) then the reduction would be 29%.

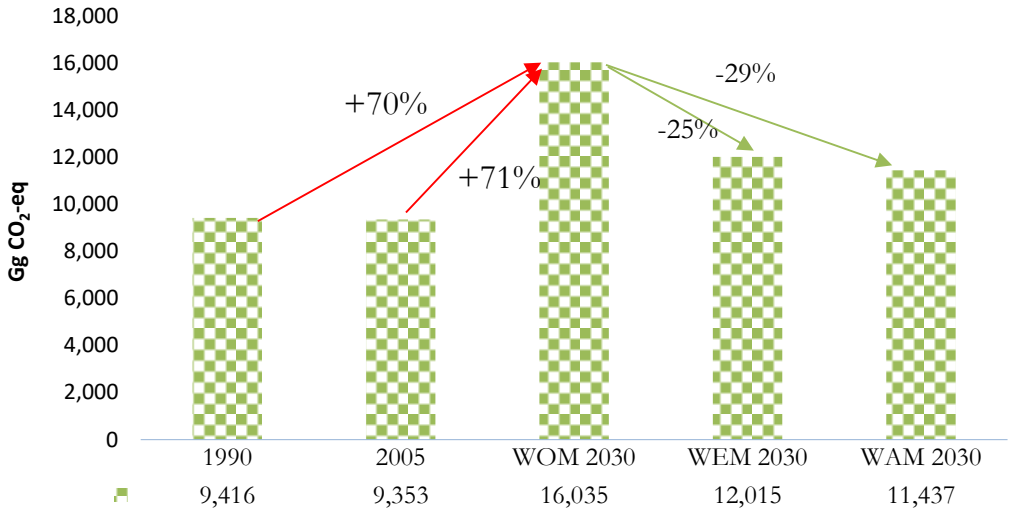


Figure 46. Comparison of GHG emissions from the Energy sector in 1990 and 2005 with the emissions in 2030 in WOM, WEM and WAM scenarios (in Gg CO_2-eq)

6.3.3 *Comparison with the goals from the Macedonian Intended Nationally Determined Contributions (INDC) and the Macedonian First Biennial Update Report (FBUR)*

The results obtained from the analyses made in this study cannot be immediately compared to the goals defined in the Macedonian Intended Nationally Determined Contributions (INDC), for several reasons:

- In addition to CO_2 emissions in this study CH_4 and N_2O emissions are also calculated, which were not included in the FBUR document nor in the INDC document
- An emission factor for electricity import was assigned in this study
- As a result of the changes made in the modeling, changes in the input data (energy prices, GDP growth, population growth, etc.) the WOM scenarios in these three documents (SBUR, INDC, FBUR) are different (Figure 47).

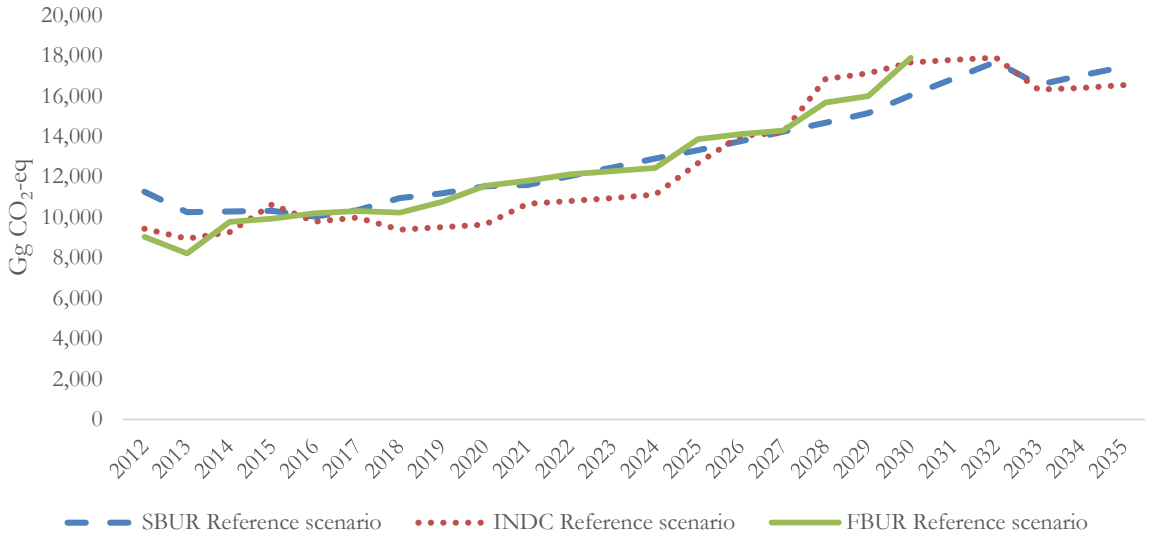


Figure 47. Comparison of the Reference Scenario from INDC and FBUR with the Reference Scenario from the Second Biennial Climate Change Report (SBUR) (in Gg CO_2-eq)

If we want to make realistic comparison with the goals of the INDC and FBUR, then it is necessary to make a selection of CO_2 emissions only, from this study and to exclude the emissions from the imported electricity. Additionally, in order to compare the reduction of the different scenarios, it is best to make a comparison with the INDC WOM scenario. The comparison results are shown in Figure 48, and it can be concluded that:

- In 2030, the WEM scenario and the WAM scenario defined in this study are more ambitious than the mitigation scenarios defined in the INDC,
- The WEM scenario reduces emissions by 34% (30% in INDC) compared to the INDC WOM scenario in 2030,
- The WAM scenario reduces emissions by 37% (36% in INDC) compared to the INDC WOM scenario in 2030.

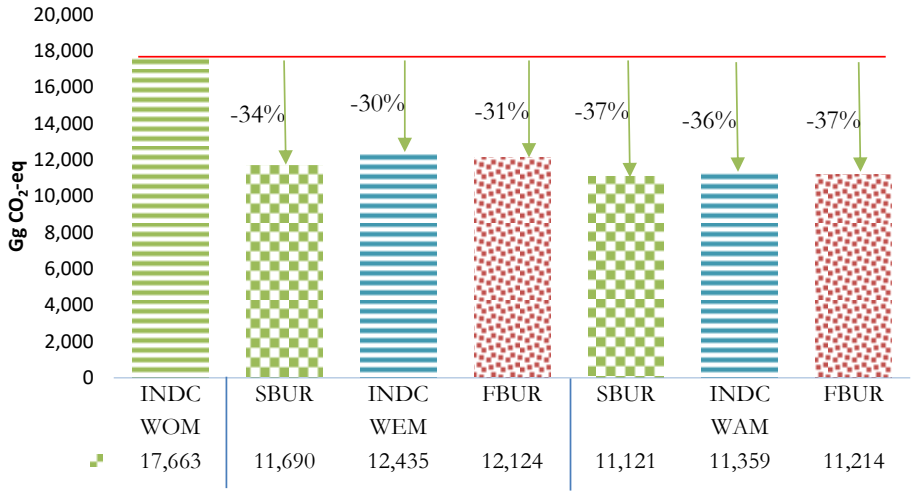


Figure 48. Comparison of the SBUR, INDC and FBUR, Mitigation and the Higher ambitious scenarios from the Energy sector with the INDC Reference scenario, 2030 (in Gg CO_2-eq)

6.3.4 Greenhouse gas emissions per capita

At the level of the European Union there is another indicator that monitors the trend of greenhouse gas emissions from almost all sectors, which is the indicator of **greenhouse gas emissions per capita** (tCO2-eq/capita). In calculating this indicator, emissions from Forestry and Other land use are excluded. In order to make a comparison of the development of Macedonia with the EU (28) and the countries of Southeast Europe, from the total emissions of each scenario, the emissions from the Forestry and Other land use sector are excluded and are divided by the forecasted population. According to this indicator, Macedonia will have an upward trend in each of the three scenarios. The value of this indicator in the WAM scenario increases by 16% in 2035. That means that every citizen of Macedonia in 2035 will create 7.5 t CO_2-eq, and in 2012 it created 6.5 t CO_2-eq. According to these forecasts, in 2035, Macedonia will be somewhere between the EU (28) (8.75 t CO_2-eq/capita) and Hungary (6.25 t CO2-eq/capita) in 2015.

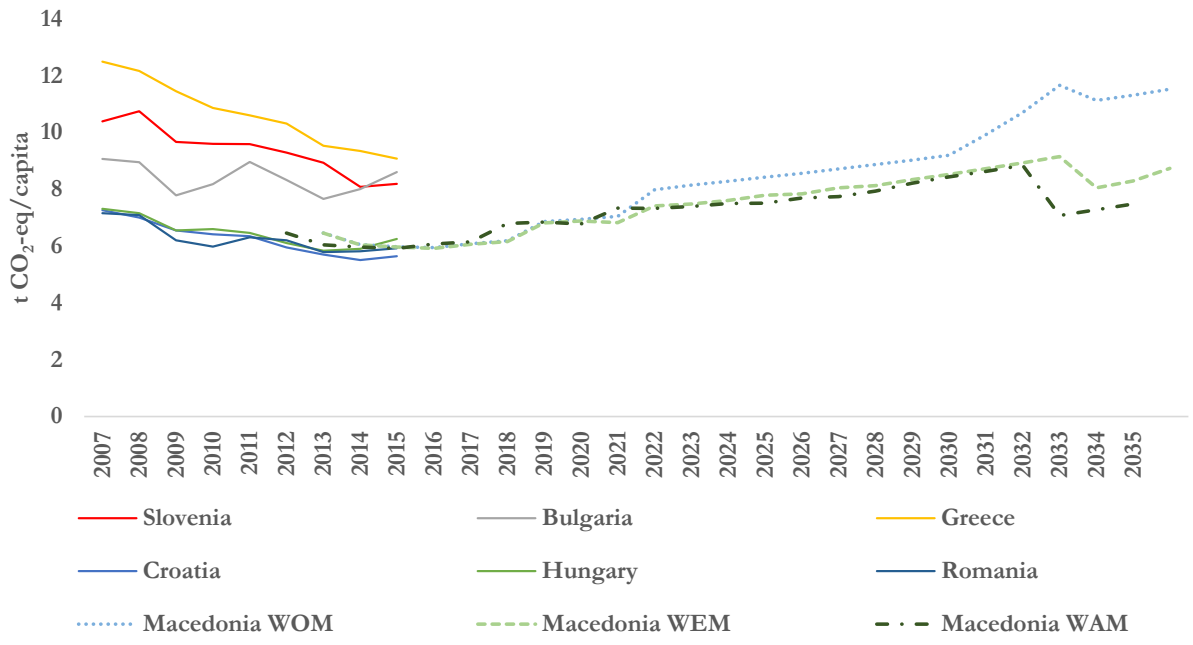


Figure 49. GHG emissions per capita (t CO_2-eq per capita)

Regarding the total greenhouse gas emissions from all sectors together (Figure 50), it is obtained that:

- The emissions in the WEM scenario in 2035 will be reduced by 25.2% compared to emissions in the WOM scenario,
- The emissions in the WAM scenario in 2035 will be reduced by 27.8% compared to the emissions in the WOM Scenario.

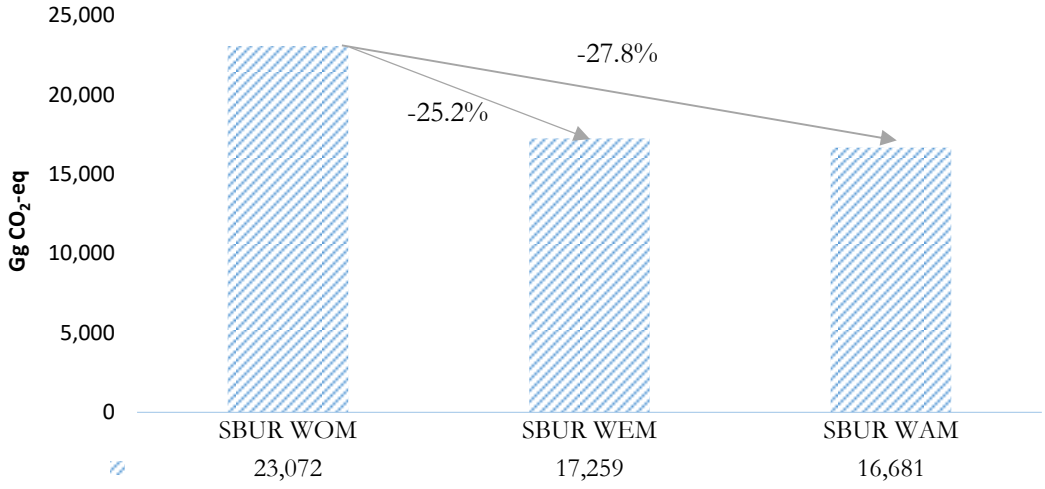


Figure 50. Comparison of total GHG emissions from all sectors in WOM, WEM and WAM scenarios, 2030 (in Gg CO_2-eq)

Action plan

7 Action plan

Table 59. Action plan for realization of the Scenario with existing measures - WEM

Policy/ measure	*Competent entity for realization*	*Type*	*Status*	*Source of funding*	*Indicative emissions reduction (2030) (Gg CO_2-eq)*	*Specific costs: (2030) (€/t CO2-eq)*	*Investments (mil. €)*			*Green jobs*		
							up to 2025	2026-2030	2031-2035	2025	2030	2035
Reduction of distribution losses	► Electricity distribution companies ► Heat distribution companies ►Ministry of Economy, Energy Agency	Technical	Ongoing	Distribution companies			107.0	36.8	76.6			
Large hydro power plants	► JSC ELEM ► Ministry of Environment and Physical Planning ► Ministry of Economy, Energy Agency	Technical	Planned	JSC ELEM, Public Private Partnership	514	-5.7	300.5	238.5	613.6			
Small hydro power plants	► Government of the RM ► Energy Regulatory Commission ► Ministry of Environment and Physical Planning ► Ministry of Economy, Energy Agency ► Private investors	Technical, Regulatory	Ongoing	Private sector	229	-7.4	108.2	44.1	24.1	138.0	142.0	146.4
Solar power plants	► Government of the RM ► Energy Regulatory Commission ► Ministry of Economy, Energy Agency ► Private investors	Technical, Regulatory	Ongoing	Private sector	84	-1.4	15.9	39.0	31.6	339.1	676.1	237.5

Solar rooftop power plants	► Government of the RM ► Energy Regulatory Commission ► Ministry of Economy, Energy Agency ► JSC EVN Distribucija ► Electricity end-users	Technical, Regulatory	Planned	Private sector	88	-13.2	18.8	37.1	22.8	257.5	392.6	139.5
Wind power plants	► Government of the RM ► Energy Regulatory Commission ► Ministry of Economy, Energy Agency ► JSC ELEM ► Private investors	Technical, Regulatory	Ongoing	JSC ELEM, Private sector	456	0	146.3	185.7	0.0	360.9	105.3	105.3
Biogas power plants	► Government of the RM ► Energy Regulatory Commission ► Ministry of Economy, Energy Agency ► Private investors	Technical, Regulatory	Ongoing	Private sector	65	-0.9	20.0	20.0	20.0	15.6	27.7	36.9
Biomass power plants (CHP optional)	► Government of the RM ► Energy Regulatory Commission ► Ministry of Economy, Energy Agency ► Private investors	Technical, Regulatory	Ongoing	Private sector	90	5	16.9	4.0	4.0	27.1	27.0	30.8
Central heating of Bitola	► Government of the RM ► JSC ELEM ► Ministry of Economy, Energy Agency	Technical	Planned	JSC ELEM	36	20	50.0	0.0	0.0			
Solar thermal collectors	► Ministry of Economy, Energy Agency ► Heat end-users	Technical	Ongoing	Private sector	83	-29	24.9	27.9	32.4	380.6	579.0	709.6
Labeling of electric appliances and equipment	► Ministry of Economy, Energy Agency ► Manufacturers and vendors of household appliances and equipment ► End-users	Regulatory	Ongoing	Private sector	202	-33	22.3	21.3	33.9			

Public awareness campaigns and network of EE info centers	► Ministry of Economy, Energy Agency ► Energy suppliers ► End-users	Information	Ongoing	Budget of the RM	893	-29	96.6	92.6	135.6			
Retrofitting of existing residential buildings	► Ministry of Economy, Energy Agency ► Donors and financial institutions ► Households	Technical, Regulatory	Ongoing	Private sector	284	2	271.1	158.1	161.0	508.3	507.9	534.3
Retrofitting of existing public buildings	► Ministry of Economy, Energy Agency ► Ministry of Finance ► Local self-government ► Public Utilities ► Donors and financial institutions	Technical, Regulatory	Ongoing	Central government, local self-government, city of Skopje	296	-2	228.5	186.4	218.8	494.8	644.8	756.0
Retrofitting of existing commercial buildings	► Ministry of Economy, Energy Agency ► Ministry of Finance ► Commercial buildings owners	Technical, Regulatory	Ongoing	Private sector	127	-4	78.7	62.7	71.0	169.3	220.1	240.6
Construction of new buildings	► Ministry of Economy, Energy Agency ► Donors and financial institutions ► Investors (households)	Technical, Regulatory	Ongoing	Private sector	101	-2	93.3	83.3	108.2	281.4	342.5	465.6
Improvement of the street lighting in the municipalities	► Local self-government ► Ministry of Economy, Energy Agency	Technical	Ongoing	Budget of the local self-governments	86	-32	4.0	4.5	6.0	9.2	12.6	16.4
Energy management in manufacturing industries	► Ministry of Economy, Energy Agency ► Private companies	Regulatory, Technical	Ongoing	Private sector	150	-32	0.0	0.0	0.0			
Introduction of efficient electric motors	► Private companies ► Ministry of Economy, Energy Agency	Technical	Ongoing	Private sector	117	-19	33.4	44.6	35.7			
Biofuels 5%	► Ministry of Economy, Energy Agency ► End-users	Regulatory	Planned	Private sector	221	20						

Increased use of the railway	► Government of the RM ► Ministry of Transport and Communication ► Ministry of Economy, Energy Agency ► JSC Makedonski zeleznici ► End-users ► Private companies	Technical, Information	Planned	Budget of the RM	20	-371	32.5	28.9	35.1
Renewing of the national car fleet	► Government of the RM ► Ministry of Transport and Communication ► Ministry of Economy, Energy Agency ► End-users	Regulatory, Policy, Information	Ongoing	Private sector	139	-147	3,776.2	6,238.3	985.1
Renewing of other national road fleet	► Government of the RM ► Ministry of Transport and Communication ► Ministry of Interior ► Ministry of Economy, Energy Agency ► Private companies	Regulatory, Policy	Ongoing	Private sector	65	-100	27.6	706.6	708.4
Increased use of bicycles, walking and introduction of parking policy	► Ministry of Economy, Energy Agency ► Local self-government ► End-users	Regulatory, Technical, Information	Ongoing	Private sector	4	-970			
Enteric fermentation in dairy cows	► Ministry of Agriculture, Forestry and Water Economy		Ongoing	Private sector	5.7	1.8	0.1	0.1	0.1
Manure management in dairy cows	► Ministry of Agriculture, Forestry and Water Economy		Ongoing	Private sector	2.1	25.1	0.5	0.3	0.3
Manure management in swine farms	► Ministry of Agriculture, Forestry and Water Economy		Ongoing	Private sector	0.4	131.6	0.5	0.3	0.3

Decreasing the number and damaged are by forest fires	► PE „Makedonski sumi“ ► Ministry of environment and physical planning ► Ministry of Agriculture, Forestry and Water Economy ► National parks ► Association of private forest owners		Ongoing	PE „ Makedonski sumi “ National parks	1,189.2	0.8	9.0	5.0	5.0	
Change of quality of forests by afforestation of transitive forest land	► PE “Makedonski sumi” ► Ministry of environment and physical planning ► Ministry of Agriculture, Forestry and Water Economy ► National parks ► Association of private forest owners		Ongoing	PE „ Makedonski sumi “ National parks	167.3	14.9	22.5	12.5	12.5	
Conversion of land use of field crops above 15% inclination	► Ministry of Agriculture, Forestry and Water Economy		Planned	Private sector	5.8	13.7	0.7	0.4	0.4	
Contour cultivation of cropland on inclined terrains (5-15%)	► Ministry of Agriculture, Forestry and Water Economy		Planned	Private sector	28.0	1.9	0.5	0.3	0.3	
Perennial grass in orchard and vineyards on inclined terrains (>5%)	► Ministry of Agriculture, Forestry and Water Economy		Planned	Private sector	8.5	6.2	0.5	0.3	0.3	
Closure of the existing landfills	► Ministry of environment and physical planning ► Public utilities	Technical	Planned	Local self-government through Public	275	2	20.5	0	0	

	► Inter-municipal board for waste management			Utilities, Public Private Partnership, Grants from the EU						
Mechanical and biological treatment (MBT) in new landfills with composting	► Ministry of environment and physical planning ► Public utilities ► Inter-municipal board for waste management	Technical	Planned	Local self-government through Public Utilities, Public Private Partnership, Grants from the EU	52	54	70.5	0	0	
Selection of waste - paper	► Ministry of environment and physical planning ► Public utilities ► Inter-municipal board for waste management	Technical	Ongoing	Local self-government through Public Utilities, Public Private Partnership, Grants from the EU	19	7	2	0	0	

8 Addressing recommendations from the technical revision of the FBUR

Table 60. Identification of the extent to which the elements of information on mitigation actions are included in the first biennial update report of the Republic of Macedonia

Decision	*Reporting requirements*	*Yes/ Partly /No*	*Comments on the extent of the information provided*	*Response to the comments*
Decision 2/CP.17, annex III, paragraph 12	For each mitigation action or groups of mitigation actions including, as appropriate, those listed in document FCCC/AWGLCA/2011/INF.1, developing country Parties shall provide the following information to the extent possible:			
(a)	Name and description of the mitigation action, including information on the nature of the action, coverage (i.e. sectors and gases), quantitative goals and progress indicators	Partly	Mitigation measures are described in section 4.3 and annex 3 to the BUR. In some instances, information is missing on quantitative goals or it is not explicitly stated. Progress indicators associated with mitigation actions are not consistently explained (e.g. they are missing for action 4.3.2, or mitigation action 11 in annex 1)	In this BUR, all the required information for each mitigation measure is provided including: name and description of the mitigation action, information on the nature of the action, coverage (i.e. sectors and gases), quantitative goals and progress indicators
(b)	Information on methodologies and assumptions: • Methodologies	Partly	The tabular presentation of mitigation actions in annex 1 contains a field to describe methodologies to complement descriptions in section 4.3. However, the methodologies describe steps envisaged, along with enabling conditions to implement actions, rather than describing the methodologies chosen to estimate reductions	Both methodology for implementation of the mitigation measure and methodology for estimation of the emission reduction are included in this BUR.

Decision	*Reporting requirements*	*Yes/ Partly /No*	*Comments on the extent of the information provided*	*Response to the comments*
	• Assumptions	Partly	Similar to methodologies above, the tabular presentation of mitigation actions in annex 1 contains a field on assumptions describing enabling conditions to implement potential actions. Economic assumptions related to modelling individual mitigation actions and associated reductions are described in section 4.3	In this BUR, the field "Assumptions" includes the assumptions related to the modelling of the individual mitigation measure.
(c)	Objectives of the action and steps taken or envisaged to achieve that action:			
	• Objectives of the action	Yes	A field within the tabular format is not provided, but objectives can be inferred from the descriptions of actions in section 4.3 and annex 1	A field "Main objective" of the measure is included within the tabular form in this BUR.
	• Steps taken or envisaged to achieve that action	Partly	A field within the tabular format provides this information in annex 1, but information is not consistently provided across the proposed or planned mitigation actions in section 4.3 and annex 1. In addition, information related to steps taken or envisaged to achieve actions is included in the descriptions of the methodologies section of annex 1 for each action	Steps taken and steps envisaged are provided in the tabular representation of each mitigation measure in this BUR.
(d)	Information on the progress of implementation of the mitigation actions and the underlying steps taken or envisaged, and the results achieved, such as estimated outcomes (metrics depending on type of			

Decision	*Reporting requirements*	*Yes/ Partly /No*	*Comments on the extent of the information provided*	*Response to the comments*
	action) and estimated emission reductions, to the extent possible:			
	• Progress of implementation of the mitigation actions	Partly	Implementation status (conceptual, planned, adopted, etc.) can be inferred through the descriptions in section 4.3 and annex 1 tabular format for most actions. However, information on progress, such as time frames for implementation, is not consistently or clearly provided for all actions (e.g. provided for actions 4.3.2 and 4.3.6, but not provided for action 4.3.12; provided generally for the WEM scenario in annex 3)	In this BUR, the implementation status is given in the Action plan (provided in Section 7), and the time frame for each mitigation measure is given in the tabular presentation of the measures.
	• Underlying steps taken or envisaged	Partly	Information is provided via descriptions in the annex 1 tabular format, in addition to this information being included within the methodology field in annex 1. In some instances, this information is also provided in descriptions within section 4.3, but information is not consistently or clearly provided for all actions (e.g. missing for some actions such as actions 4.3.11 and 4.3.12 (mitigation actions 3 and 9))	Steps taken and steps envisaged are provided in the tabular representation of each mitigation measure in this BUR.
	• Results achieved, such as estimated outcomes (metrics depending on type of action) and estimated emission reductions, to the extent possible	Yes	The projected emission reductions are provided for each mitigation action in kt CO_2 eq in section 4.3 and	For each mitigation measure, the results achieved (if the measure is in progress) and envisioned

Decision	*Reporting requirements*	*Yes/ Partly /No*	*Comments on the extent of the information provided*	*Response to the comments*
			annex 1. For mitigation actions where implementation is under way, some interim results are provided that are consistent with progress indicators identified (e.g. action 3.3 or mitigation action 13)	are presented depending on the progress indicators. Additionally, for each measure the estimated emission reduction is provided for the years 2025, 2030 and 2035.
(e)	Information on international market mechanisms	Partly	Section 2.3.1 indicates a national CDM strategy. Some mitigation actions in annex 1 include a field on international market mechanisms (e.g. mitigation actions 35, 37 and 38)	Information on finantial sources are included in the Action plan (provided in Section 7) for each mitigation measure

Abbreviations: BUR = biennial update report, CDM = clean development mechanism, CO_2 eq = carbon dioxide equivalent, WEM = 'with existing measures'

9 Recommendations

- The main recommendation is the development of an integrated tool that will encompass all sectors that will enable integrated modeling of all policies/measures;
- Develop specific scenario that will reflect the mitigation potential of the actions induced by the private sector, in order to envision a mix of public and private actions that will ease reduction of GHG emissions for up to 37% by 2035.
- Develop a MARKAL model with the possibility of calculating local emissions;
- Updating the data in the MARKAL model in accordance with the revised energy balances;
- Upgrading the Industrial Processes and Product Use sector tool, developed as part of this project, with the ability to model climate change mitigation measures;
- Visualization of the results for greater awareness of the citizens and politicians.

Appendix

Table 61. Key data sources

Data needed	Sources
Energy balance for 2012-2015	▶ Energy balances of the Republic of Macedonia (State Statistical Office, Ministry of Economy)
Fuel prices in the Republic of Macedonia	▶ Energy Regulatory Commission of the Republic of Macedonia (ERC)
Resouce potential including, import and export	▶ Strategy for energy development in the Republic of Macedonia until 2030 ▶ Draft version of the Strategy for energy development in the Republic of Macedonia until 2035 ▶ Strategy for utilization of renewable energy sources in the Republic of Macedonia until 2020 ▶ Action plan for renewable energy sources ▶ Action plan for energy efficiency ▶ Strategy for the transport sector ▶ Pre-assesmant economic program ▶ The Third National Communication on Climate Change ▶ First Biennial Update Report for Climate Change ▶ Intended Nationally Determined Contributions
Installed capacity and characteristics of the existing PPs and CHPs	▶ Annual report for 2012, 2013, 2014 from JSC ELEM (www.elem.com.mk) ▶ Report from TE-TO JSC Skopje (www.te-to.com.mk)
Load curve	▶ Load curve for 2014 - JSC MEPSO (www.mepso.com.mk)
Drivers	▶ Population growth – UN
Fuel price projections	▶ World Energy Outlook (WEO) 2014, 2015 - *IEA*
GDP growth	▶ National Bank of the Republic of Macedonia, World Bank, State Statistical Office
Industrial production growth	▶ Industrial production growth – State Statistical Office
Waste quantity	▶ Annual statistics, communal waste – State Statistical Office
Livestock, forestry	▶ Annual statistics – State Statistical Office
EU and UN indicators	▶ EUROSTAT database

Table 62. Comparison of the measures/policies of the Second Biennial Update Report on Climate Change with the measures from the Intended Nationally Determined Contributions and the First Biennial Update Report on Climate Change

	Second Biennial Update Report on Climate Change	Intended Nationally Determined Contributions	First Biennial Update Report on Climate Change
	Energy		
	Energy Industries		
1	Reduction of distribution losses	Reduction of distribution losses	Distribution losses reduction
2	Large hydro power plants	Large hydro power plants	Increased utilization of renewable energy sources
3	Small hydro power plants	Small hydro power plants	Higher number of preferential producers
4	Solar power plants	Solar power plants	Increased utilization of renewable energy sources/ Higher number of preferential producers
5	Solar rooftop power plants		
6	Wind power plants	Wind power plants	Increased utilization of renewable energy sources/ Higher number of preferential producers
7	Biogas power plants	Biogas power plants	
8	Biomass power plants (CHP optional)	Biomass combined heat and power plants	
9	Central heating of Bitola	Central heating of Bitola	
10	Natural gas power plants (CHP)	More natural gas power plants	
		Geothermal power plants	
			Electricity import (market)
			Introduction of CO_2 tax and electricity import (market)
	Residential, Non-Specified (commercial and service sector)		
11	Solar thermal collectors	Solar thermal collectors	Higher penetration of solar collectors
12	Labeling of electric appliances and equipment	. Labeling of appliances	Labeling of appliances

13	Phasing out of resistive heating devices and inclusion of more heat pumps	Phasing out resistive heating devices	Phasing out of resistive heating devices
14	Public awareness campaigns and network of EE info centers	Public awareness campaigns and EE info centers	Public awareness campaigns, EE info centers
15	Retrofitting of existing residential buildings	Retrofitting of buildings	Rulebook on energy performance of buildings
16	Retrofitting of existing public buildings		
17	Retrofitting of existing commercial buildings		
18	Construction of new buildings	Construction of new buildings	
19	Construction of passive buildings	Construction of passive buildings	
20	Phasing out of incandescent lights	Phasing out incandescent light bulbs	Phasing out of incandescent light bulbs
21	Improvement of the street lighting in the municipalities		
22	"Green procurements"		
23	Gasification (residential and commercial and public sector)	Gasification of households and of the commercial sector	
24	Increased use of central heating systems		
25	Utilization of the district heating system for sanitary hot water combined with solar collectors		
	Manufacturing Industries and Construction		
26	Energy management in manufacturing industries		
27	Introduction of efficient electric motors		
	Transport		
28	Biofuels 5%	Biofuels 5%	Biofuels – delay until 2025
29	Biofuels 10%	Biofuels 10%	10% Biofuels

30	Increased use of the railway	Increased use of the railway	Increased use of railway
31	Renewing of the national car fleet	Renewing the car fleet	Renewal of the vehicle fleet
32	Renewing of other national road fleet		
33	Increased use of bicycles, walking and introduction of parking policy	Increased use of bicycles, walking and introduction of parking policy	Increased use of bicycles, walking and introduction of parking policy
34	Construction of the railway to Republic of Bulgaria	Railway to Bulgaria	Extension of railway to Bulgaria
35	Electrification of the transport	Electrification of transport	Improving vehicle efficiency, tax exemption for hybrid and electric vehicles
	Agriculture, Forestry and Other Land Use		
36	Enteric fermentation in dairy cows		
37	Manure management in dairy cows		
38	Manure management in swine farms		
39	Decreasing the number and damaged area by forest fires		
40	Change of quality of forests by afforestation of transitive forest land		
41	Conversion of land use of field crops above 15% inclination		
42	Contour cultivation of cropland on inclined terrains (5-15%)		
43	Perennial grass in orchard and vineyards on inclined terrains (>5%)		
	Waste		

Closure of the existing landfills		
Mechanical and biological treatment (MBT) in new landfills with composting		
Selection of waste - paper		

Table 63. Marks of the proposed measures/policies and for the Reference scenario given by the steakholders that participated on the Workshop held in MASA on 13.4.2017

Mitigation measure/policy	**Average mark (from 1 to 5, where 1 means not agree with the proposed measure and 5 means totally agree with the proposed measure)**
Energy	
Energy industries	
Construction of solar power plants (including rooftop power plants)	4.65
Installation of solar thermal collectors	4.65
Reduction of distribution losses	4.62
Introduction of new ways of subsidizing production from renewable sources	4.62
Construction of wind power plants	4.54
Construction of waste power plants	4.50
Construction of biogas power plants	4.42
Construction of biomass power plants (with CHP option)	4.42
Construction of natural gas power plants (CHP)	4.15
Construction of small hydro power plants (180 MW until 2035)	4.12
Construction of system for central heating of Bitola	3.96
Construction of large hydro power plants (Boskov most, Lukovo pole, Gradec, Spilje revitalization, Veles, Globocica II, Tunnel Vardar-Kozjak, Cebren)	3.88
Introduction of carbon price	3.58
Residential, Non-Specified (commercial and service sector)	
Construction of new buildings (according to the the Rulebook on Energy Performance of Buildings and Directive 2010/31/EU)	4.61
Labeling of electric appliances and equipment	4.57
Increased use of central heating systems	4.56
Penetration of "white" devices with greater efficiency class	4.54
Improvement of the sreet lighting in the municipalities	4.54
Energy management in the commercial sector	4.46
Encouraging the replacement of windows in residential sector	4.39
Utilization of the district heating system for sanitary hot water combined with solar collectors	4.38
Retrofitting of existing residential buildings	4.32
Inclusion of more heat pumps	4.31

Retrofitting of existing public buildings	4,29
Gassification (residential and commercial sector)	4.26
Retrofitting of existing commercial buildings	4.21
„Green procurements“	4.19
Use of more efficient biomass stoves (including pellets)	4.15
Public awareness campaigns and networks of EE info centers	4.15
Utilizing waste biomass in schools	4.07
Phasing out of resistive heating devices	3.96
Phasing out of incandescent lights	3.93
Manufacturing Industries and Construction	
Energy management	4.86
Utilizing waste heat	4.79
Gasification	4.61
Transport	
Increased use of bicycles, walking and introduction of parking policy	4.56
Increased use of the railway	4.44
Electrification of the transport	4.39
Procurement of vehicles in accordance with the criteria for "green" procurement	4.36
Renewing of the national fleet	4.26
Railway to Republic of Bulgaria	4.15
Introduction of 5% biofuels	3.68
Introduction of 10% biofuels	3.56
Agriculture, Forestry and Other Land Use	
Changing the quality of forests with afforestation of the transitional forest land	4.60
Reducing the number and areas damaged from forest fires	4.54
Reduction of CH_4 emissions from fermentation of dairy cows by 3%	4.46
Reduction of N_2O emissions from fertilizer management of dairy cows by 20%	4.46
Reduction of N_2O emissions from fertilizer management of swines by 13%	4.42
Perennial grass in orchard and vineyards on inclined terrains (>5%)	4.08
Conversion of land use of field crops above 15% inclination	4.04

Contur cultivation of cropland on inclined terrains (5-15%)	3.96
Waste	
Prevent uncontrolled burning of waste	4.89
Construction of new regional landfills	4.78
Selecting waste and recycling	4.77
Rehabilitation of existing landfills	4.60
Construction of wastewater treatment plants	4.60
Construction of systems for methane collection and its controlled combustion	4.56
Construction of waste composting systems	4.26
Reference scenario	
Do you agree with the proposed reference scenario?	4.19

Записник

од работилницата за презентација на Референтното сценарио за емисии
на стаклснички гасови и можните мерки за ублажување на емисиите,
13.4.2017 година, Македонска академија на науките и уметностите

Во рамките на проектот „Втор двогодишен извештај за климатски промени“, поддржан од GEF и UNDP, на 13.4.2017 година во просториите на Македонската академија на науките и уметностите (МАНУ) се одржа работилница за презентација на референтното сценарио за емисии на стаклснички гасови и можните мерки за ублажување на емисиите. Во оваа работилница учество земаа околу педесетина чинители од релевантни институции во земјата. Чинителите имаа прилика да се запознаат со референтното сценарио и мерките и преку дискусија и пополнување на прашалник да придонесат за нивно подобрување, променување или потврдување.

Во воведниот дел свои обраќања имаа акад. Глигор Каневче од МАНУ и д-р Теодора Обрадовиќ Грнчаровска од Министерството за животна средина и просторно планирање.

Првиот дел од работилницата го започна раководителот на проектот, Павлина Здравева, која ја прикажа моменталната состојба со емисиите на стаклснички гасови и климатските промени во светски рамки. Понатаму, м-р Александар Дединец од Истражувачкиот центар за енергетика и одржлив развој при МАНУ ги запозна присутните со измените направени во моделирањето и влезните податоци во однос на претходните анализи. Воедно го презентираше референтното сценарио за емисии на стаклснички гасови до 2035 година, опфаќајќи ги проекциите на вкупните емисии и емисиите по поединечните сектори.

После завршувањето на презентацијата следеше расправа за референтното сценарио. Главната забелешка од чинителите беше ниската застапеност на обновливите извори на енергија. Како одговор на оваа забелешка беше објаснето дека зголемениот продор на обновливи извори на енергија е дел од мерките за ублажување со помош на кои по завршувањето на работилницата ќе се изработат сценарија за ублажување, додека референтното сценарио не предвидува мерки за ублажување. Исто така, беше поставено и прашање околу Националните придонеси за климатски промени (INDC) и периодот на нивно ревидирање. За првпат по поднесувањето на INDC во 2015 година, сценаријата ќе се ревидираат во склоп на Вториот двогодишен извештај за климатски промени, што ќе биде пракса и во секој наредсн двогодишен извештај.

Во следниот дел од работилницата, беа презентирани можните мерки за ублажување на емисиите на стаклснички гасови по одделни сектори. Вкупно беа претставени 58 мерки за ублажување. Во секторот Енергетика (вклучувајќи снабдување со енергија, згради - домаќинства, комерцијален и услужен сектор, производни индустрии и градежништво и транспорт) беа предложени 43 мерки, во секторот Земјоделство, шумарство и користење на земјиштето - 8 мерки и во секторот Отпад - 7 мерки. Сите овие мерки потекнуваат од стратешки документи на

државата, но и развојни планови на компаниите. После претставувањето на мерките за секој од секторите следеше дискусија за секторите и соодветните мерки.

Во секторот Земјоделство, шумарство и користење на земјиштето, беше образложена мерката за ублажување на емисиите на стаклени̌чки гасови која предвидува регулирање или индустријализација на фармите, при што би се намалиле емисиите поради промена на исхраната на добитокот, а со зголемување на бројот на регулирани фарми би се променил и начинот на управување со арското ѓубре.

Понатаму, беа дискутирани мерките за секторот Отпад. Во текот на дискусијата беше истакната потребата од податоци за пречистителни станици, на пример за бројот на постојни станици и станици во изградба, како и за одредени индустриски постројки кои веќе имаат инсталирано сопствени пречистителни станици. Освен тоа, беше посветено внимание и на компостирањето и неговиот ефект врз намалувањето на емисиите. На крајот, беше заклучено дека анаеробната дигестија и третманот на отпадот имаат најголем потенцијал за намалување на емисиите од овој сектор.

За секторот Енергетика беше предложено да се направи корелација со Директивата за големи постројки за согорување, при што беше објаснето дека истата е индиректно вклучена преку развојните планови на компаниите. Исто така, беше дискутирана мерката со која се предвидува воведување на цена на јаглерод, за која беше дообјаснето дека се однесува на тргувањето со јаглеродни емисии. Во однос на мерката за гасификација на домаќинствата, се водеше расправа околу домаќинствата кои имаат пристап до топлификациона мрежа и нивното опфаќање во анализата за гасификација. Според чинителите, постојат противречности помеѓу стратешките документи за гасификација и развојните планови на компаниите за топлификација. Покрај тоа, во транспортот како дел од секторот Енергетика, беше образложено дека со мерката за електрификација на транспортот се земени предвид и јавниот транспорт и индивидуалните возила.

Во делот на индустриски процеси, беше предложено да се земат предвид IPPC дозволите кои се законска обврска на компаниите. Како пример за извор на податоци беше посочен прашалникот што Државниот завод за статистика го испраќа до индустриските компании.

За мерките во целина беше коментирано дека треба да се направи споредба со мерките од Првиот двогодишен извештај и да се одреди колку од нив се имплементирани и колку изнесуваат заштедите од истите. Дополнително, беше коментирано дека мерките треба да се поделат на технички и легислативни (меки) мерки. Дадени беа и други предлози за мерки како што е трансферот на технологии, но и други документи кои можат да послужат како извори на мерки, како што е Стратегијата за одржливо управување со шумите и десетгодишните планови во шумарството.

Во текот на работилницата чинителите имаа можност да пополнуваат прашалник и да ги оценуваат мерките и референтното сценарио (со оцени од 1 до 5), но и да остават коментари и да предлагаат други мерки. Добиените 28 пополнети примероци од прашалникот беа обработени по завршувањето на работилницата.

Резултатите од прашалникот покажуваат дека чинителите го оцениле претставеното референтно сценарио со просечна оцена 4,19, додека предложените мерки ги оцениле со просечна оцена 4,35. Врз основа на добиените резултати од прашалниците направено е рангирање на мерките според просечната оцена на секоја од нив (во табелата од прилогот на крајот од записникот).

Што се однесува до коментарите и предлозите во однос на референтното сценарио (верификација и валидација на прогнозата за БДП и потрошувачката на финална енергија во 2035 година, намалување на увозната зависност и др.) и во однос на други предлози за мерки (спроведување на Директивата за индустрија, воведување на „нет метеринг“ и др.), истите ќе бидат земени предвид во понатамошната анализа.

Во следните чекори, за секоја мерка ќе се утврди нејзиниот придонес кон намалувањето на емисиите, трошоците за остварување на истата и индикаторот со кој се мери тоа остварување. Потоа, ќе се направи мулти-критеријално рангирање на мерките, сè до конечниот избор на мерки кои ќе се користат во сценаријата за ублажување. Откако ќе се изработат сценаријата за ублажување (преку моделирање во MARKAL), истите ќе се споредат со референтното сценарио, со цел да се воочи ефектот од ублажувањето.