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MACEDONIAN ENHANCED NATIONALLY DETERMINED CONTRIBUTIONS

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Source: “Design and inspire climate action” contest for youth.

ENHANCED NATIONALLY DETERMINED CONTRIBUTIONS
TECHNICAL DOCUMENT

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Abbreviations and acronyms

AFOLU	Agriculture, Forestry and Other Land Use
CHP	Combined Heat and Power Plants
EC	European Commission
EU	European Union
FBUR	First Biennial Update Report
GAP	Good agricultural practice
GDP	Gross Domestic Product
GHG	Greenhouse Gases
HPP	Hydropower Plant
HEV	Hybrid Electric Vehicle
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)
MEMO	Memo item
NCSP	National Communication Supporting Programme
NDC	Enhanced Nationally Determined Contributions
OECD	Organization for Economic Co-operation and Development
PHEV	Plug-in Hybrid Electric Vehicle
RES	Renewable energy sources
SBUR	Second Biennial Update Report SDG Sustainable Development Goals
STUGRES	Study on the Heating in the City of Skopje Analysis of Policies and Measures
SOM	Soil Organic Matter
TNC	Third National Communication
TMR	Total Mix Ration
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
WAM	With additional measures
WEM	With existing measures
e-WAM	Extended mitigation scenario
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 Republic of North Macedonia has signed (2015) and ratified (January 2018) the Paris Agreement, with the following contribution to the global efforts for GHG emissions reduction (**Macedonian NDC**): "To reduce the CO_2 emissions from fossil fuels combustion for 30%, that is, for 36% at a higher level of ambition, by 2030 compared to the business as usual (BAU) scenario." North Macedonia became the twenty-third country in the world that submitted its Intended Nationally Determined Contributions for Climate Change (INDC). The focus of the Macedonian NDC is put on climate change mitigation, that is, on policies and measures which lead to GHG emissions reduction, and particularly to CO_2 emissions from fossil fuels combustion which covers almost 80% of the total GHG emissions in the country. The following sectors are of dominant share: energy supply, buildings and transport.

Since then, few documents in the field of Energy and Climate Change were prepared and adopted, i.e. the Second Biennial Update Report – SBUR (submitted to UNFCCC in 2018), the Strategy for Energy Development up to 2040 (adopted by the Government in 2019), Third Biennial Update Report – 3rd BUR – Mitigation Report (2020), the draft version of the National Energy and Climate Plan –NECP (2020) and the draft version of the Long Term Strategy on Climate Change (2020), which subsequently build upon each other in terms of the policies and measures (PAMs) and the scenarios for mitigation of GHG emissions (Figure 1).

North Macedonia is the first country of the Energy community which besides PAMs from the Energy sector, analyzes and incorporates in its scenarios PAMs from Transport, Industry, Agriculture, Forestry and Other Land Use (AFOLU) and Waste sectors, which also are important target sectors for climate action. In that way, the Energy and Climate are brought closer together, gaining momentum for integrated Energy and Climate planning.

Figure 1. Documents prepared after the adoption of Intended Nationally Determined Contributions

Compared to the other documents, in the enhanced Nationally Determined Contribution (NDC) only two scenarios are presented, a Baseline scenario (scenario without measures - WOM) and a Higher ambition scenario (scenario with additional measures - WAM). The scenarios presented in the enhanced NDC are the ones given in the latest climate and energy policy documents specified in the picture above. In each document, different names of the scenarios have been used. To avoid any confusion, Table 1 shows the correlation of the scenarios defined in this document with the scenarios described in the other documents. Most of the text and findings presented in the enhanced NDC are used from these documents.

Table 1. Correlation of scenarios in the enhanced NDC with the scenarios in other documents

	WOM	WAM
Strategy for Energy Development (only Energy sector)	BAU	Green
3rd Biennial Update Report on Climate Change	WOM	e-WAM
National Energy and Climate Plan		WAM

A Monitoring, Reporting and Verification (MRV) system to monitor the implementation of climate actions has not yet been established in the country. Still, there are other mechanisms which can help MRV of climate actions. Two of them (top-down and bottom-up) are applied in the process of 4th National Energy Efficiency Action Plan (NEEAP) development. These methodologies are given in the Rulebook for energy audit and Rulebook for the characteristic of buildings. The draft version of the 4th NEEAP 2016-2021, presents a total of 41 energy efficiency policies and measures that have been implemented in the period 2015-2019, which also contribute to the climate change mitigation. Almost all of them are also defined in the INDC. Based on the 4th NEEAP, the total final energy savings in 2018 are 180 ktoe, which is about 20% above the target for 2018 set in the 3rd NEEAP. Also, these policies and measures in the period 2016-2018 have contributed to the reduction of around 760 kt CO_2 emissions. Compared to the goals defined in the INDC for 2030 (a reduction of 3166 kt CO_2) this is an achievement of 23% of the goal in a period of only three years.

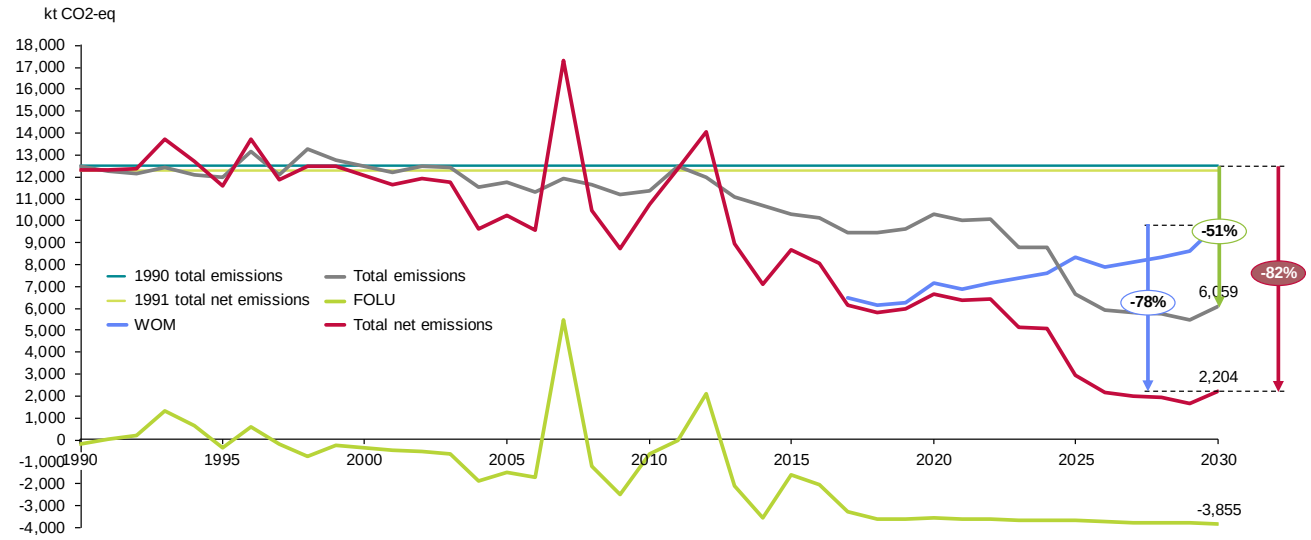
In the Enhanced Nationally Determined Contributions, 63 climate change mitigation measures/policies are considered in the higher ambition scenario, out of which 32 in the Energy sector, 11 in AFOLU (4-Agriculture, 2- Forestry, 6- Land use change), 4 in Waste and there are 16 additional PAMs which are enablers of mitigation actions.

The target for climate change mitigation in Macedonia is expressed as a reduction of greenhouse gas emissions and a reduction of net greenhouse gas emissions. The difference is that the FOLU sector is included in the GHG net emissions. The **targets** are expressed in relation to 1990, as a base year and are:

- **51% GHG emissions reduction**
- **82% net GHG emissions reduction**

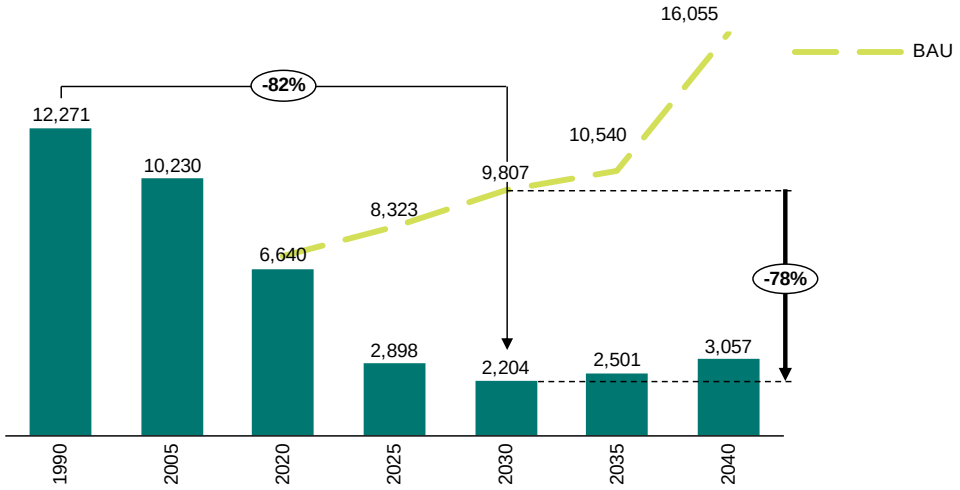
Additionally, compared to the WOM scenario, the economy-wide GHG emission reduction **target** for Macedonia **is 78%** in 2030 (Figure 2). The indicative trajectory shows that by 2020, Macedonia will reach a reference point of 56% of the total GHG reduction target (which means that more than half of the emission reductions will be achieved by 2020), and 93% in 2025 (Figure 3). After 2030, there is an increase in the GHG emissions, that are mainly result of the transport sector (increase in the transport of goods).

Figure 2. Trajectory of GHG emissions (in Gg CO_2-eq) and indicative reduction targets (in %)



Note: 2000 is removed from the figure for better presentation of the results

Figure 3. Trajectory of net GHG emissions (in Gg CO2-eq) and indicative reduction targets (in %)

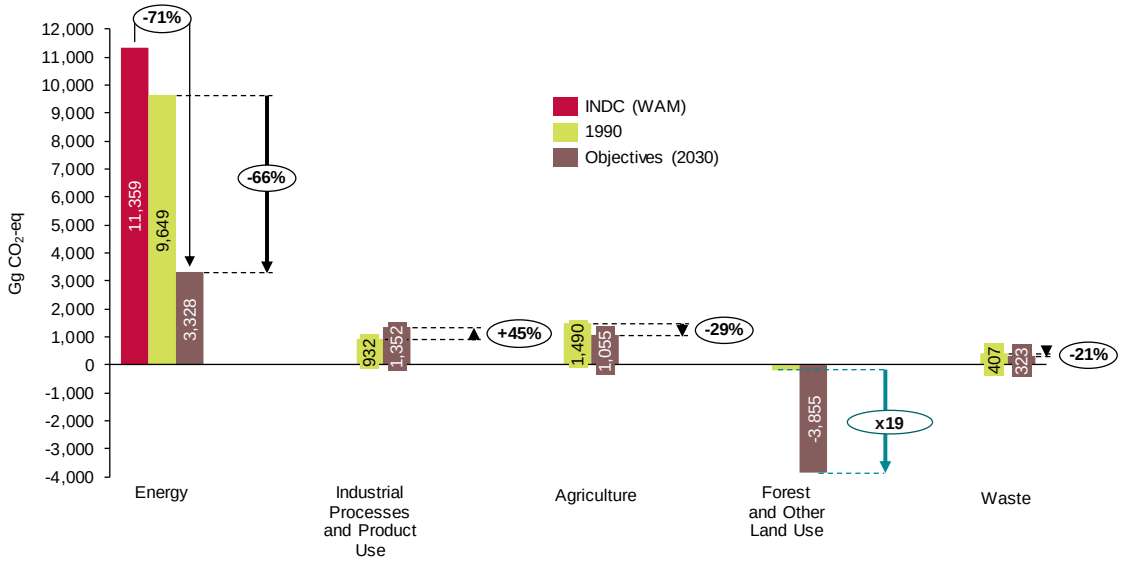


Source: Results from the Strategy for energy development up to 2040 and TBUR, project team analyses

In order to achieve the target for GHG emissions reduction, sectoral **objectives** are set for 2030 relative to 1990 level (Figure 4):

- Energy sector – 66% (6,321 Gg CO_2-eq) GHG emissions reduction (mainly through decommissioning of coal-fired TPP Oslomej in 2021 and TPP Bitola up to 2027)
- Industrial Processes and Product Use – 45% (420 Gg CO_2-eq) GHG emissions increase
- Agriculture – 29% (435 Gg CO_2-eq) GHG emissions reduction
- Forest and Other Land Use – 18 times (2,647 Gg CO_2-eq) GHG removals increase
- Waste – 21% (84 Gg CO_2-eq) GHG emissions reduction

Figure 4. Sectoral objectives for 2030 relative to 1990 level, and comparison with INDC target



Source: Results from the Strategy for energy development up to 2040 and TBUR, project team analyses

The reduction in net emissions of 82% seems big and frightening, but a detailed review of emissions in the period until 2016 must be made to see how this goal of 82% is obtained. The 1990s sinks from the Forestry sector are quite low, i.e. they amount to about 200 kt CO_2-eq. Over the years, the sinks in this sector have increased, with the exception of 2000, 2007 and 2012 when, as a result of large forest fires, instead of sinks in this sector, there are greenhouse gas emissions. Starting from 2004 until 2016, the sinks on average amounted to around 2000 kt-CO_2-eq, reaching a maximum in 2014 (3,597 kt-CO_2-eq), followed by 2009 (2,598 kt-CO_2-eq) and 2013 (2,146 kt-CO_2-eq). The projected sinks in 2030 that are assumed to be realized with the implementation of the planned measures are only 7% higher than the sinks in 2014.

At the same time, the emissions from the energy sector in 2016 decreased by 23% compared to 1990, as a result of the reduced electricity production from coal, almost complete removal of the use of heavy fuel oil for electricity generation and the introduction of natural gas.

Because there are significant changes in greenhouse gas emissions during the years 1990-2016, and in order to be clearer to the general public, the emissions and net emissions targets in 2030, in addition to 1990 are expressed in relation to other years. The years that are most often used to express emissions are 2005 and 2010. Additionally, in this document, 2014 will be used, as well as 2016 as the last year of the greenhouse gas inventory.

The results (Figure 5) of the comparison show that emissions in 2030 will decrease by:

- 48% in relation to 2005
- 47% in relation to 2010
- 43% in relation to 2014
- 40% in relation to 2016

The results (Figure 6) of the comparison show that net emissions in 2030 will decrease by:

- 78% in relation to 2005
- 79% in relation to 2010
- 69% in relation to 2014
- 73% in relation to 2016

Figure 5. 2030 GHG emission target compared to 2005, 2010, 2014 and 2016

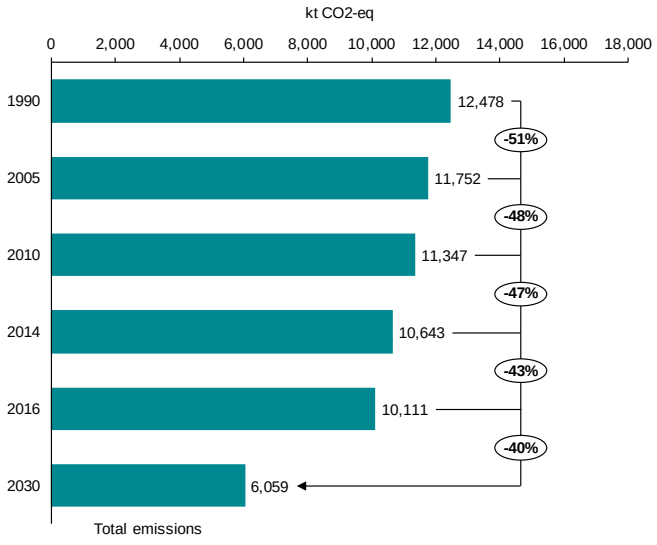
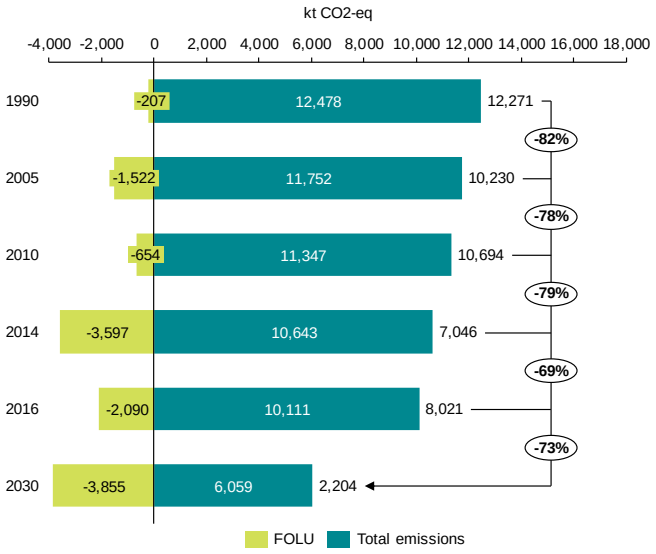


Figure 6. 2030 net GHG emission target compared to 2005, 2010, 2014 and 2016



If comparisons are made with 1990 in terms of net emissions, it should be noted that in 2014 about 52% of the target for 2030 has already been achieved (Figure 7). The comparison in terms of only emissions shows that in 2014 about 29% of the goal was achieved (Figure 8).

Figure 7. Achievement in 2014 compared to 2030 target – net GHG emissions

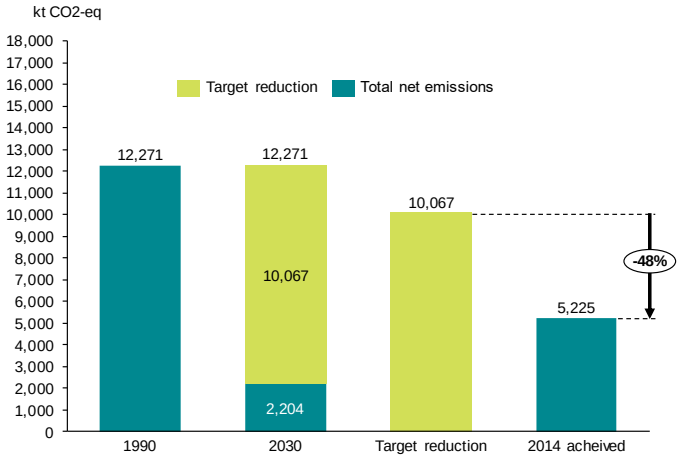
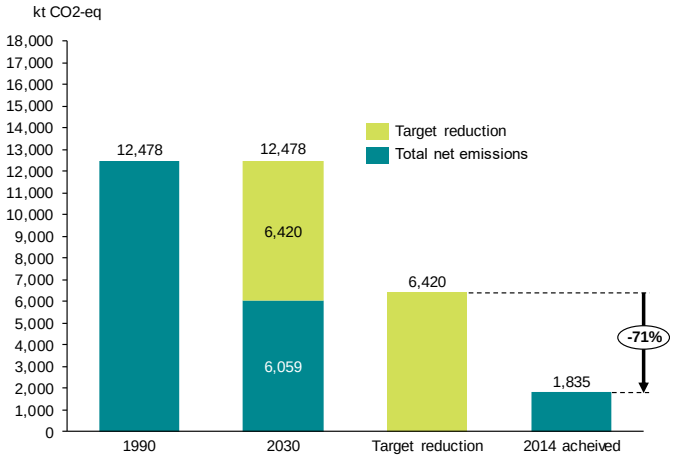


Figure 8. Achievement in 2014 compared to 2030 target – emissions



Regardless of the year in which the comparisons of emissions and net emissions are made, what is important is that a **green agenda** is planned that will contribute to the continuation of the downward trend of emissions that has already begun and additionally intensify it, especially in the period after 2025. Particular attention needs to be paid to sectors where emissions are expected to increase, such as the Transport sector.

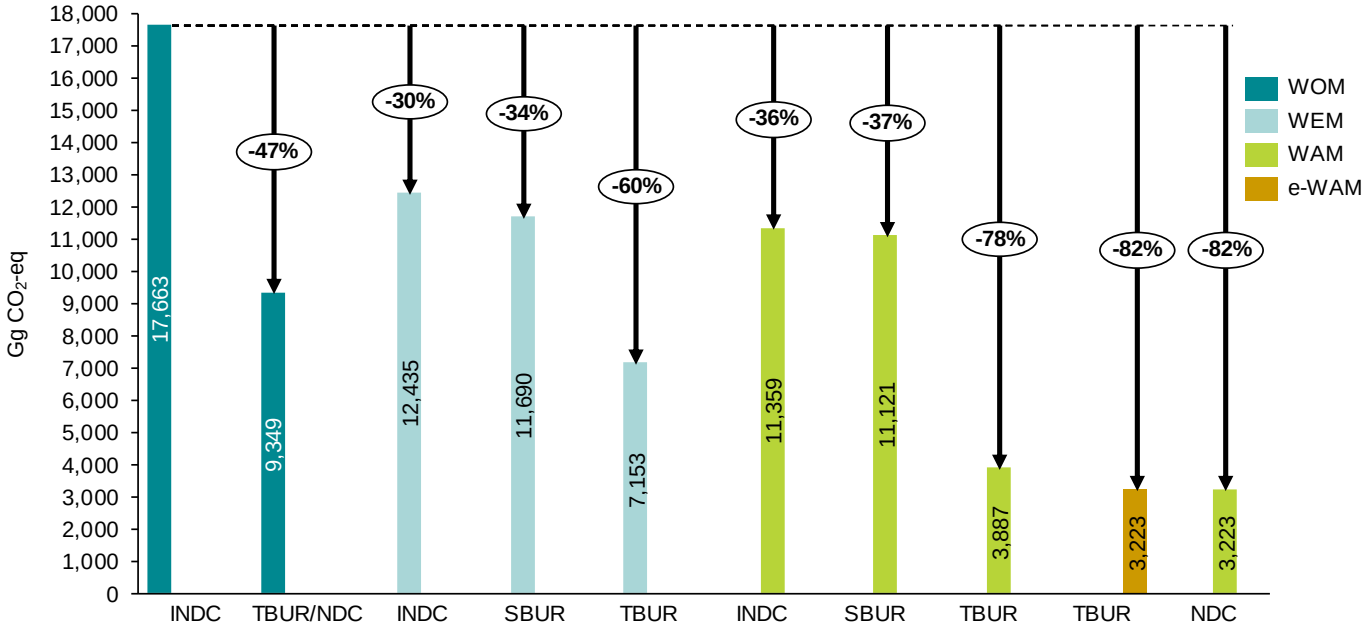
The results obtained from the analyses in the enhanced NDC cannot be directly compared with the goals defined in the INDC because:

- besides CO_2 emissions, the climate change mitigation analyses under enhanced NDC include the emissions of CH_4 and N_2O, which were not considered in the INDC,
- an emission factor has been attributed to the import of electricity, to take into account that in reality, this could not be considered as an emission-free measure,
- as a result of the developments in the modelling, like the change of input parameters (prices of fuels, Gross Domestic Product (GDP) growth, population growth etc.), the scenario without measures (WOM) in NDC is different from the WOM scenario in the INDC,
- The mitigation analyses include measures across all relevant sectors, i.e. in Energy, AFOLU and Waste sectors, including policy measures to improve the research and development activities in these areas.

If one makes a realistic comparison with the INDC targets, only the CO_2 emissions should be taken into account, while disregarding the emissions related to electricity import. Additionally, a comparison with the INDC WOM scenario should be made to assess the relative decreases with respect to that scenario. The results from the comparison are displayed in Figure 9, which shows that in 2030:

- the projected CO_2 emissions in the NDC WOM scenario are 47% lower compared to the INDC baseline (WOM scenario).
- the targeted emissions in the NDC mitigation scenario (WAM) are by 82% lower compared to the INDC WOM scenario, which is around three times more ambitious than the WAM scenario in the INDC.

Figure 9. Comparison of the SBUR, TBUR and NDC, WOM, WEM and WAM scenarios from the Energy sector with the INDC Reference scenario, 2030 (in Gg CO_2-eq)



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) and Environmental effectiveness (or mitigation potential). The results show that 70% of the reduction can be achieved with a “win-win” policies and measures, which means that these measures are reducing the emissions by negative specific costs (total cost of the proposed measure are lower compared to the costs of the WOM scenario). Furthermore, an additional 20% of the reduction is realized by measures with specific costs in a range from 0-5 €/t CO2-eq.

In addition to the economic and environmental effectiveness of the proposed policies and measures, the social aspect is analyzed through the number of newly created green jobs. The maximal number of green jobs is in the WAM scenario in 2035 with 9895 green jobs, from which 77% are from the energy efficiency and the remaining are from RES. Regarding the contribution by measures, the ones that have the highest share in the number of new domestic green jobs under the WAM scenario in 2035 are: Retrofit of existing residential buildings (42%), Construction of passive houses (21%), RES without incentives (6%) and Solar thermal collectors (8%) (Figure 10). Based on the types of jobs, very basic analyses are done concerning the gender issue. It is found that at least around 27% of the maximum number of job positions in 2035 can be assigned to women (Figure 10).

The anticipated costs of the enhanced NDC WAM scenario are ~ 21 bill €, of which about 99% for investments in the energy sector. The average yearly investments are approximately 7.7% of the total average annual GDP (Figure 11). If all of the measures are implemented in parallel, and the “Energy efficiency first” principle is applied, then, the total investment can be reduced up to 7% compared to the situation when each of the measures are implemented separately.

Figure 10. Number of domestic green jobs by measure in WAM

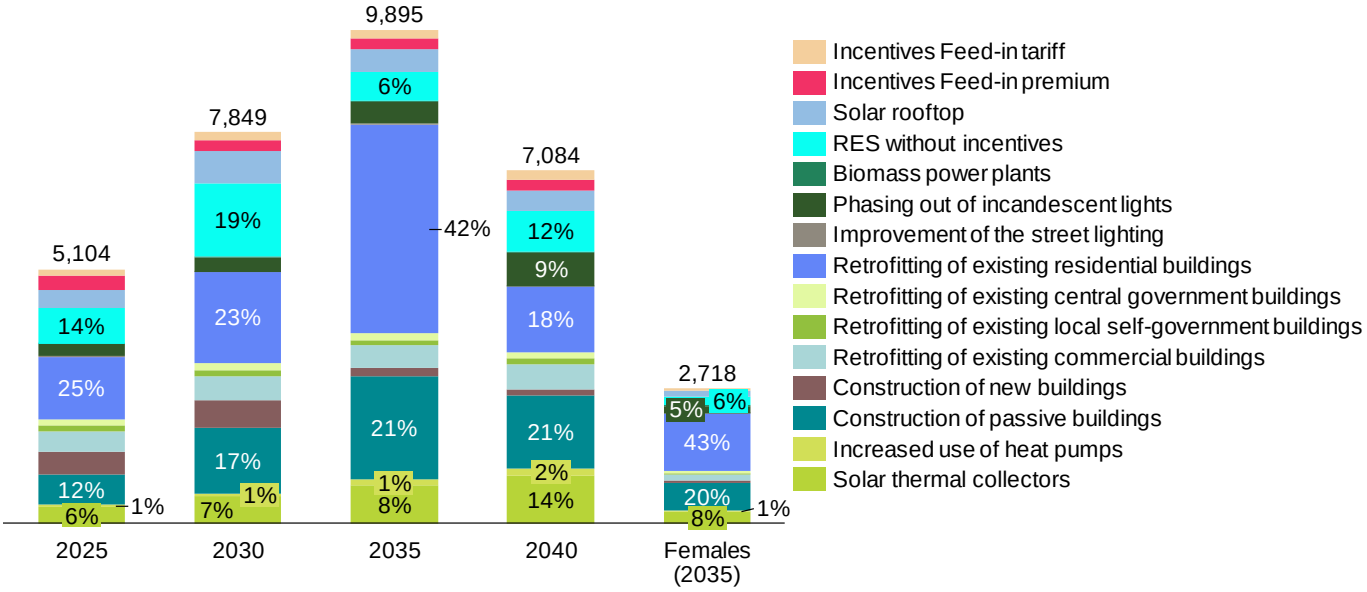
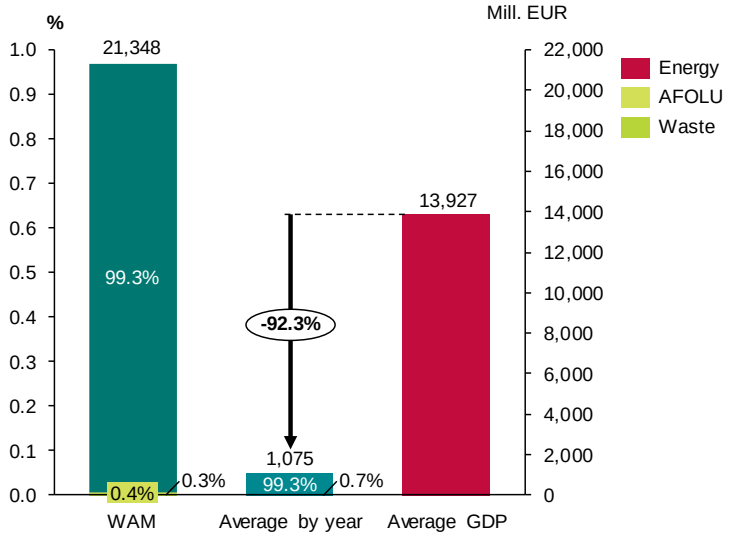


Figure 11. Investments in WAM and annual investments compared to average GDP



Finally, an Action Plan for mitigation of climate change is given (in Appendix 2), in which the stakeholders relevant for the implementation of all 63 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), and 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 the low-carbon sustainable development of North Macedonia.

INTRODUCTION

The Republic of North Macedonia, a **non-Annex I party** to the United Nations Framework Convention on Climate Change (UNFCCC) has signed (2015) and ratified (January 2018) the Paris Agreement, with the following contribution to the global efforts for GHG emissions reduction (**Macedonian NDC**): "To reduce the CO_2 emissions from fossil fuels combustion for 30%, that is, for 36% at a higher level of ambition, by 2030 compared to the business as usual (BAU) scenario." North Macedonia became the twenty-third country in the world that submitted its Intended Nationally Determined Contributions for Climate Change (INDC). The focus of the Macedonian NDC is put on climate change mitigation, that is, on policies and measures which lead to GHG emissions reduction, and particularly to CO_2 emissions from fossil fuels combustion which covers almost 80% of the total GHG emissions in the country. The following sectors are of dominant share: energy supply, buildings and transport.

Since then, few documents in the field of Energy and Climate Change were prepared and adopted, i.e. the Second Biennial Update Report – SBUR (submitted to UNFCCC in 2018), the Strategy for Energy Development up to 2040 (adopted by the Government in 2019), Third Biennial Update Report – 3rd BUR – Mitigation Report (2020), the draft version of the National Energy and Climate Plan –NECP (2020), the draft version of the Long Term Strategy on Climate Change (2020) which subsequently build upon each other in terms of the policies and measures (PAMs) and the scenarios for mitigation of GHG emissions (Figure 1).

Figure 12. Documents prepared after the adoption of Intended nationally determined contribution

In many aspects, these developments can be considered as a strong entry point to the mitigation analyses within the NDC.

First of all, it **is the capacity, both analytical and institutional**, and **the participatory process**, which has been created, maintained and enhanced over the Energy strategy, SBUR, INDC, FBUR and the three NCCC timelines.

Secondly, Macedonian SBUR goes beyond the requirements from the UNFCCC Guidelines for Non-Annex I Countries since, besides economic and environmental evaluation, it addresses social aspect estimating **co-benefits** from the implementation of mitigation policies and measures (PAMs). This good practice can be utilized and further extended since it provides essential input for prioritization of the PAMs and for informed policy design and decision-making. Worth mentioning in this regard, is the Study on the Heating in the City of Skopje (**STUGRES**) and Study on Transport (**STUTRA**) conducted also under SBUR, which certainly have a significant role to play when it comes to mitigation action at local level. In TBUR the role of the private sector in the mitigation action is particularly analyzed in the Study on Industry Analysis of Policies and Measures (**STUIND**). In this study more disaggregated and additional PAMs in the Industry sector that contribute to (i) increasing energy efficiency, (ii) increasing renewable sources utilization for

electricity production and (iii) improving waste management are considered. Moreover, these studies can serve as good practice showcasing that in the face of an air quality emergency and the climate crisis, solutions that tackle one or the other cannot be afforded. But solutions that tackle both are the way to go.

Representation of the PAMs in a tabular form, with elements prescribed in UNFCCC Guidelines for BUR preparation, is yet another element which is broadly implemented in the mitigation analyses. Indeed, this practice of representation of the PAMs with description, steps taken or envisaged, results achieved and estimated outcomes, estimated emission reductions, timeframe, costs, implementing entity, as well as progress indicator, provides solid base for monitoring, reporting and verification (MRV) of the achievement of each the PAMs, but also of the achievement of national energy and climate targets (RES share, EE improvements, GHG emissions reductions). The later assumes appropriate MRV institutional setting and communication flows at the national level are established and operational.

Finally, Macedonian NDC besides PAMs from the Energy supply and buildings sectors analyzes and incorporates in its scenarios **PAMs from Transport, Industry, Agriculture, Forestry and Other Land Use (AFOLU) and Waste sectors**, which also are important target sectors for climate action. In that way, the Energy and Climate are brought closer together gaining momentum for **integrated Energy and Climate planning**, which were duly applied in TBUR, National Energy and Climate Plan and the forthcoming revision of the NDC.

Compared to the other documents in the enhanced NDC only two scenarios are presented, a Baseline scenario (scenario without measures - WOM) and Higher ambitious scenarios (scenario with additional measure -WAM). The scenarios presented in the enhanced NDC are the ones presented in the latest developed documents. In each document, for some reasons, different names of the scenarios have been used. To avoid any confusion, Table 1 shows the correlation of the scenarios defined in this document with the scenarios defined in the other documents. Most of the text and findings presented in the enhanced NDC are taken from these documents.

Table 2. Correlation of scenarios in the enhanced NDC with the scenarios in other documents

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3rd Biennial Update Report on Climate Change	WOM	e-WAM
National Energy and Climate Plan		WAM

NATIONAL CIRCUMSTANCES

1.1 Macroeconomic content

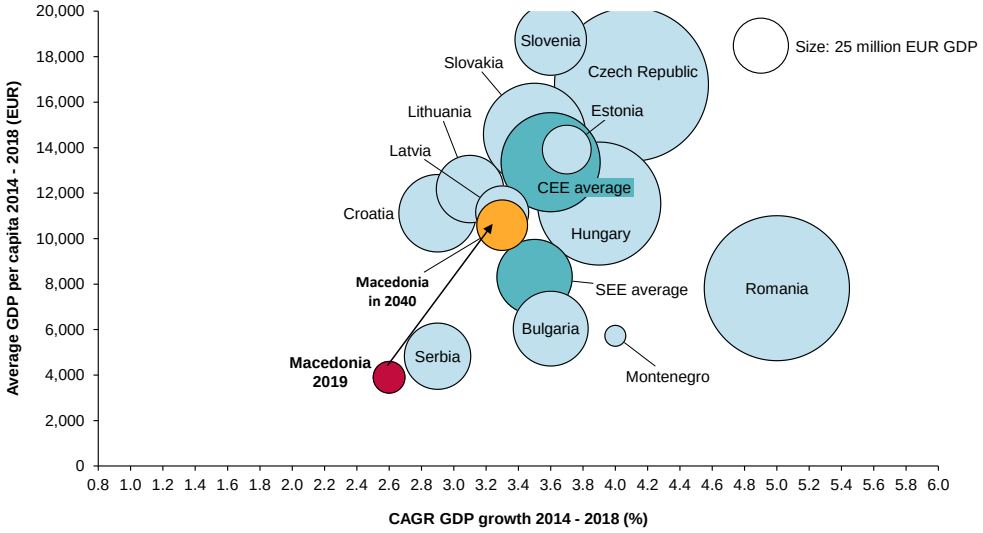
1.1.1 Introduction

The Republic of North Macedonia as Energy Community Contracting Party and EU candidate country is willing to follow the European energy policy and is obliged to transpose and implement the EU energy directives and regulations. North Macedonia was granted the candidate status for entering the European Union in 2005. Since 2009, the Commission has recommended to the Council to open accession negotiations with North Macedonia. Furthermore, in 2018, the Commission has also recommended that the accession negotiation will be opened with North Macedonia in 2019. In March 2020, the General Affairs Council of EU decided to open accession negotiations with North Macedonia and the members of the European Council endorsed the decision.

1.1.2 Gross domestic product and unemployment

GDP growth till 2040 is projected to position North Macedonia closer to today's CEE region economies. GDP, as the most important measure of a country's economic activity, shows that today North Macedonia lags behind the SEE average, as well as the CEE region. Taking into account the projections of the International Monetary Fund and Ministry of Finance, it is projected that until 2040 the Macedonian real GDP growth rate will grow at an average rate of 3.3%. Such GDP growth rate could be expected for a developing country, and should lead to convergence towards levels of GDP per capita that are common for developed CEE countries today (Figure 13).

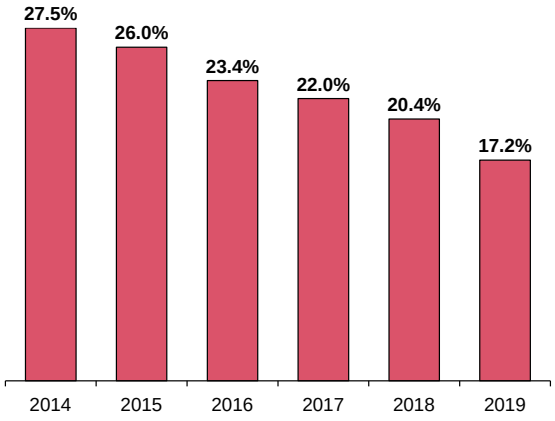
Figure 13 CEE and SEE GDP trends



Note: SEE includes AL, BA, BG, HR, MK, RS, ME, SI and RO; CEE includes HU, LV, LT, CZ, EE and SK; GDP growth projections for North Macedonia take into consideration growth rates of 3.3% per annum.
Source: Eurostat, Government of North Macedonia GDP projections, Expert analysis

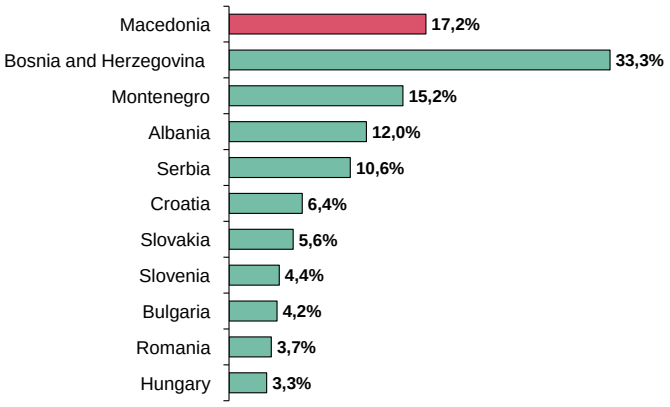
North Macedonia has the second highest unemployment rate in the region, but it is showing a positive trend over the years (Figure 14, Figure 15). Besides, employment is characterized with unfavourable gender structure, which has remained unchanged over a longer period due to unstable economic and social conditions, as well as the imbalance between the available and required profiles on the labour market. The employment rate in women population in 2019 was 48.4% (315 thousand women), significantly lower than the man employment rate of 69.7% (467 thousand men), of the active population aged from 20 to 64 years.

Figure 14 Unemployment rate in North Macedonia, 2014 – 2019, %



Source: Eurostat, ec.europa.eu reports; Trading Economics; Expert analysis

Figure 15Unemployment rate CEE and SEE, 2019, %



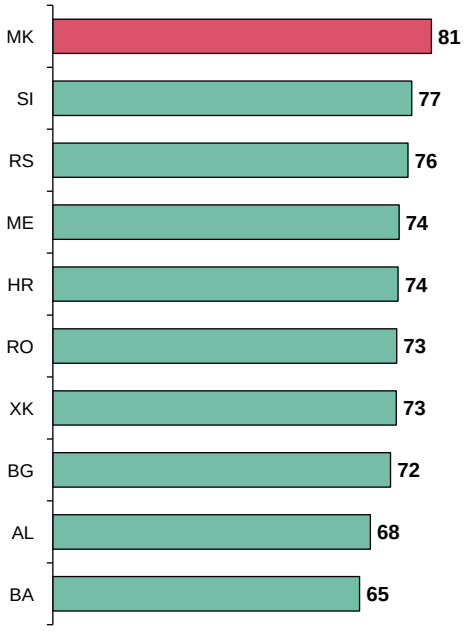
North Macedonia has a positive business environment to provide opportunities for small and medium enterprises in RES and energy efficiency. According to The World Bank Doing Business 2020 report, North Macedonia has the highest cumulative index for business environment compared to countries in the region, and in particular stands out in the fields of protecting minority investors and dealing with construction permits. Still, there is room for improvement in the other categories, especially in trading across borders as their ranking is lagging behind the countries in the region (Figure 16, Figure 17). It is expected that future investments, including the investments in the energy sector (especially RES and energy efficiency), could have a positive impact on decreasing county's unemployment rate as well as the economic growth.

Figure 16 Business environment per category, 2019

Category	Description	Global ranking (out of 190)
Starting a business	Procedures required from an entrepreneur to start a business (time and cost)	78
Dealing with construction permits	Procedures required to comply with building regulations (time and cost)	15
Getting Electricity	Time and cost to obtain electricity connection as well as supply reliability and tariff transparency	68
Registering property	Effective administration of land, necessary for formal property transfer	48
Getting loan	Considers the depth of loan information and strength of legal rights	25
Protecting minority investors	Protection from conflict of interest and shareholders rights in corp. govern.	12
Paying taxes	Considers tax rates and tax administration complexity	37
Trading across Borders	Time and cost associated with the logistical process of export and import	32
Enforcing contracts	Time and cost for resolving standardized commercial dispute through local first-instance court	47
Resolving Insolvency	Time, cost and outcome of insolvency proceedings involving local legal entities	30

Source: The World Bank – Doing Business 2020 report, Expert analysis

Figure 17 Business environment compared to countries in the region, 2019 (the ease of doing business score)



1.1.3 Foreign direct investment

The energy sector can contribute to attract foreign direct investments. The process of globalization has increased the importance of foreign direct investments, especially for developing countries such as North Macedonia. Due to the limited internal financial and investment capacity the interest of all developing countries is to achieve a more favourable investment climate and better operating conditions. Additionally, entrance of new foreign companies can stimulate domestic companies to improve their business and consequently contribute in boosting overall market development. In the long run, such economic trends create positive externalities. Foreign direct investments in North Macedonia amounted 225 million EUR per year or 107 EUR per capita which is substantially lower than the region (Figure 18, Figure 19).

Figure 18 Foreign direct investments in North Macedonia, 2014 – 2019, mil. EUR

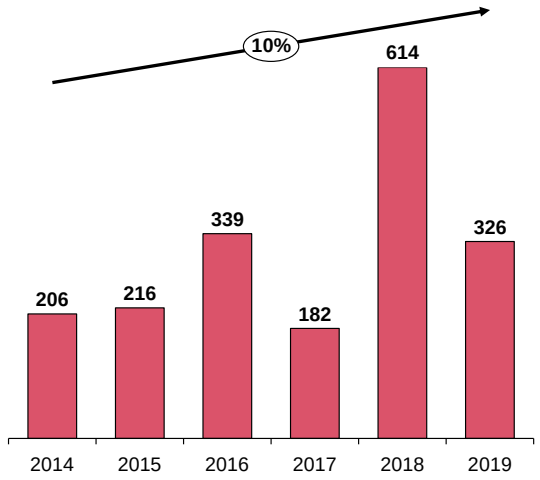
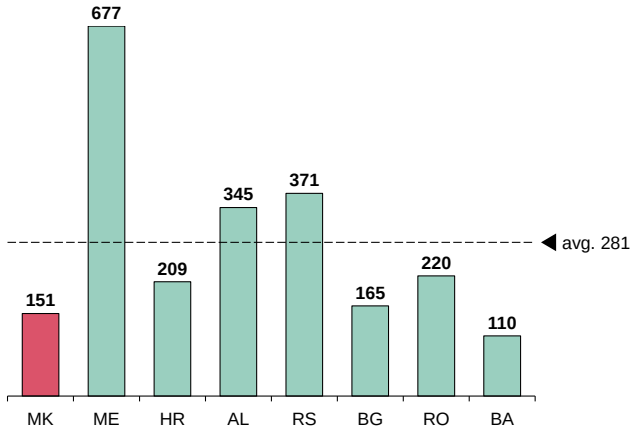


Figure 19 Foreign direct investments per capita – Region inflow, average 2014 – 2019, EUR



Note: Countries analysed for the region are BA, RO, BG, RS, AL, HR and ME
Source: United Nations – World Investment Report 2020, Eurostat, Expert analysis

1.2 Energy sector

Compared to the other sectors, the Energy sector by far has the largest share in the GHG emissions in Macedonia. This is because this sector is mainly based on fossil fuels, primarily coal, which accounts 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 electricity import, which additionally increases the import dependence of the country, estimated at 54%. There is also an increasing trend of the share of renewable energy in the gross final energy consumption, which from 18% in 2009 has increased to 20% in 2017. The efficiency of the Macedonian energy system (conversion from the total required energy into final energy) is about 71%. 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, 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.

1.2.1 Primary and final energy consumption

In general, a decreasing trend can be noticed in primary energy consumption while final energy consumption remained stable. In the period 2010 – 2018, the primary energy consumption decreased for 9% mainly due to higher import of electricity and petroleum products, as well as the implementation of energy efficiency measures and increased RES electricity production. The final energy consumption remained stable with few variations (a small increase of 3%) mainly due to fluctuation of industry consumption and increased consumption of fuels in the transport sector (***Figure 20***, Figure 21).

Figure 20 Primary energy consumption by fuel, 2010 – 2018*,Mtoe

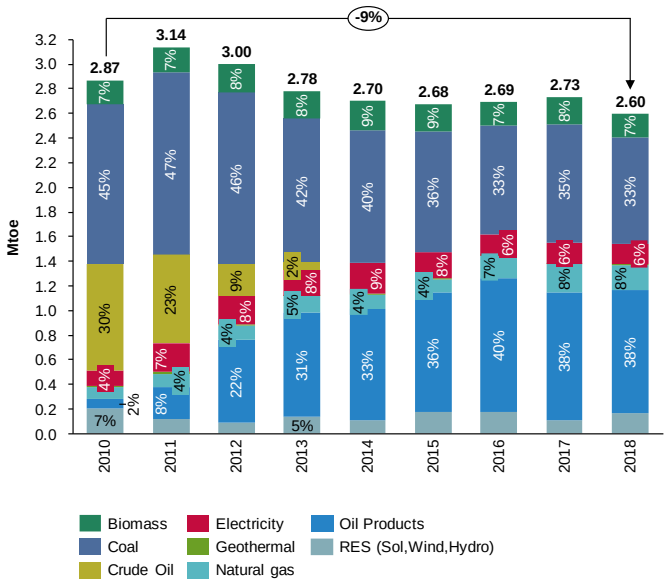
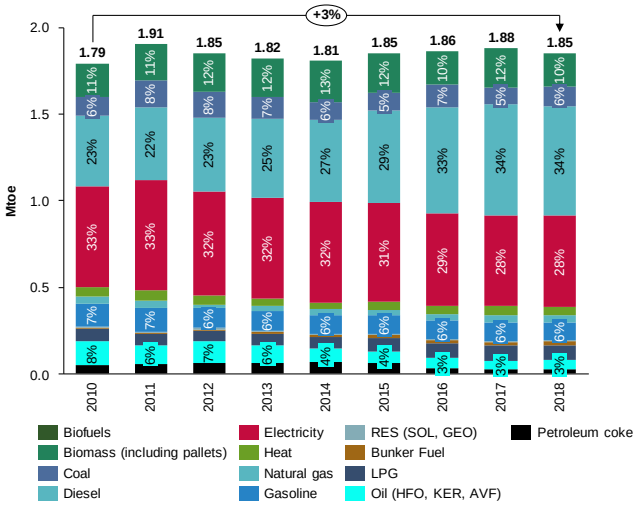


Figure 21 Final energy consumption by fuel, 2010 – 2018*, Mtoe



**Note: Preliminary data for 2018*
Source: State Statistical Office, Energy Balances, 2010 – 2018 (MAKStat Database)

1.3 Industrial Processes and Product Use

The GHG emissions from Industrial Processes and Product Use (IPPU) in Macedonia originate from production industries and 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 result of the use of substituents of ozone-depleting substances.

1.4 Agriculture, Forestry and Other Land Use

Forests and forest lands are the main CO_2 sinks in Macedonia. According to the data from the project "TCPF Assessment of the methodology for implementation of the forest inventory (TCP/MCD/3604)" the total area of forest, forest land and barren land (estimated in the 2017) is 1.122.258 ha out of which 1.001.489 ha are forest, 109.126 ha forest land and 11.643 barren land. This generally is in line with the official data from the State Statistical Office, Forestry management plans (PE "Macedonian forests", other subjects that manage forests and Ministry of Agriculture, Forestry and Water Economy). Furthermore, according to the findings of the project TCP/MCD/3604 in the period of 2009 to 2017 year about 43.252 ha of other wood land were changed to forest. This process of land cover changes (especially from other land cover to forest) is very important for planning of mitigation measures and adaptation to climate change. In terms of the ownership, around 90% of the forests are state-owned and the rest are private forests.

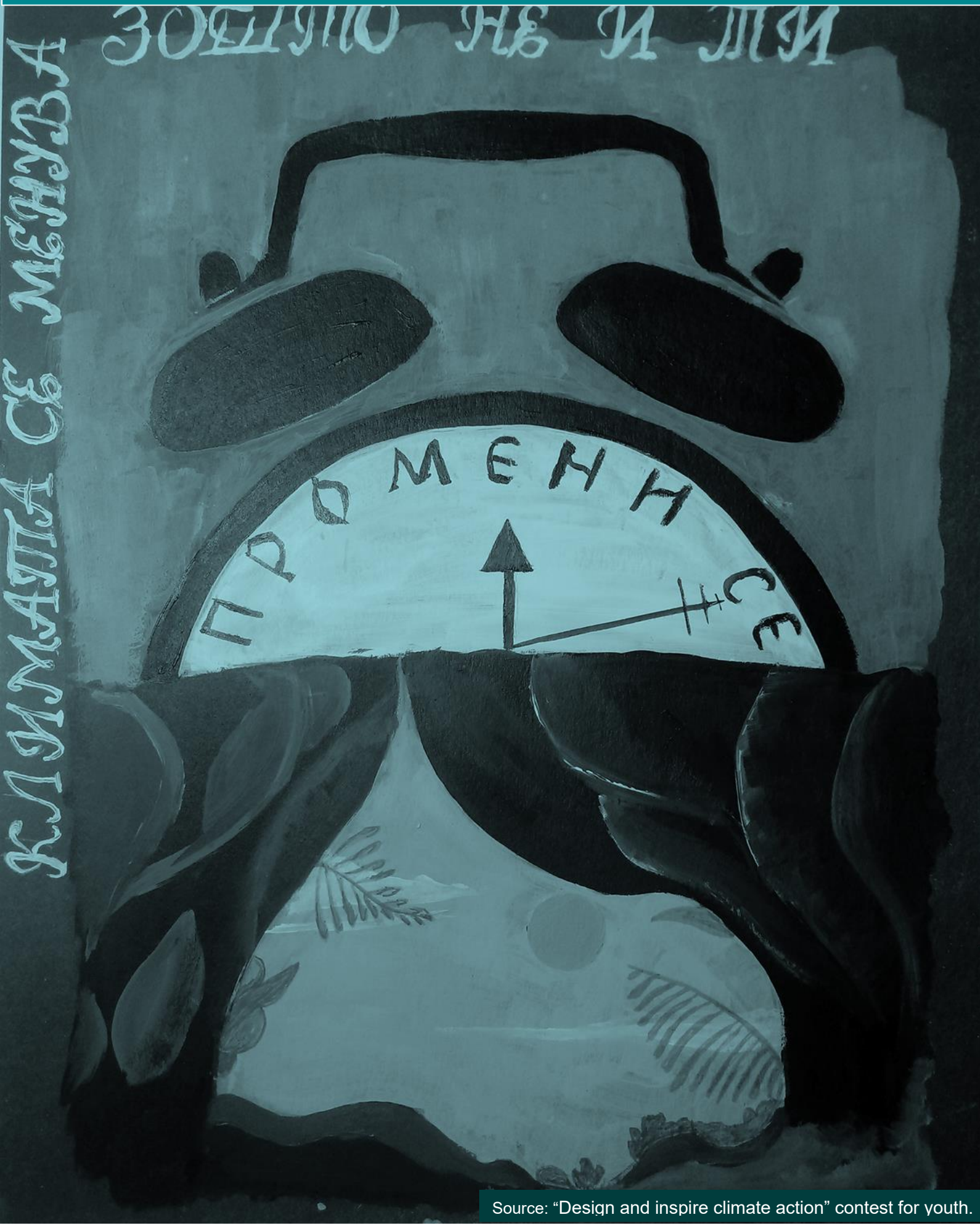
In Macedonia, the activities related to livestock production emit greenhouse gases mainly as a result of enteric fermentation and management of manure. On the other hand, greenhouse gas emissions from crop production are a consequence of several major sources, such as inadequate and excessive fertilization with mineral fertilizers, which in the long term causes a 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 an intensive plant production system, inadequate management of arable land and improper management when fertilizing.

1.5 Waste

According to the Macedonian GHG inventory, the emissions in the waste sector are increased by 50% between 1990 and 2016, making this sector the fastest growing. Considering the fact that most of the emissions are from Solid Waste Disposal Sides, as well as the forecasts for their growth as a result of the increased amount of waste that citizens are increasingly creating, special attention should be paid to this sector. The following categories act as contributors to the GHG emissions: Solid Waste Disposal, Biological Treatment of Solid Waste,

Incineration and Open Burning of Waste, and Wastewater Treatment and Discharge. The GHG emissions from this sector follow a monotonously growing trend. Solis waste disposal is the category with the highest share of GHG emissions in this sector.

3 BETWEEN TWO NDCs



Source: “Design and inspire climate action” contest for youth.

BETWEEN TWO NDCs

Although Monitoring, Reporting and Verification (MRV) system to monitor the implementation of climate actions has not yet been established in the country, there are other mechanisms which can help MRV of climate actions. Two of them (top-down and bottom-up) are applied in the process of 4th National Energy Efficiency Action Plan (NEEAP) development. These methodologies are given in the Rulebook for energy audit and Rulebook for characteristic of buildings. According to the draft version of the 4th NEEAP 2016-2021, a total of 41 energy efficiency policies and measures, which also contribute to climate change mitigation, have been implemented in the period 2015-2019. Almost all of them are also defined in the INDC.

The Republic of North Macedonia as a party to Energy Community regularly prepares National Energy Efficiency Action Plans (NEEAPs), which includes information on the progress towards the national energy efficiency target. Hence, the estimated annual savings achieved with the energy efficiency measures could serve as an indicator to track the progress of implementation of the mitigation measures between the two NDCs (Table 3). A total of 41 measures are reported in the 4th NEEAP, of which for 34 there are detailed data, and for 7 partial data. The total final energy savings in 2018 are 180 ktoe which is about 20% above the target for 2018 which is set in the 3rd NEEAP. Only in the period 2016-2018, final energy savings of around 100 ktoe were achieved.

With the implementation of 18 measures (marked with green in Table 3), larger energy savings were achieved than those planned in the 3rd NEEAP, while with 6 measures, smaller savings were achieved than planned (marked in red in Table 3). What is important and should be emphasized is that the implementation of most of the measures is aimed at fulfilling the Green Scenario of the Energy Strategy and that is one of the reasons why in the NDC the WAM scenario is presented.

Measures that achieve the greatest energy savings are increased use of heat pumps (inverter air conditioners), as well as renovation and construction of new buildings.

These measures used to achieve final energy savings, also contributed to the reduction of primary energy consumption. However, in addition to these measures, there are measures whose implementation achieves savings only on primary energy, 212 ktoe (Table 4).

Table 3. Measures used to achieve final energy savings and comparison with the projected savings from the third NEEAP

	Measure	Corresponding measure in the 3rd NEEAP	Cumulative (3rd NEEAP)	Achieved annual energy savings - final energy (ktoe)			Achieved cumulative savings including the savings from the 3rd NEEAP	Expected cumulative savings according to 3rd NEEAP
			2015	2016	2017	2018	2018	2018
1	EE obligation schemes						0	
2	Public awareness campaigns and network of energy efficiency (EE) info centers	R.4.	2.7	0.82	0.82	0.97	5.31	3.85
3	Solar rooftop power plants	R.3., P.4., C.3.	7.77				33.66	15.72
4	Solar thermal collectors			0.53	0.4	0.25		
5	Increased use of heat pumps			7.2	9.04	8.47		
6	Labeling of electric appliances and equipment	R.2.	0.7	0.2	0.21	0.24	1.35	0.86
7	Replacement of windows			0	0.14	0.12	0.26	
8	Retrofitting of existing buildings (res+comm)	B.1., R.1., C.1., P.1.	19.4	0.2	0.16	0.13	32.31	30.05
9	Construction of new residential buildings			2.93	2.86	2.58		
10	Construction of new commercial buildings			0.79	0.91	0.94		
11	Retrofitting of existing central and local self-government buildings			0.18	0.07	0.08		
12	Construction of new central and local self-government buildings			0.41	0.41	0.26		
13	EE certificates for buildings			0.29	0.54	0.15	0.98	

14	Construction of passive buildings			0	0.02	0	0.02	
15	Phasing out of incandescent lights			1.35	3.37	5.4	10.12	
16	Improvement of the street lighting in the municipalities	P.3.	1.69	0.56	0.56	0.56	3.37	2.34
17	"Green procurements"	P.5.	0.22	0.05	0.05	0.1	0.42	0.36
18	Energy management in manufacturing industries	I.2.	2.98	0.5	0.5	0.5	4.48	5.3
19	Introduction of efficient electric motors	I.3.	1.42	0.2	0.2	0.2	2.02	1.77
20	Introduction of more advanced technologies	I.1., I.4.	13.7	1.8	1.8	1.8	19.1	16.1
21	Increased use of the railway	T.4.	5.16	0	1.36	0.76	7.28	18.76
22	Renewing of the national car fleet	T.1.	6.45	1.8	1.68	2.01	11.94	9.95
23	Renewing of other national road fleet (light duty and heavy goods vehicles and buses)			0.16	0.4	0.38	0.94	
24	Advanced mobility	T.3.	2.36	0.24	0.2	0.27	3.07	4.21
25	Construction of the railway to Republic of Bulgaria			0	0	0	0	
26	Electrification of the transport			0.02	0	0.01	0.03	
27	Biomass power plants (CHP optional)						0	
28	Increased use of more efficient biomass stoves	R.5.	0	0.18	0.32	0.73	1.23	1.12
29	Increased use of central heating systems			0.13	0.16	0.18	0.47	
30	Reduction of network losses	E.2.	3.4				3.4	7.2
	Total savings		67.95	13.66	20.12	22.92	141.76	117.59
	Additional measures reported in the annual reports							
31	Inspection of boilers/air conditioning systems	B.2.	0.06	0	0	0	0.06	0.1
32	Energy management - public buildings	P.2.	0.96	0.2	0.2	0.2	1.56	1.56
33	Rehabilitation of water supply systems and sewage systems	P.6.	0	0.05	0.05	0.1	0.2	0.02
34	Energy management	C.2.	0.75	0.15	0.15	0.2	1.25	1.45
35	Cogeneration	I.5.	5.1	8.7	5.7	8	27.5	18.2
36	Heat cost allocators	E.1.	0	0	0	0	0	0.04
37	Promotion of sustainable urban transport systems	T.2.	5.55	0.8	0.8	0.8	7.95	9.75
	Total savings of the additional measures reported in the annual reports		12.42	9.9	6.9	9.3	38.52	31.12
	Total savings in 4th NEEAP		80.37	23.56	27.92	32.22	180.28	148.71

Table 4. Measures used to achieve only primary energy savings

	Measure	Corresponding measure in the 3rd NEEAP	Cumulative (3rd NEEAP)	Achieved annual energy savings - final energy (ktoe)			Achieved cumulative savings including the savings from the 3rd NEEAP
			2015	2016	2017	2018	2018
38	Incentives Feed-in tariff			5.61	5.61	3.67	14.89
39	RES without incentives			0.04	0.25	0.37	0.66
40	Reduction of network losses			1.44	3.17	5.28	9.89

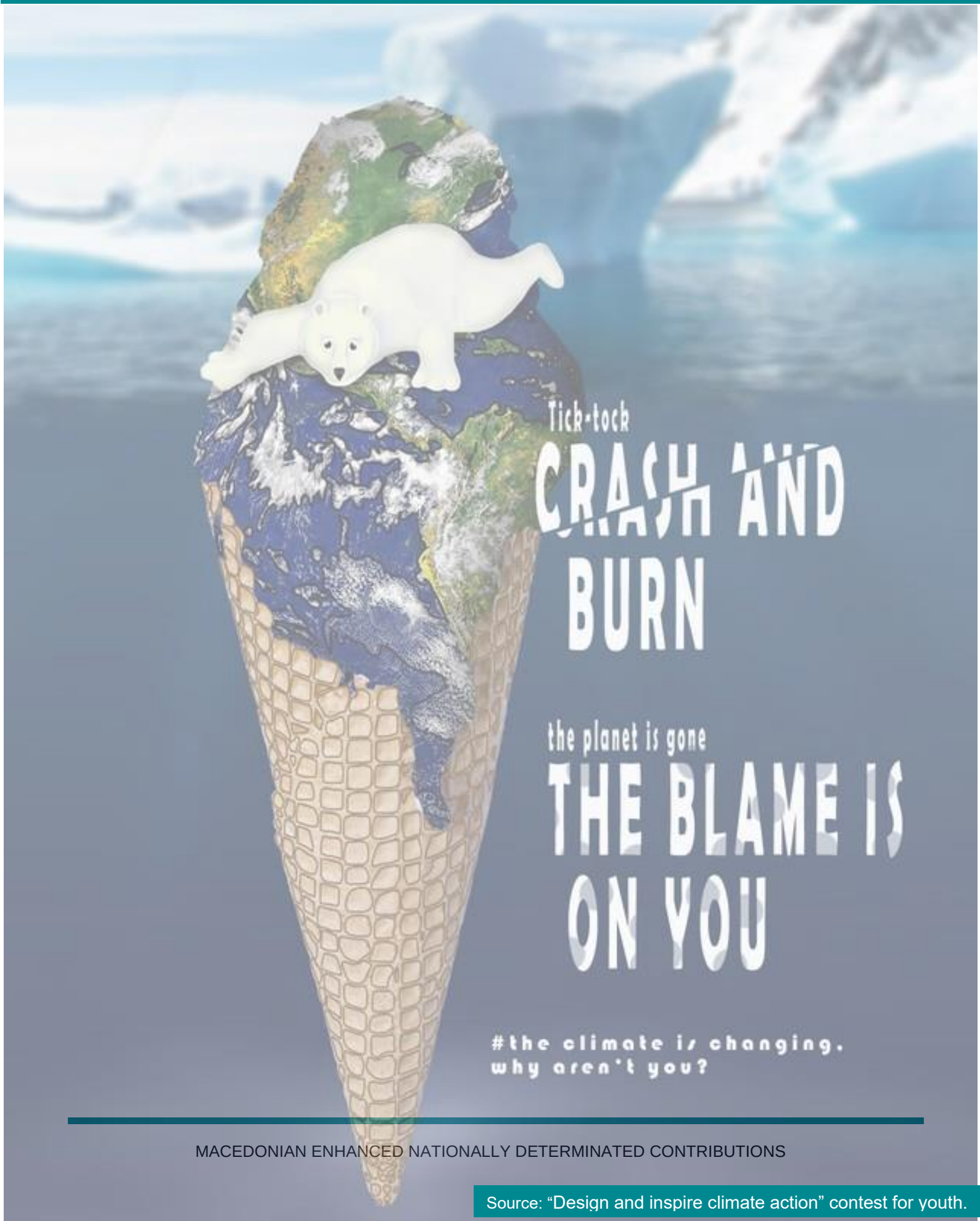
In addition to the energy savings calculations, as part of 4th NEEAP, the reduction of greenhouse gas emissions is also calculated. It is not easy to compare with INDC savings because there are some differences in the methodology. Using the MARKAL model (methodology applied in INDC) it is calculated what exactly will happen with the energy system if a certain measure is implemented, i.e. sometimes instead of saving coal for electricity production there is a reduction in electricity imports. In contrary, the methodology applied in NEEAP calculates emissions in such a way that it is assumed that the energy would have been produced in the country. However, the deviations are not high and can only occur in some of the measures. It is important to see that there is a downward trend. The results show that in the period 2016-2018 the PAMs have contributed to the reduction of around 760 kt CO_2 emissions. Compared to the goals defined in the INDC for 2030 (reduction by 3166 kt CO_2) this is achievement of 23% of the goal in a period of only 3 years.

Table 5. GHG emissions reduction achieved of the INDC measures (as reported in the 4th NEEAP)

Intended Nationally Determined Contributions	4th National Energy Efficiency Action plan	
Measure	Measure	GHG reduction 2016-2018
Energy		
Energy Industries		
Reduction of distribution losses	Reduction of network losses	43.2
Large hydro power plants	Large hydro power plants	0
Small hydro power plants Solar power plants Wind power plants Biogas power plants	Incentives Feed-in tariff	67.3
	Incentives feed-in premium	0
	RES without incentives	3
	Solar rooftop power plants	0
Biomass combined heat and power plants	Biomass power plants (CHP optional)	0
Central heating of Bitola	Not considered	n/a
More natural gas power plants	Not considered as mitigation measure	n/a
Geothermal power plants	Not considered	n/a
	Introduction of CO2 tax	n/a
Residential, Non-Specified (commercial and service sector)		
Solar thermal collectors	Solar thermal collectors	18.1
Labeling of appliances	Labeling of electric appliances and equipment	3.8
Phasing out resistive heating devices	Increased use of heat pumps	255.5
	EE obligation schemes	
Public awareness campaigns and network of EE info centers	Public awareness campaigns and network of energy efficiency (EE) info centers	15.1

Retrofitting of building Construction of new buildings	Retrofitting of existing central and local self-government buildings	11.6
	Construction of new central and local self-government buildings	
	Retrofitting of existing buildings (res+comm)	48.6
	Construction of new commercial buildings	
	Replacement of windows	
	Construction of new residential buildings	
Construction of passive buildings	Construction of passive buildings EE certificates for buildings	3.1
Phasing out of incandescent lights	Phasing out of incandescent lights	156.5
	Improvement of the street lighting in the municipalities	26.1
	“Green procurements”	3.1
Gasification of households and of the commercial sector		
	Increased use of central heating systems	19.5
	Increased use of more efficient biomass stoves	
Manufacturing Industries and Construction		
	Energy management in manufacturing industries	11.2
	Introduction of efficient electric motors	9.3
	Introduction of more advanced technologies	40.4
Transport		
Biofuels 5%	Not considered, only Biofuels 10% is considered	n/a
Biofuels 10%	Development of the biofuels market	0
Increased use of the railway	Increased use of the railway	6.6
Renewing the car fleet	Renewing of other national road fleet (light duty and heavy goods vehicles and buses)	2.9
	Renewing of the national car fleet	17.1
Increased use of bicycles, walking and introduction of parking policy	Advanced mobility	2.7
Railway to Bulgaria	Construction of the railway to Republic of Bulgaria	0
Electrification of transport	Electrification of the transport	0.1
Total		**764.8**

4 SCENARIO WITHOUT MEASURES (WOM)



Source: "Design and inspire climate action" contest for youth.

SCENARIO WITHOUT MEASURES (WOM)

WOM scenario assumes no major changes in technology, economics, or policies so that normal circumstances can be expected to continue unchanged. This scenario has no likelihood of occurrence because it implies, for instance, that the efficiencies of devices used in households in 2040 would be the same as the efficiencies of the devices used in 2017. Nevertheless, such a scenario is of crucial importance because it allows all policies and measures to be compared to a referent option ("no action" case) and identify their performance (energy, emissions and financial savings).

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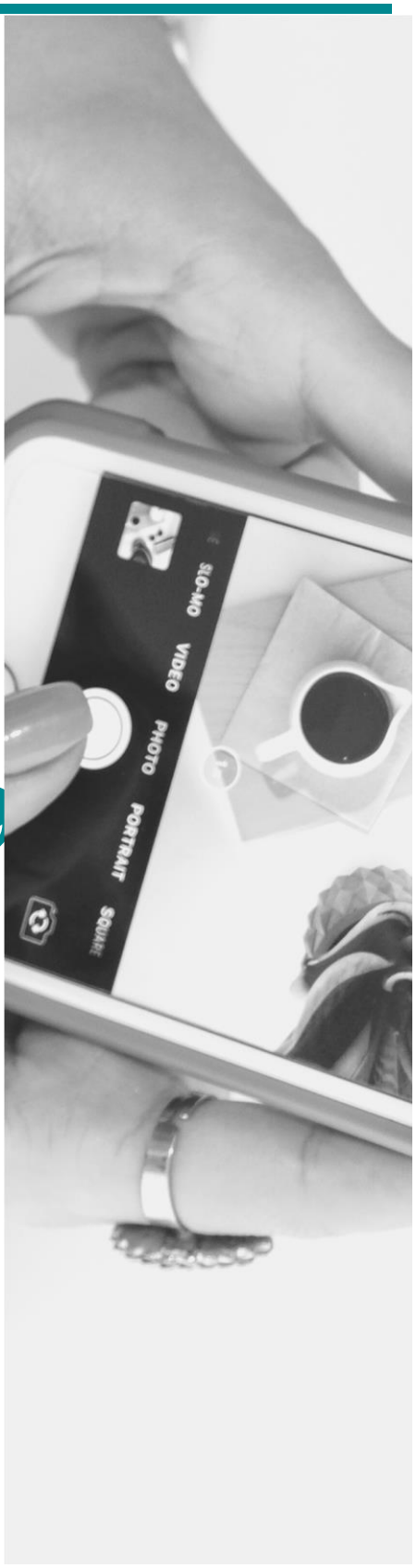


1.1 Energy

The Energy part of the WOM scenario is based on the Business-as-usual scenario developed in the Energy efficiency part of the Strategy for Energy Development up to 2040.

1.1.1 Key assumptions

In general, all assumptions in the Energy sector are based on the Strategy for Energy Development up to 2040. These include projections of:

- GDP, an average growth rate of 3.3% (Figure 22)
- Population, decline for 0.2% (Figure 23)
- Prices of domestic fuels for the period 2012- 2017 (Energy Regulatory Commission)
- Fuel prices – gas (Figure 24), coal, oil (World Energy Outlook (WEO) 2017)
- CO_2 emissions price (Figure 25) (WEO 2017)
- The import price of electricity for the period 2012-2017 (HUPX)

Figure 22 Macedonia GDP projections

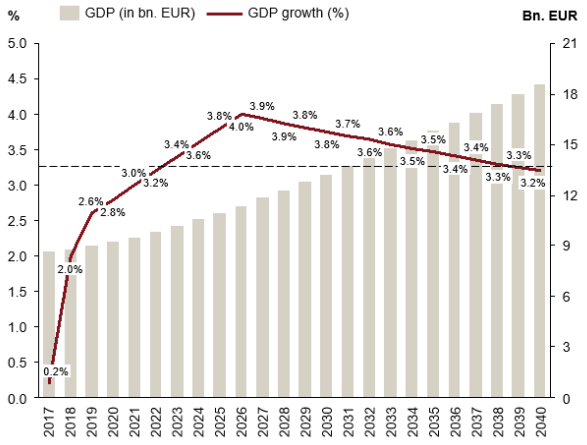


Figure 23 Macedonia population growth

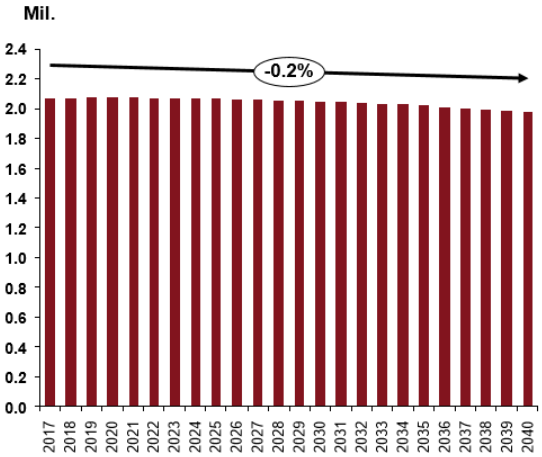


Figure 24. Gas price projection, 2018 – 2040

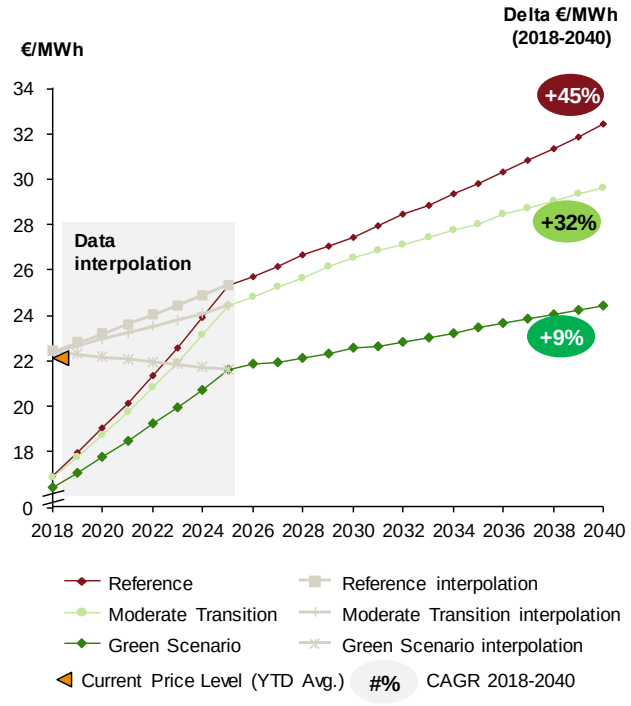
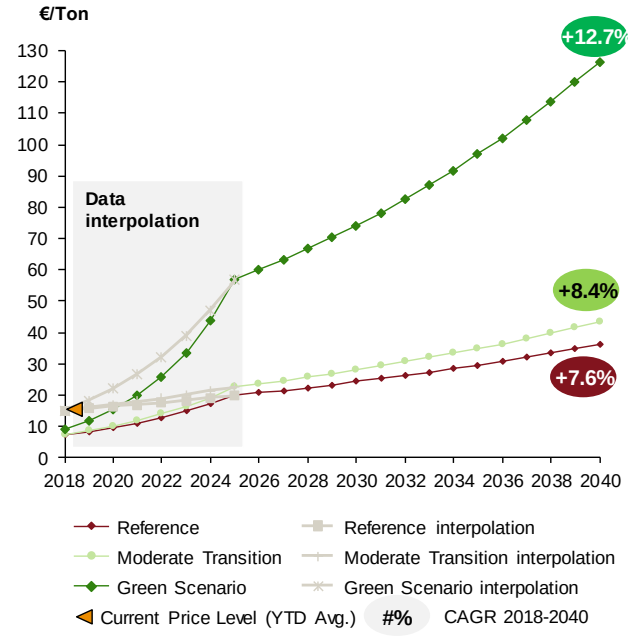


Figure 25. CO2 price projections, 2018 - 2040



Moreover, the good practices established as a part of the SBUR are implemented in this report with upgraded data for the period 2015-2017. These include the basic assumptions made in SBUR, such as:

- Dependence of value added of each industry to the GDP,
- Dependence of the transport sector on the number of vehicles (new and old) bought in Macedonia, the average number of kilometers traveled, the average number of tones of goods transported, etc.,
- Dependence of the residential and non-specified sector on the detailed data about 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, heating and cooling degree days.

All these data are updated with the most recent data used in the Strategy for Energy Development up to 2040.

1.1.2 Method

As support and help in forecasting the energy demand in the period until 2040, the MARKAL (MARKet ALlocation) program package is used. MARKAL is a complex model for planning the development of the overall energy sector at local, national and/or regional level.

According to the IPCC methodology, it is important to mention that the Energy sector includes all sub-sectors that have energy consumption, i.e. in the Energy sector the emissions from fuel consumption are reported. It often happens that the Industry subsector (Manufacturing, Industry and Construction) is equated with the IPPU sector. The IPPU sector includes emissions which are result from certain industrial processes, while the Industry sub-sector in the Energy sector includes emissions from fuel consumption in the Industry. The same applies to the Agriculture subsector, which is present as a subsector in Energy, but also as a separate sector AFOLU.

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.

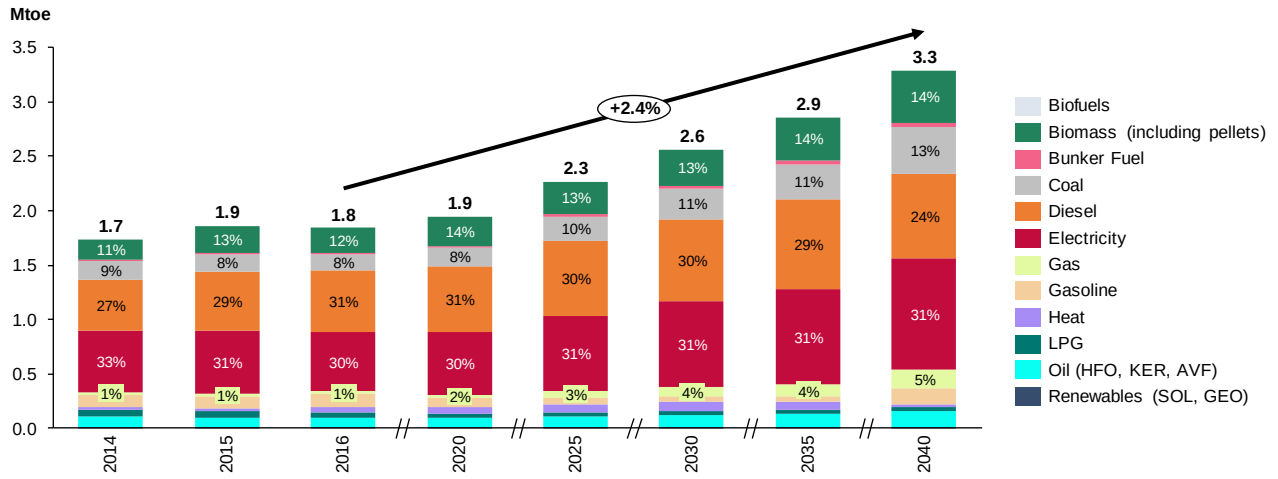
The emission factor of imported electricity

The method developed as a part of the SBUR process regarding the GHG emission from the imported electricity is also used for this report. Namely, in previous reports, under 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 the import of electricity can be treated as a climate change mitigation measure. To avoid such a 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.

1.1.3 Results

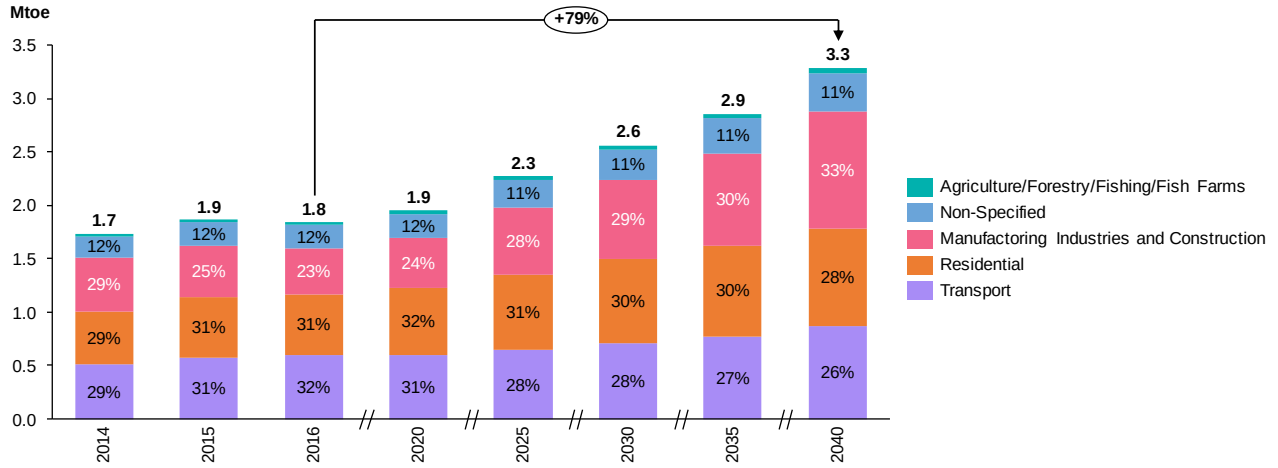
On one hand, the increase in the useful energy demand and on the other hand, not investing in energy efficiency leads to an increase in final energy consumption, which is growing at a rate of 2.4% per year in the period 2016-2040 (Figure 26). Electricity and diesel will continue to play an important role in the final energy consumption participating with around 60%. If the biomass consumption is excluded, the share of the other RES (solar, geothermal) is negligible. However, the share of coal and gas is going to increase, achieving 18% in 2040.

Figure 26. Final energy consumption by fuels



Regarding the final energy consumption by sectors, the Manufacturing Industries and Construction, Residential and the Transport sector are the most dominant ones during the whole period (Figure 27). The largest growth is in the Manufacturing Industries and Construction sector (2.5 times higher in 2040 compared to 2016).

Figure 27. Final energy consumption by sectors



In addition to the increase of the final energy consumption, as well as not investing in RES will double the primary energy consumption in the considered period (Figure 28). Coal will still dominate, but to a much higher extent in the period 2035-2040, reaching a share of 50% in 2040. Oil products are the second largest contributors with an average share of around 30%. The fastest-growing fuel is natural gas, whose consumption is increased around 4 times in 2040 compared to 2016. The increase of the primary energy consumption which is based on fossil fuels will increase GHG emissions in the analyzed period by 77% in 2040 relative to 2016 (Figure 29). Compared to the 1990 level, emissions will be increased by 61% in 2040. It is important to note that the emissions presented in Figure 29 for the period 2014-2040 also include the emissions from electricity import and international aviation, which are not reported in the national total emissions in the GHG Inventory (according to the IPCC methodology). In this report, electricity import is included to properly evaluate the proposed mitigation policies and measures, and not include electricity import as a mitigation option

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Figure 28. Primary energy consumption by fuels

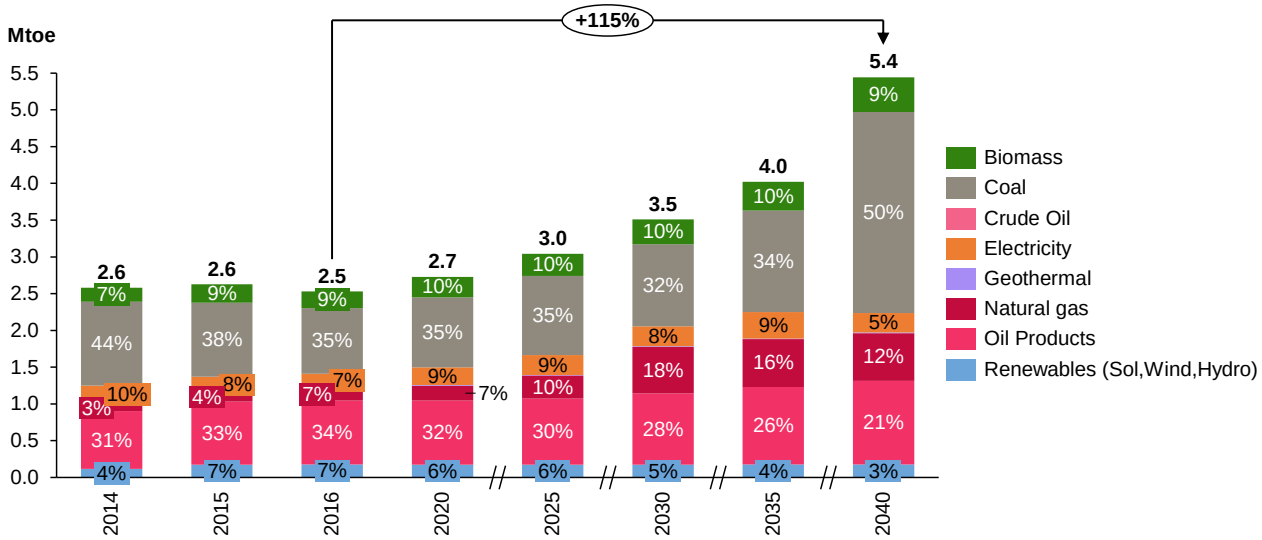
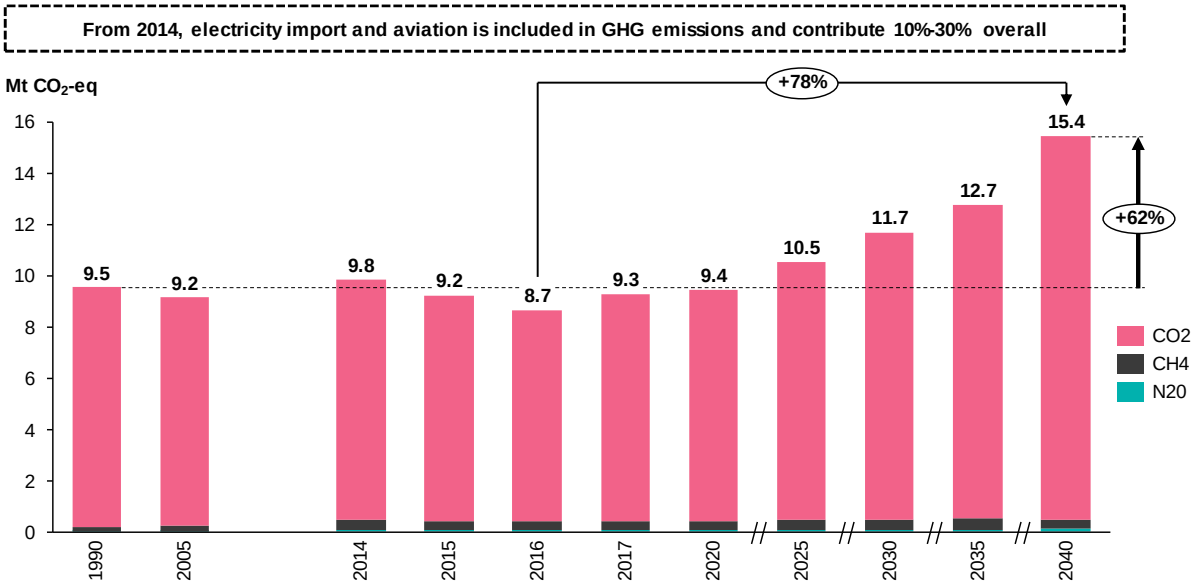
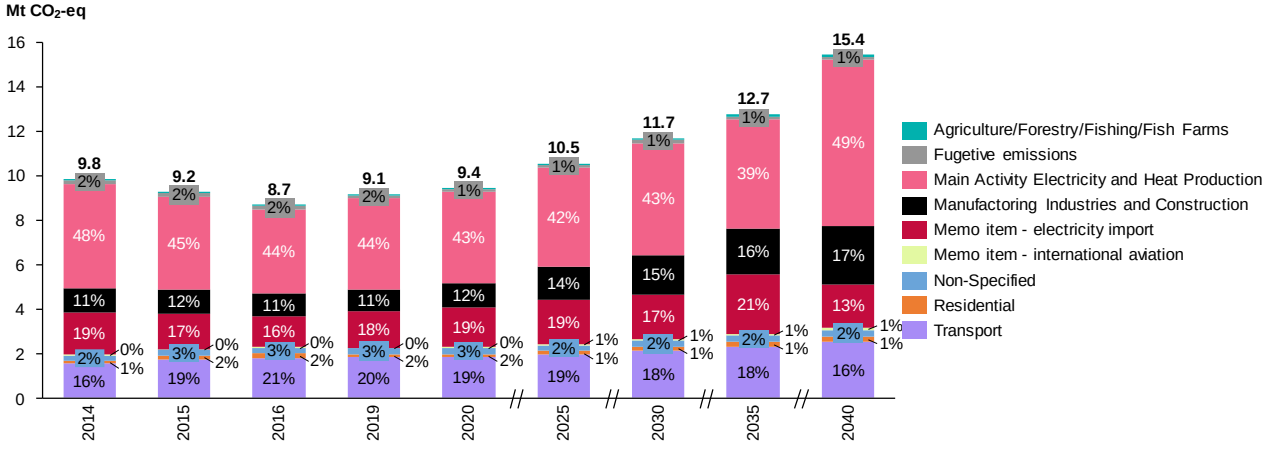


Figure 29. GHG emissions by gas



The consumption of coal makes the Main Activity Electricity and Heat Production sector the greatest producer of GHG emissions (a share of 49% in 2040). As can be noted, electricity import significantly affects GHG emissions with a share of around 18% during the analyzed period (Figure 30).

Figure 30. GHG emissions by sector



1.2 Industrial Processes and Production Use

1.2.1 Key assumptions

In the IPPU sector there are emissions from the following categories: Mineral Industry, Metal Industry and Product Uses as Substitutes for ODS.

The fundamental assumption used to plan the GHG emissions in this sector 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 each industry category is made. The data used for the correlation in SBUR are upgraded for two more years, so the results from the correlation are more precise in TBUR. However, this assumption does not apply to the category Product Uses as Substitutes for ODS, where the main source of emissions is from imported appliances (such as refrigerators and air conditioners). For this category it is assumed that the import of appliances depends on GDP.

1.2.2 Method

The methodology for the calculation of the GHG emissions from IPPU that was developed in the SBUR is also applied in the TBUR. To determine the dependence of the historical emissions from the value added in the Mineral and the Metal industry, a correlation between them is calculated (Figure 31 and Figure 32). From these figures, the equation on their dependence is obtained, which is then used to estimate the emissions from these categories up to 2040. It should be emphasized that this is a basic method for calculation of GHG emission and more attention is needed in this sector during the preparation of Fourth National Communication on Climate Change. Most probably, as a result of energy efficiency measures, there is a negative trend of GHG emission in the Mineral industry. Besides, the production capacity of the entities as well as the products that are produced may contribute to GHG reduction.

For the emissions from the Product Uses as Substitutes for ODS category, a correlation with the total GDP in Macedonia was made, and the obtained equation, together with the planned GDP growth are used to plan the emissions from this category for the period up to 2040 (Figure 33).

Figure 31. Dependence between GHG emissions and value added in the Mineral industry

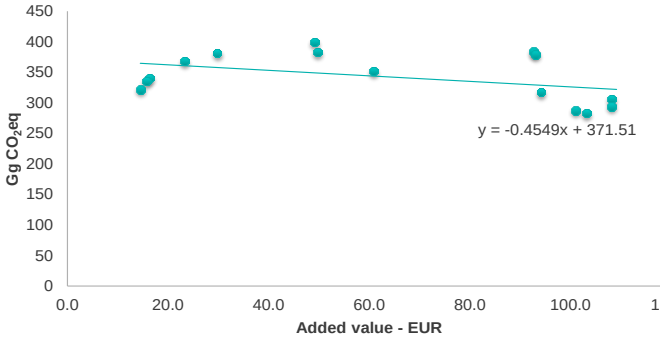


Figure 32. Dependence between GHG emissions and value added in the Metal industry

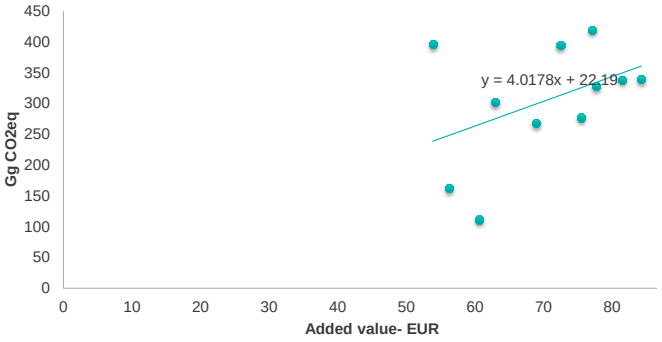
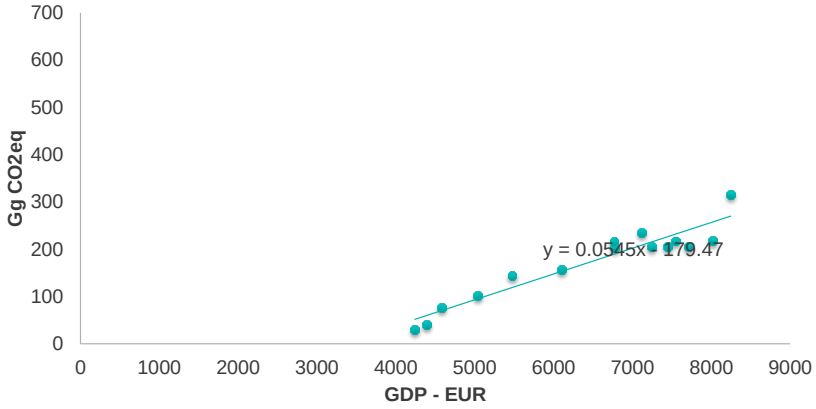


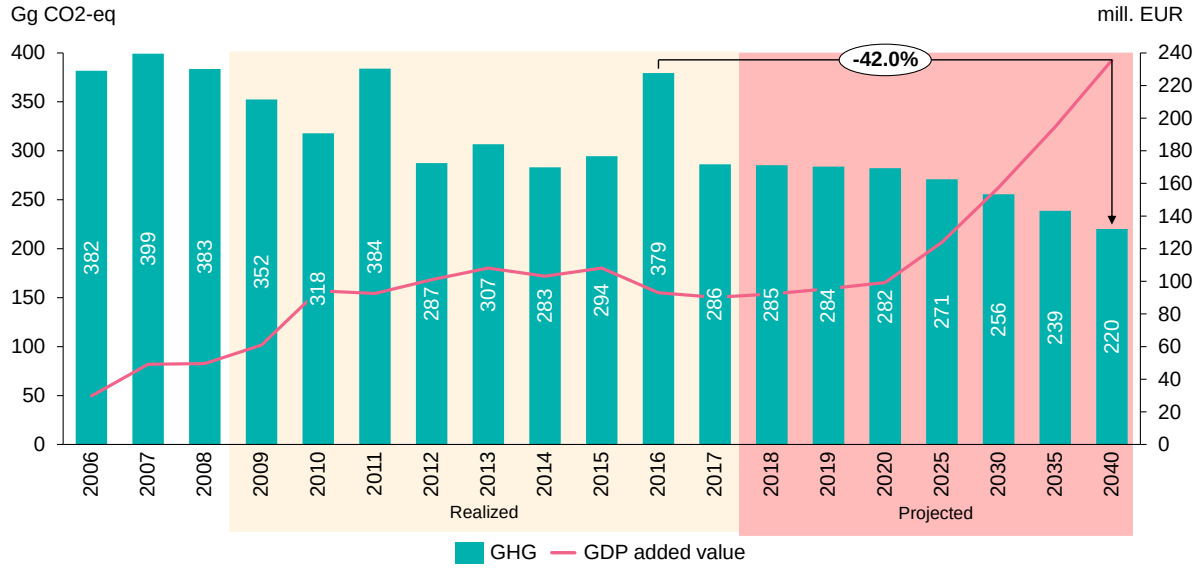
Figure 33. Dependence between GHG emiss0ions in the category Product Uses as Substitutes for Ozone Depleting Substances and total GDP



1.2.3 Results

It is projected that GHG emissions from the Mineral industry, in the period up to 2040 will be reduced by 42% compared to the 2016 level (Figure 34), as the emissions in this category tend to get lower as the GDP value added increases.

Figure 34. Historic and projected GHG emissions and value added in the Mineral industry (in Gg CO_2-eq)



On the other hand, the emissions in the Metal industry are positively correlated to the GDP value added in this category, so the emissions in 2040 are increased by 88.5% compared to 2016 (together with the increase in the value added), reaching 710 Gg CO2-eq in 2040(Figure 35).

The emissions in the category Product Uses as Substitutes for ODS follow the growth of the GDP in Macedonia, and in 2040 they will achieve around 860 Gg CO2-eq or around 3 times more compared to 2016 (Figure 36).

Figure 35. Historic and projected GHG emissions and value added in the Metal industry (in Gg CO_2-eq)

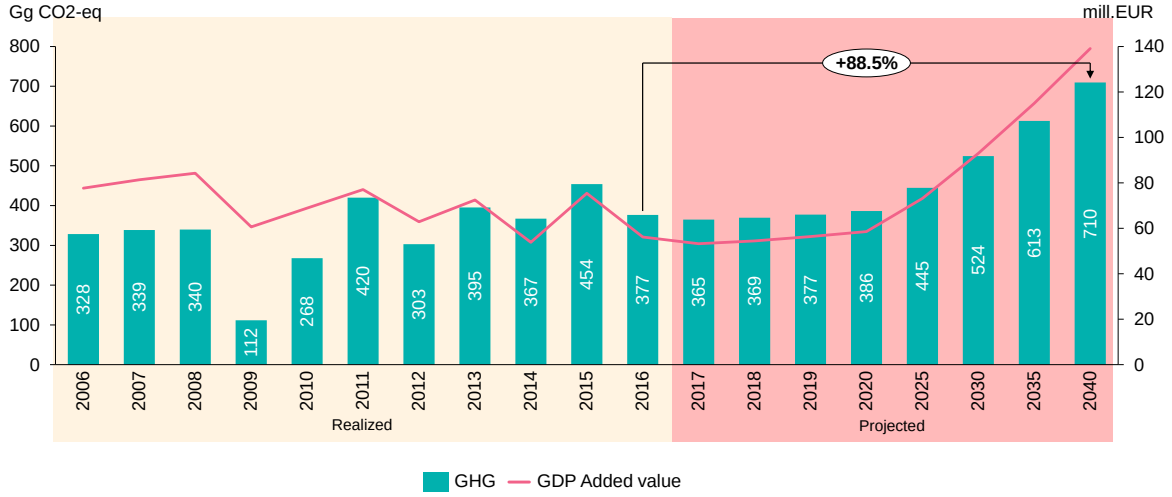
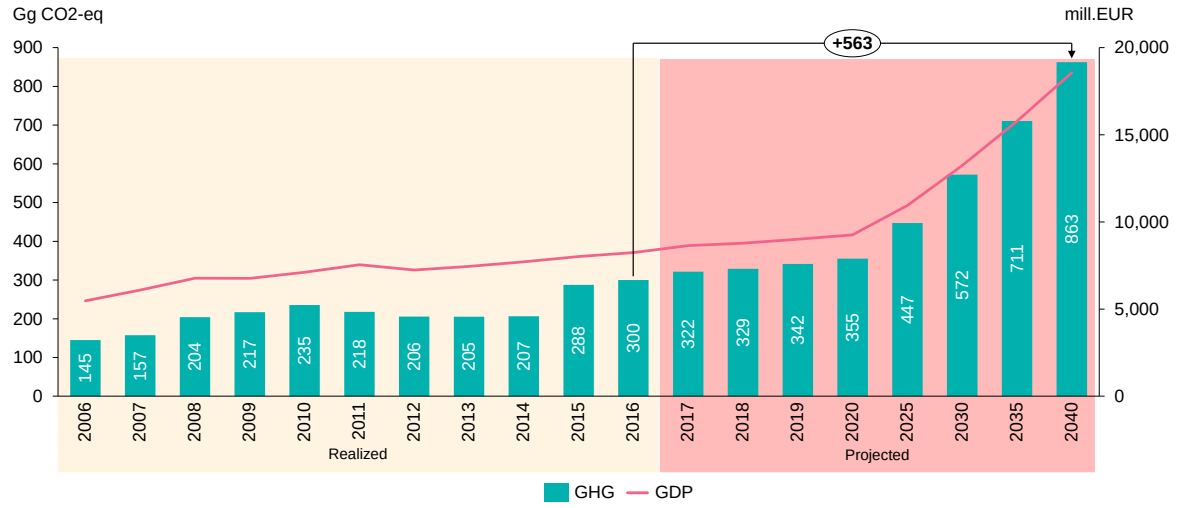
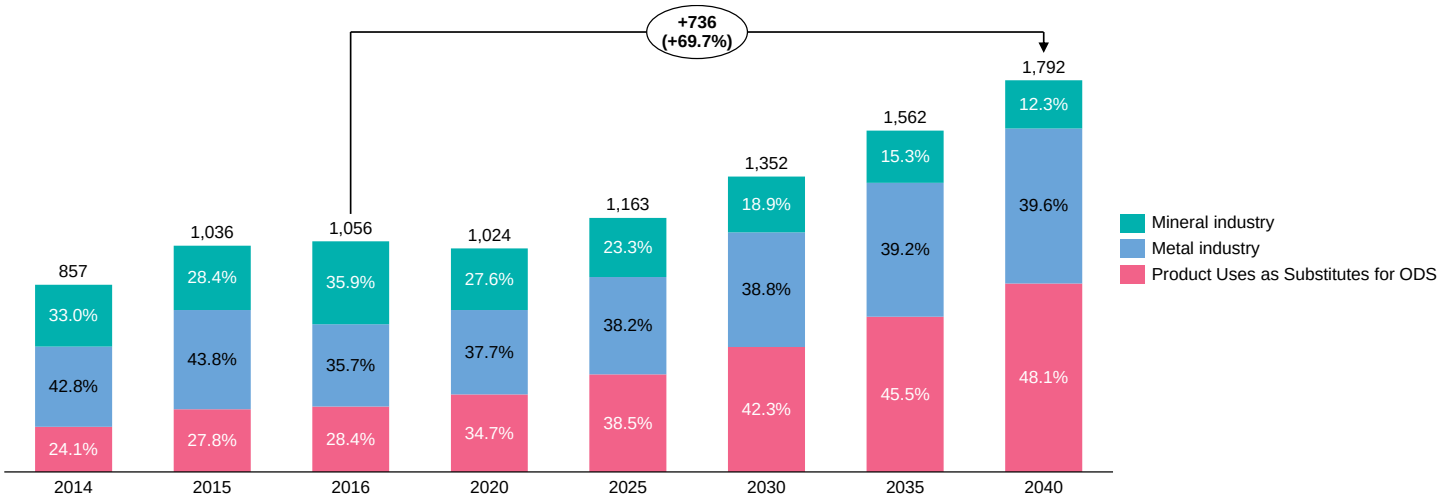


Figure 36. Realised and projected GHG emissions in the category Product Uses as Substitutes for Ozone Depleting Substances and GDP (in Gg CO_2-eq)



Summing up the projections of the emissions in the IPPU sector shows that there is an increase of about 70% in 2040, compared to 2016 (Figure 37). The emissions will reach 1,792 Gg CO2-eq in 2040. Product Uses as Substitutes for ODS will be the most dominant category with an emission share of 48% in 2040 (28.4% in 2016). The share of the Metal Industry is almost the same during the planning period, while the share of the Mineral industry is reduced from 36% in 2017 to 12% in 2040.

Figure 37. Total GHG emissions in Industrial processes and product use sector by categories (in Gg CO2-eq)



1.4 Agriculture, Forestry and Other Land Use

1.4.1 Key assumptions

The major drivers of GHG emissions in the AFOLU sector explained by IPCC (increased livestock numbers, increased area under agriculture, increased use of fertilizer, increased area under irrigation, increased human and animal populations etc.) are not noticed in the country, quite the opposite, the official data show that the livestock number decreased, as well as utilized agricultural area and irrigated area. In addition, there is no evidence on increasing in fertilizer use. Moreover, the population in the country is almost stable in the last 30 years. However, this situation can easily change as a result of country NATO membership, advances in the EU approximation process and other processes making the country more attractive for investments in the agricultural sector. The scenario used in predicting the GHG emission from the AFOLU sector was based on the present situation of decreasing trends. Nevertheless, such a situation can quickly change and become outdated as a result of significant investments in the sector.

In defining the WOM scenario for the AFOLU sector, the hypothesis is that the rate of conversion of the land for the period 2000-2016 will keep the same trend by 2040. The assessment of the values for the period 2013-2040 was prepared employing a 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. However, CO_2 emissions are calculated according to the basic dynamics of the past changes in land use. Besides, in this scenario, it was assumed that no mitigation measures will be applied, i.e. the usual practice in land use will be continued. In the Livestock sector the size of the population is expected to be reduced. This decrease began in the early '90s 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. Also, it is assumed in the case of dairy farms, their number will be reduced while efficiency in milk production will be increased, due to economic logic.

1.4.2 Method

Livestock

To anticipate GHG emissions from the activities related to livestock production, a Reference scenario is prepared initially without the 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 to be maintained over the whole planning period.

The data used in the forecasts 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 the population are based on expert opinion. For all types of domestic animals in the Reference Scenario, in 2015 the official statistics for 2015 were used.

Cattle group consists of two different production groups, e.g. dairy cows and other cattle. 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 the aspect of efficiency in the work, it is realistic to expect that many of the existing 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. Every 5 years subsequently, an additional 5% of dairy farms will be transformed into organized, thus in 2040 their share is expected to be 30% 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 if the current descending trend of dairy population remains (a drop of about 17% by 2040), milk production is expected to increase, primarily due to the increased production per head. Other cattle are also expected to experience a moderate decrease in the population, primarily due to the 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 (1990-2016) continues, then it is realistic to expect a decrease in the population by an additional 28% by 2040 (Table 6).

The population of ungulates (horses and donkeys) counts nearly 20,000 heads. This population contributes insignificantly to 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 2040 the population of pigs will decrease (from 28,671 in 2016 to 20,000 in 2040), but at the same time, the number of pigs for fattening will decrease from 202,758 (2016) to 185,000 (2040).

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 6. Statistical (2014, 2015 and 2016) and foreseen data on the number of domestic animals used in forecasting GHG emissions in Livestock

Types and categories	*2014*	*2015*	*2016*	*2020*	*2025*	*2030*	*2035*	*2040*
Dairy cows	155,432	156,699	160,603	144,814	140,534	136,381	132,350	128,438
Other cattle	86,175	96,743	94,165	93,671	92,405	91,318	90,367	87,656
Sheep	619,839	599,869	607,622	480,725	461,817	442,910	424,002	405,093
Sheep up to 1 year	113,671	123,426	116,933	120,756	116,096	112,043	108,457	104,101
Goats	81,346	88,064	101,669	44,462	36,559	28,655	20,752	12,849
Horses	19,371	18,784	19,263	19,921	19,926	19,931	19,936	19,941
Swine	23,511	20,857	28,671	22,000	21,000	20,000	20,000	20,000
Fattening pigs	141,542	174,586	202,758	165,000	168,000	170,000	180,000	185,000
Poultry	1,939,879	1,761,145	1,865,769	1,820,645	1,910,712	2,005,922	2,106,577	2,201,888
Laying hens	1,884,289	1,423,841	1,705,948	1,790,075	1,879,578	1,973,557	2,072,235	2,166,288
Broilers	4,355	51,256	15,998	6,532	7,839	9,406	11,288	12,873
Turkeys	3,690	2,910	10,070	5,535	6,642	7,971	9,565	10,908
Other poultry	19,477	17,908	36,245	18,503	16,653	14,988	13,489	11,818

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

Several modeling options were evaluated, but as a most appropriate, IPCC methodology was selected However, using the IPCC methodology, the changes in output data can be initiated by modifying the input data (by altering the land use change areas or by modifying parameters and coefficients required accordingly to the management practices prevailing in the country). Unfortunately, both data types are not available in the country, therefore the approach used was implementing the extrapolation method. However, there are intensive activities to derive land use changes data from historical satellite imagery and to establish datasets required for improvement of the modeling capacities in the AFOLU sector.

Moreover, the research on available options for future modeling improvement was conducted. The model AFOLU-B (bottom-up approach) (Hasegawa et al, 2017, Pradah et al, 2019) was determined as an advanced tool for development mitigation analyses in AFOLU sector, but for implementing such a model, the scenario for agricultural production is required as well as many other datasets that are still not available in the country. Moreover, The Joint Research Center of the European Commission published the technical paper Mitigation measures in the Agriculture, Forestry, and Other Land Use sector in 2016 (Leip et al, 2017). This paper provides information on data requirements, for evaluating the mitigation measures and options. However, once again the lack of datasets with decent quality was a major shortcoming for implementation of some advanced approach in modelling. According to the JRC report data sources are mainly developed by observation and research for establishing the

parameters required. Therefore, high priority should be given on capacity building for research and observations required for the development of the dataset on national emission coefficients during the next period.

Therefore, the IPCC methodology was the method of choice. Due to a lack of available datasets and scenarios the IPCC methodology was combined with empirical modelling to estimate trends in Agriculture and land-use changes. However, this hybrid approach is not sustainable and certain steps should be taken for the development of the datasets required.

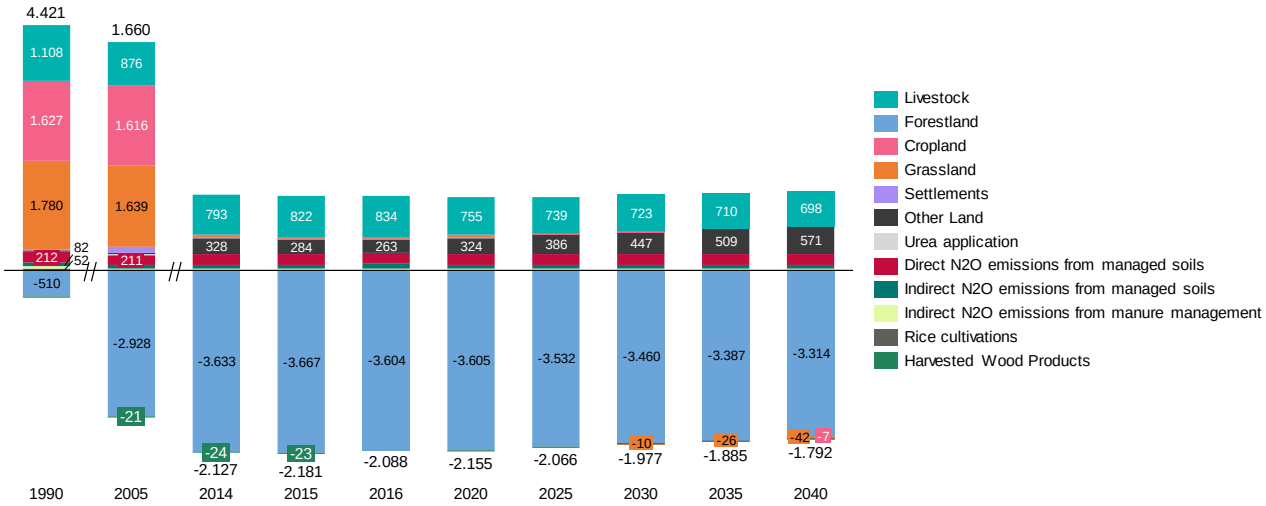
1.4.3 Results

In the period 2014 to 2040 the AFOLU sector emissions in the WOM scenario will increase by 17.5% (Table 7). The main reason is decreasing of the forest carbon sink for almost 10%. At the same time, the emissions from the other land use are increased by around 30%. Dairy cows and other cattle are the main emitters of GHG emissions in livestock production, while other 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 emissions from the Livestock sub-sector will reduce by 16.6% mainly due to the reduction in the number of animals. The GHG emissions from the sub-sector Aggregate sources and non-CO2 emissions sources on land in 2040 will remain at almost the same level as in 2014, while the sinks from the sub-sector Other are increased by around 45% although the share of this sector in total sinks is negligible.

Table 7. Estimated total emissions for the period 2014-2040 in the AFOLU sector

	2014	2015	2016	2020	2025	2030	2035	2040
AFOLU	**-2129.9**	**-2185.7**	**-2062.1**	**-2,155.5**	**-2,066.4**	**-1,976.9**	**-1,885.4**	**-1,791.8**
Livestock	**789.8**	**816.5**	**831.2**	**754.7**	**738.8**	**723.3**	**709.8**	**698.5**
Land	**-3234.2**	**-3316.3**	**-3281.1**	**-3,226.5**	**-3,118.7**	**-3,010.9**	**-2,903.0**	**-2,795.2**
Forestland	-3632.8	-3666.6	-3603.6	-3,605.2	-3,532.4	-3,459.6	-3,386.8	-3,313.9
Cropland	34.76	28.84	31.22	28.07	19.22	10.37	1.52	-7.33
Grassland	32.25	27.94	25.80	22.21	6.09	-10.04	-26.16	-42.29
Settlements	3.64	9.36	2.92	4.59	2.79	0.99	-0.81	-2.61
Other Land	327.87	284.16	262.57	323.85	385.63	447.41	509.19	570.98
Aggregate sources and non-CO_2 emissions sources on land	**338.78**	**337.41**	**359.78**	**342.4**	**341.8**	**341.2**	**340.6**	**340.0**
Urea application	3.67	3.51	3.19	3.1	2.7	2.4	2.0	1.6
Direct N_2O emissions from managed soils	209.33	208.37	224.45	214.5	216.9	219.3	221.7	224.2
Indirect N_2O emissions from managed soils	75.46	75.26	80.71	76.0	75.8	75.6	75.4	75.2
Indirect N_2O emissions from manure management	26.27	27.10	28.01	25.9	25.0	24.1	23.2	22.4
Rice cultivations	24.05	23.17	23.42	22.9	21.3	19.8	18.2	16.6
Other	**-24.19**	**-23.27**	**28.01**	**-26.0**	**-28.3**	**-30.5**	**-32.8**	**-35.0**
Harvested Wood Products	-24.19	-23.27	23.42	-26.0	-28.3	-30.5	-32.8	-35.0

Figure 38 Total GHG emissions in AFOLU sector by subcategories (in Gg CO2-eq)



1.5 Waste

1.5.1 Key assumptions

The approach established as a part of the SBUR is also used in the TBUR. In the Waste and Energy sectors, the same key drivers are used, i.e. GDP and population (explained in the section on macroeconomic drivers). To calculate the GHG emissions from Municipal Solid Waste Disposal, one of the key parameters, besides population, is the amount of waste per capita. For that purpose, the 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. It is interesting to note that for example in Austria the quantity of waste during the period 2008-2017 is stable. The same situation is with Greece and Croatia, while in Bulgaria the amount of waste per capita is reduced by about 25%. At the EU 28 level there is a downward trend, while in Macedonia, if 2017 is excluded, there is a trend of growth. In the SBUR it was assumed that these trends will continue and in 2035 Macedonia will have the same level of waste per capita as the EU28. In TBUR the same assumption is applied. Additionally, it is assumed that in the period after 2035, the amount per capita will start to decline (Figure 39).

In the reference scenario it is also assumed that the composition of waste going to solid waste disposal will remain the same during the whole period as they are for 2016, i.e. food – 36.7%, garden – 10.7%, paper – 10.8%, wood – 0.4%, textile – 3.7%, nappies – 5.0% and plastic, other inert – 32.6%. Additionally, the distribution of waste by waste management treatment will be equal to the distribution in 2016, for the whole period. For calculating the industrial waste, the data for the value added for the industry from the MARKAL model are used

1.5.2 Method

A completely new Excel model able to calculate the GHG emissions from the Waste sector was developed in the SBUR. This model 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 2040 are calculated.

For the first time, in the reference scenario mechanical and biological treatment with composting is included (Figure 39). Based on the historical data for the period 2011-2016, an equation for the trendline of the emissions from composting is obtained. Based on this equation, the emissions for the period from 2017 to 2040 are calculated.

Figure 39. Quantity of municipal waste per capita in Macedonia, EU28 and countries in the SEE region (in kg/capita)

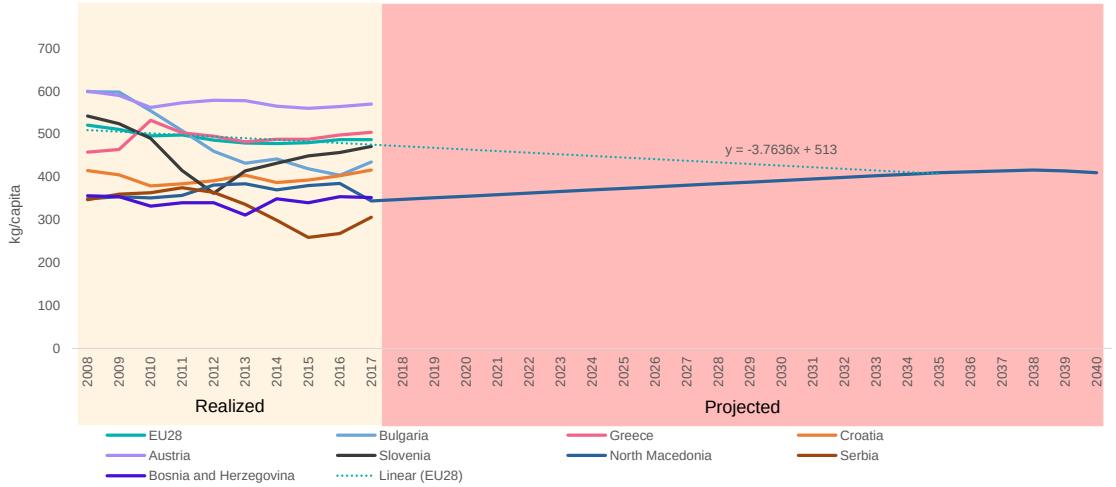
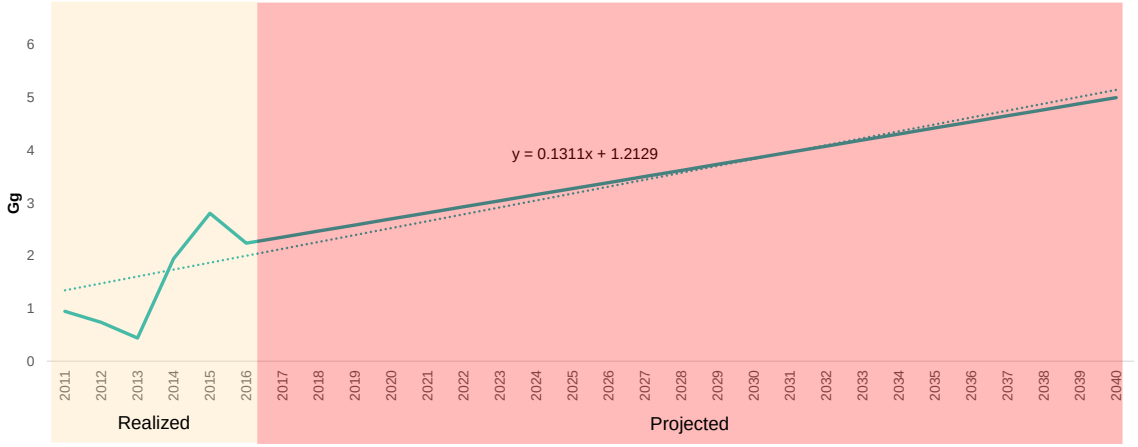
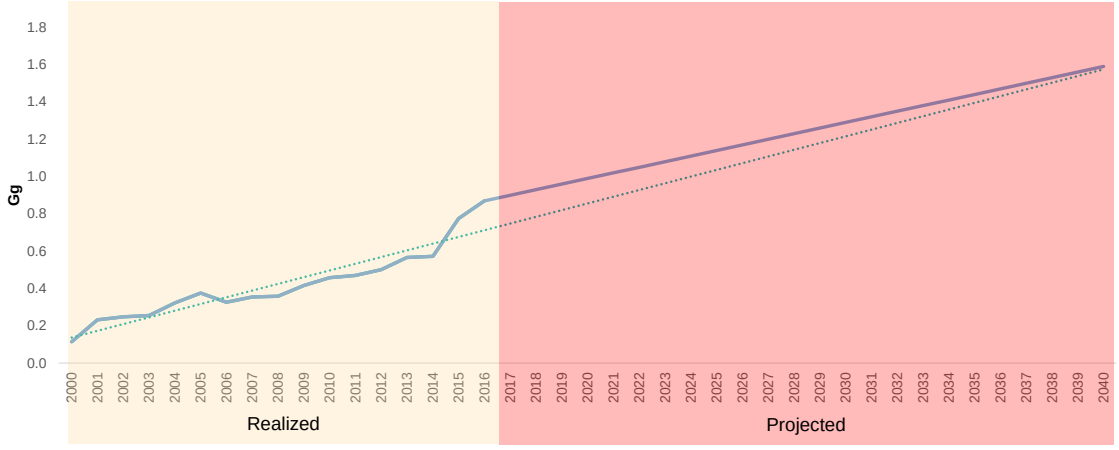


Figure 40. Calculation of waste treated by biological treatment facilities



The emissions from waste incineration are also considered in the WOM scenario, and again a trendline is calculated based on the available historical data for the period 2000-2016 (Figure 41). Using the trendline, emissions from incineration of waste up to 2040 are calculated.

Figure 41. Calculation of the total amount of waste incinerated



In order to estimate the emissions from the industrial wastewater sector, a correlation is made between the Total organic degradable material in wastewater with the value added in the industry for the period from 2008-2016 (Figure 42). The derived equation for the correlation is used to calculate the total organic degradable material in wastewater for the period up to 2040 (Figure 43).

Figure 42. Correlation between the total organic degradable material in wastewater and value added in the industry for the period 2008-2016

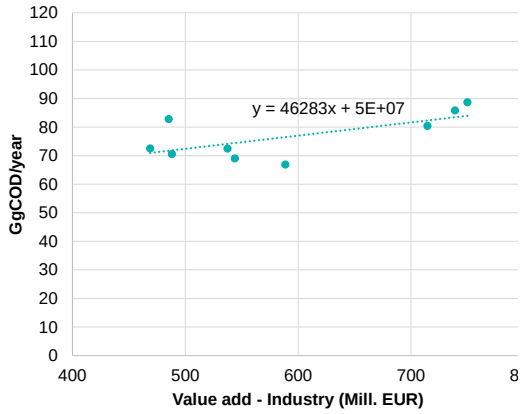
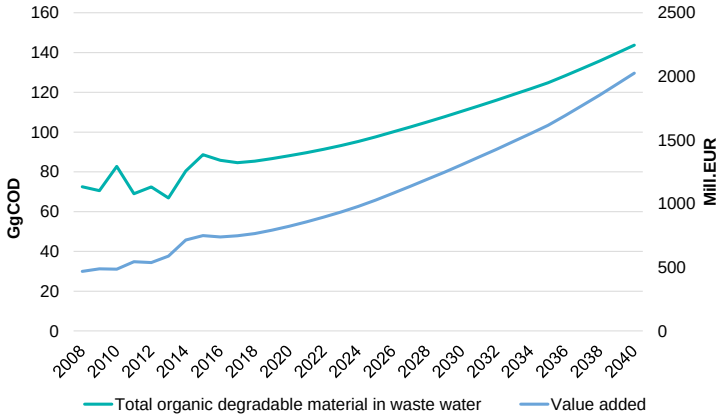


Figure 43. Total organic degradable material in wastewater and value added in the industry for the period 2008-2040



1.5.3 Results

The results for the Waste sector in the WOM scenario show that the total GHG emissions from this sector will increase by 50% in 2040 (914 Gg CO_2-eq) compared to 2016 (Figure 44). The subcategory with the largest share of emissions (81% in 2040) remains the Solid waste disposal for the whole period, followed by the subcategory Industrial Wastewater (10% in 2040) and Domestic Wastewater (6% in 2040). Concerning the emissions by gases, by far the largest amount is from CH_4, with a share of 95% in 2040 (Figure 45).

Figure 44. Total GHG emissions in the Waste sector by subcategories (in Gg CO_2-eq)

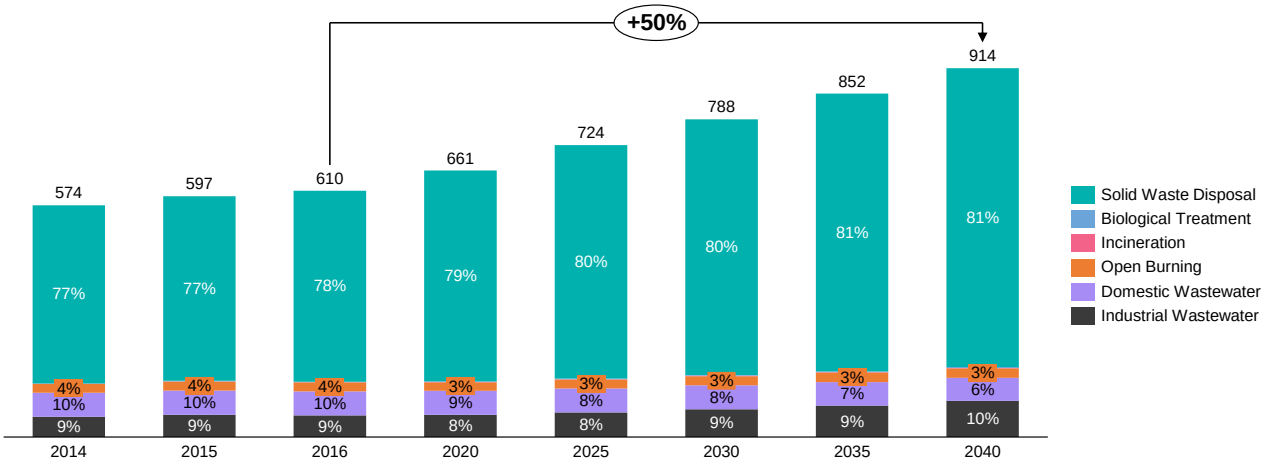
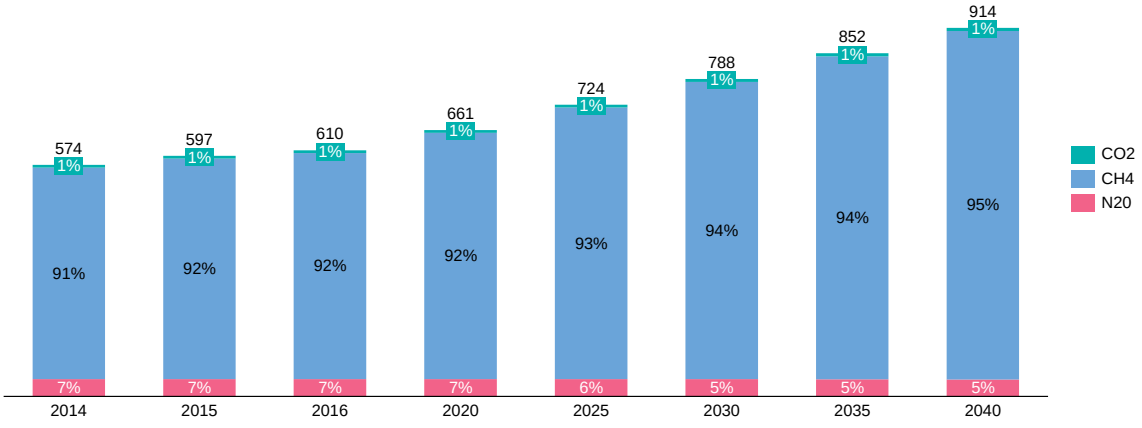


Figure 45. Total GHG emissions in the Waste sector by gasses (in Gg CO_2-eq)

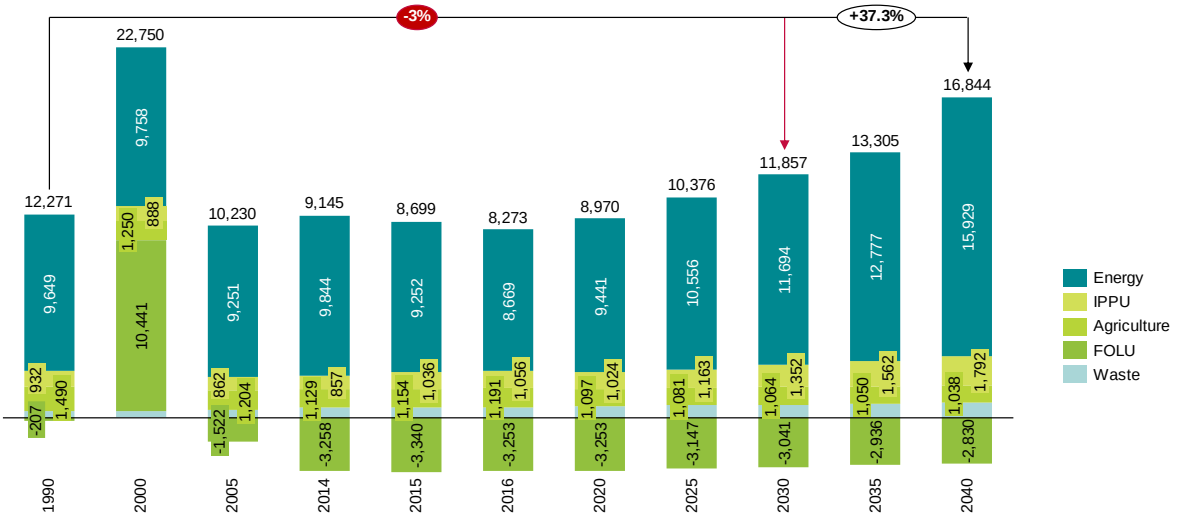


1.6 Total emissions

The total net GHG emissions from all sectors in the WOM scenario is expected to increase by 37.3% in 2040 compared to 1990, or by 64.7% compared to 2005, reaching 16,844 Gg CO_2-eq in 2040 (Figure 46). Compared to 2030, the net emissions are reduced by 3%. The comparison is made relative to 1990 and 2005 because the exact base year for Macedonia is not defined yet. When analyzing the total GHG emissions without the FOLU sector, this increase is even more dramatic, i.e.+19% in 2030 and +57.7% in 2040 compared to 1990 (Figure 47). From these emissions, the largest amount is from the Energy sector, which increases its share by up to 81% in 2040. Additionally, the fastest growing sector in terms of emissions is the Waste sector, where the emissions in 2040 are 2.25 times larger than in 1990. On the other hand, the only sector that is absorbing CO_2 emissions (has negative emissions) is the FOLU sector, and the amount of emissions absorbed is increased in 2040 compared to 1990 and 2005, but it is decreased by 13% compared to 2016.

The IPCC methodology does not include emissions from electricity imports, as well as from international aviation. To compare the results with the GHG inventory of Macedonia, but also with the results from the other countries, in this report the results without electricity import and international aviation (MEMO) are also presented (Figure 48). Using this approach, in 2030 the net emissions are reduced by 20%,while in 2040 the GHG emissions are increased by 30.8% compared to 1990. The difference between these two approaches is mainly due to the import of electricity, which in the IPCC approach reduces the GHG emissions.

Figure 46. Total GHG emissions by sectors - WOM scenario (in Gg CO_2-eq)



Note: Due to the large area affected by fires in 2000, FOLU instead of sinks, contributed to the increase of the GHG emissions.

Figure 47. Total GHG emissions by sectors (without FOLU) - WOM scenario (in Gg CO_2-eq)

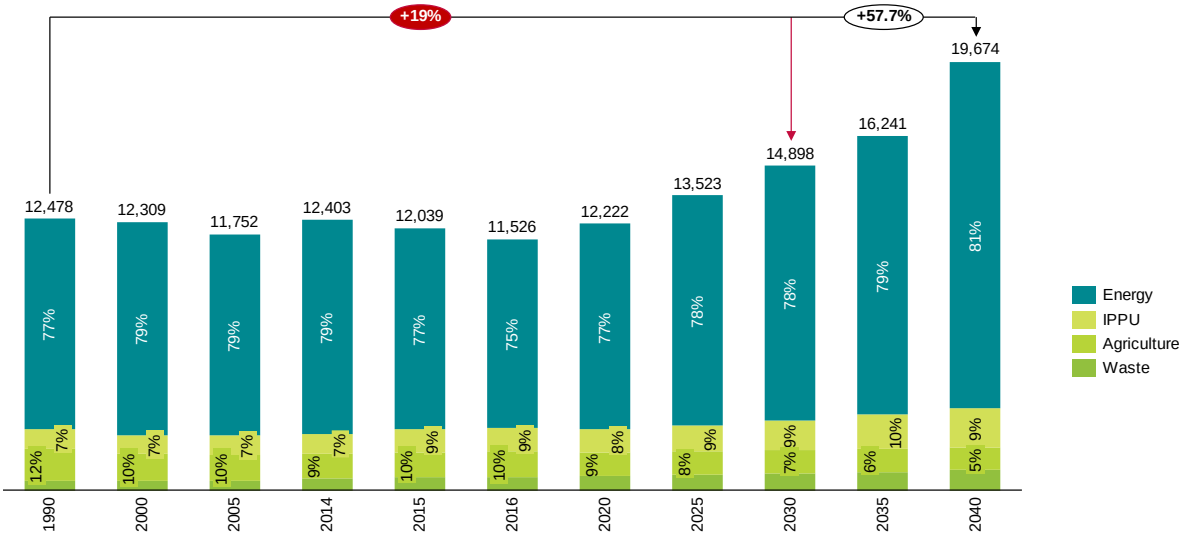
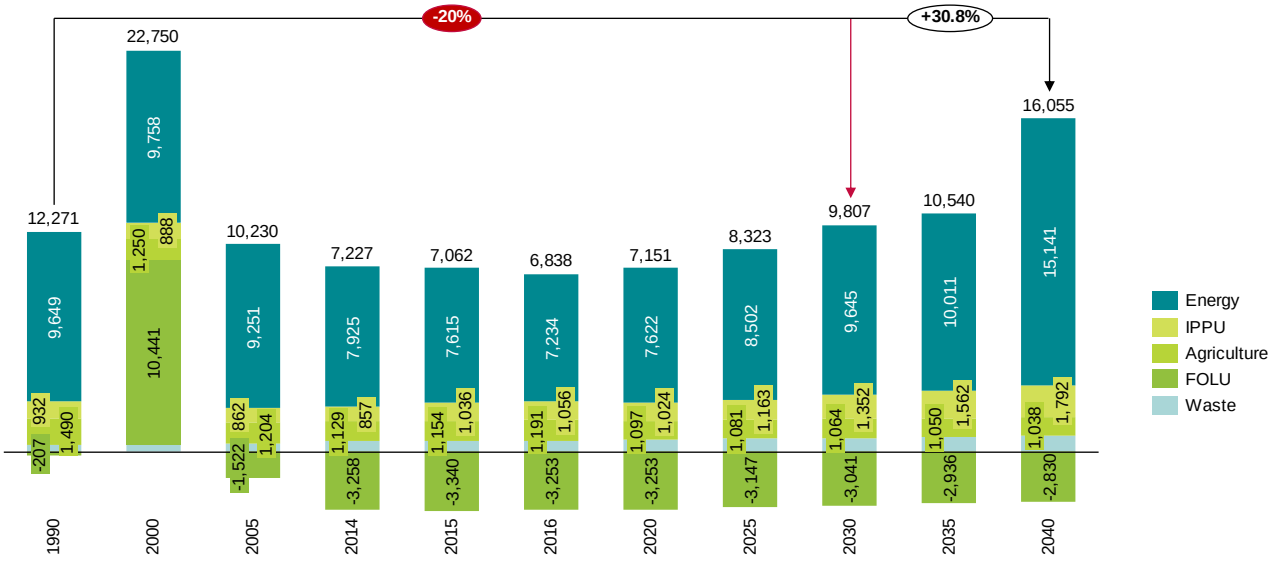


Figure 48. Total GHG emissions by sectors without MEMO - WOM scenario (in Gg CO_2-eq)



5 MITIGATION MEASURES AND THEIR INDIVIDUAL EFFECT

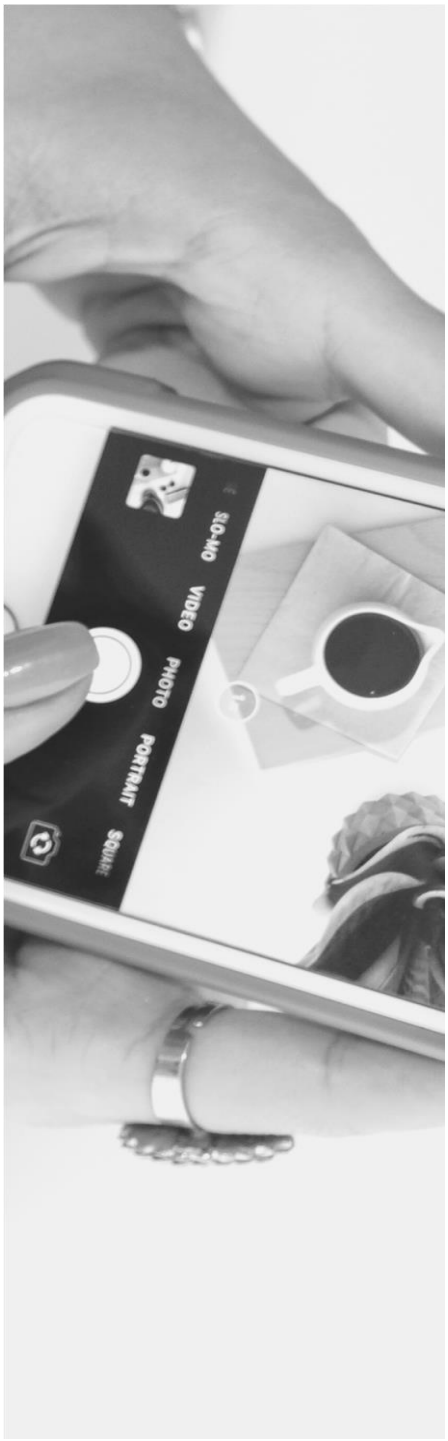
Source: "Design and inspire climate action" contest for youth.

MITIGATION MEASURES AND THEIR INDIVIDUAL EFFECT

63 climate change mitigation measures/policies are considered in this scenario of which 32 in the Energy sector, 11 in AFOLU (4-Agriculture, 2- Forestry, 5- Land use change), 4 in Waste and there are 16 additional PAMs which are enablers of mitigation actions. All PAMs are presented in this chapter in tabular form and are providing information on:

1 Mitigation action;
2 Main objective;
3 Description;
4 Information: Type; Sector; Relevant Planning documents, legal and regulatory acts; Gases; Methodology; Assumption;
5 Progress of implementation: Steps taken or envisaged to achieve the action; Energy savings (Final Energy and Primary Energy); Estimated emission reductions; Timeframe; Finance (Budget, Costs [1] and Specific Costs [2]); Implementing entity;
6 Progress indicators;
7 Contribution to the achievement of the SDGs.

The effect of the mitigation measures regarding energy savings, emissions reduction and costs are presented in relation to the WOM scenario. The final energy consumption, primary energy consumption and GHG emissions for the Energy sector, in the WOM scenario, are presented on Figure 26 and Figure 27 , respectively .



[1] Annual cost includes: Fuel Supply costs, Delivery costs, O&M costs, Annual Investment

[2] Specific cost (Economic effectiveness) - shows the number 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

1.1 ENERGY

1.1.1 Energy supply

PAM 1 Reduction of network losses

Main objective: Reduction of losses in electricity and heat networks

Description: Technical measures for reducing distribution electricity losses comprise of overhead lines replacement with underground (where possible), transition to 20 kV voltage level, installation of new transformation stations to shorten the low voltage lines, as well as automation and remote network management. All these improvements will contribute to better SAIDI and SAIFI indicators. For the heating sector, technical measures include continuous replacement of existing heat pipelines with pre-insulated ones and optimization of the substation operations through automatic control.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Technical	Energy supply	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Strategy for Energy Development up to 2040 • Development plan of EVN Macedonia, AD • Development plan of Balkan Energy Group (BEG)
Methodology	Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
Assumptions	• Technical interventions will reduce the electricity transmission and distribution losses from 12% to 8%, while the district heating system losses will be reduced from 12% to at least 7%.
Status of implementation	Under implementation
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 (modernization of the SCADA system, integration of the distribution networks). • Installation of modern equipment for regulation and monitoring in the heating substations for control and reduction of the consumed heat

Indicators		Value in the last reporting year	Indicative trajectory		Target value
		2016-2018	2020	2025	2030
Progress	Network losses reduced (%)	14.2% for electricity 12.5% heat			10.5% for electricity 10% heat
Emissions reduction (Gg CO_2-eq)		43.2	201.8	167.0	323.4
Other	Primary energy savings (ktoe)	9.9	11.0	15.0	28.9

Finance – Budget	170 M€
Finance – Source of finance	Electricity and heat distribution companies
Implementing entity	• Electricity distribution companies • Heat distribution companies
Monitoring entity	Energy Agency, Ministry of Economy

Contribution for the achievement of the SDGs	direct	indirect
	7 AFFORDABLE AND CLEAN ENERGY	12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION

PAM 2 Large hydro power plants

Main objective: Increase of the domestic generation capacity from renewable energy sources
Description: Construction of new large hydro power plants taking into account environmental and social impacts

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Technical	Energy supply	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Strategy for Energy Development of the Macedonia up to 2040 • Strategy for utilization of renewable energy sources in the Republic of Macedonia • Development plan of ESM AD (JSC Macedonian Power Plants).
Methodology	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: • Vardar valley – 2025-2030 • Chebren – 2029 • Tunnel Vardar – Kozjak, Veles and Gradec • Globochica II – 2035
Status of implementation	Under implementation
- Steps taken	• Feasibility/pre-feasibility studies developed • Chebren feasibility study • Prequalification tender for Chebren published
- Steps envisaged	• Invitation for tenders for the construction of the other hydropower plants, selection of the best bidder and commencement of the construction

Indicators		Value in the last reporting year	Indicative trajectory		Target value
		2018	2020	2025	2030
Progress	Additional installed capacity (MW)	/			808
Emissions reduction (Gg CO_2-eq)		/	0	37.0	740.7
Other	Primary energy savings (ktoe)	/	0	6.4	28.8

Finance	Budget	1716.2 M€
	Source of finance	Public private partnership, ESM
Implementing entity		• ESM AD (JSC Macedonian Power Plants). • Ministry of Environment and Physical Planning • Energy Agency, Ministry of Economy
Monitoring entity		Energy Agency, Ministry of Economy

Contribution for the achievement of the SDGs	direct	indirect
	7 AFFORDABLE AND CLEAN ENERGY	12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION

* Most critical capacities are Chebren, Veles and Gradec. Latest in 2022, concrete activities for Veles and Gradec should be undertaken. If these capacities are not built the electricity import dependence of the country increase. Another possibility is to substitute the electricity production of Veles and Gradec with production from natural gas power plants, but in this case the set GHG emissions that are coming from the electricity production will increase.

PAM 3 Incentives feed-in tariff

Main objective: Incentives feed-in tariff
Description: Construction of new small hydro power plants, wind and biogas with feed-in tariffs that will stimulate the construction

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Technical, regulatory	Energy supply	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Strategy for Energy Development of the Republic of Macedonia • Strategy for Utilization of Renewable Energy Sources in the Republic of Macedonia • Renewable Energy Action Plan • Law on Energy • Bylaws for renewable energy
Methodology	Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
Assumptions	Through stimulation with feed-in tariffs, it is envisaged that by 2040 additional capacity of: • 86 MW wind power plants • 13 MW biogas power plants • 92.5 MW small hydro power plants will be constructed.
Status of implementation	Under implementation
- Steps taken	• Regulation on feed-in tariffs adopted (17.04.2013) • Decree on the measures for support of electricity generation from renewable energy sources adopted (5.04.2019). • Decision on the total installed capacity for preferential producers of electricity adopted (5.04.2019).
- Steps envisaged	• Construction of power plants

Indicators		Value in the last reporting year	Indicative trajectory		Target value
		2016-2018	2020	2025	2030
Progress	Additional installed capacity (MW)	17.6			159
Emissions reduction (Gg CO_2-eq)		67.3	11.7	109.7	149.5
Other	Primary energy savings (ktoe)	14.9	1.8	19.7	24.5

Finance	Budget	356.9 M€
	Source of finance	Private, incentives through consumer bills
Implementing entity		• Government of the Republic of North Macedonia • Energy Regulatory Commission • Ministry of Environment and Physical Planning • Ministry of Economy, Energy Agency • Private investors
Monitoring entity		Energy Regulatory Commission
Contribution for the achievement of the SDGs	direct	
	indirect	

PAM 4 Incentives feed-in premium

Main objective: Increase of the domestic generation capacity from renewable energy sources
Description: Construction of solar and wind power plants with feed-in premium tariffs to stimulate the construction

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Technical, regulatory	Energy supply	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Strategy for Energy Development of the Republic of Macedonia up to 2040 • Law on Energy • Bylaws for renewable energy
Methodology	Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
Assumptions	Through stimulation with feed-in premium, it is envisaged that by 2040 additional capacity will be constructed: • 200 MW solar power plants • 64 MW wind power plants
Status of implementation	Under implementation
- Steps taken	• Decree on the measures for support of electricity generation from renewable energy sources as well as decision on the total installed capacity for preferential producers of electricity adopted (5.04.2019). • Public call on awarding an agreement for right to use premium for electric power produced from photovoltaic power plant constructed on land owned by the Republic of North Macedonia (21.07.2019) • Public call on awarding the right to use a premium for electricity generated and sold from photovoltaic power plants built on land not owned by the Republic of North Macedonia or on land owned by the Republic of North Macedonia on which right to use has been established (2.10.2019) • Electronic auction for both tenders • Public call on awarding an agreement for right to use premium for electric power produced from photovoltaic power plant constructed on land owned by the Republic of North Macedonia • Public call on awarding the right to use a premium for electricity generated and sold from photovoltaic power plants built on land not owned by the Republic of North Macedonia or on land owned by the Republic of North Macedonia on which right to use has been established
- Steps envisaged	• Construction of solar power plants • New public call on awarding an agreement for right to use premium for electric power produced from photovoltaic power plant constructed on land owned by the Republic of North Macedonia • New public call on awarding the right to use a premium for electricity generated and sold from photovoltaic power plants built on land not owned by the Republic of North Macedonia or on land owned by the Republic of North Macedonia on which right to use

Indicators		Value in the last reporting year	Indicative trajectory		Target value
		2018	2020	2025	2030
Progress	Installed capacity (MW)	/			264
Emissions reduction (Gg CO_2-eq)		/	0	109.7	162.6
Other	Primary energy savings (ktoe)	/	0	24.4	21.5

Finance	Budget	240.6 M€
	Source of finance	Private, incentives from the central government budget
Implementing entity		• Government of the Republic of North Macedonia • Energy Regulatory Commission • Ministry of Economy • Private investors
Monitoring entity		Ministry of Economy
Contribution for the achievement of the SDGs	direct	indirect

PAM 5 Biomass power plants (CHP optional)

Main objective: Increase of the domestic generation capacity from renewable energy sources

Description: This measure considers construction of distributed small sized biomass power plants (CHP optional) with stimulation through feed-in tariffs. Beside increasing the RES share with this CHPs, they should also contribute in increasing the flexibility of the electricity system and ensuring the security of supply. It is envisioned that waste biomass will be used, taking into account the sustainability of the biomass at national level.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Technical, regulatory	Energy supply	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Strategy for Energy Development of the Republic of Macedonia up to 2040 • Law on Energy • Bylaws for renewable energy
Methodology	Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
Assumptions	• Through stimulation with feed-in tariffs, it is envisaged that by 2040 biomass power plants with capacity of 15 MW will be constructed
Status of implementation	Under implementation
- Steps taken	• Decree on the measures for support of electricity generation from renewable energy sources adopted (5.04.2019). • Decision on the total installed capacity for preferential producers of electricity adopted (5.04.2019).
- Steps envisaged	• Attract the investors

Indicators		Value in the last reporting year	Indicative trajectory		Target value
		2018	2020	2025	2030
Progress	Installed capacity (MW)	/			10
Emissions reduction (Gg CO_2-eq)		/	0	14.9	21
Other	Primary energy savings (ktoe)	/	0	1.3	3.0

Finance	Budget	24.3 M€
	Source of finance	Private, incentives from the central government budget
Implementing entity		• Government of the Republic of North Macedonia • Energy Regulatory Commission • Ministry of Environment and Physical Planning • Ministry of Economy, Energy Agency • Private investors
Monitoring entity		Ministry of Economy, Energy Agency
Contribution for the achievement of the SDGs		direct: 7 AFFORDABLE AND CLEAN ENERGY indirect: 12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION

PAM 6 Solar rooftop power plants

Main objective: Increase of the domestic generation capacity from renewable energy sources

Description: Construction of solar rooftop power plants, on private as well as public buildings, either prosumers or systems from which the overall produced electricity will be used for own purposes or will be stored. One of the possibilities for increasing the installed capacity of solar roof-top systems is through renewable energy communities.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Technical, regulatory	Household, commercial and industry sector	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Strategy for Energy Development of Macedonia up to 2040 • Law on Energy • Bylaws on renewable energy
Methodology [for estimating the emissions]	Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
Assumptions	• 400 MW solar capacities are envisioned to be constructed by 2040
Status of implementation [idea, planning phase, under implementation]	Under implementation
- Steps taken	• Rulebook on renewable energy sources adopted. • Distribution grid code
- Steps envisaged	• Information campaigns

Indicators		Value in the last reporting year	Indicative trajectory		Target value
		2016-2018	2020	2025	2030
Progress	Installed capacity (MW)	3.3			256
Emissions reduction (Gg CO_2-eq)		6.1	0	46.9	164.3
Other	Primary energy savings (ktoe)	1.4	0	10.6	29.9

Finance	Budget	263.4 M€
	Source of finance	Private, donors, subsidies from national and local budget, EE fund
Implementing entity		• Government of the Republic of North Macedonia • Energy Regulatory Commission • Ministry of Economy, Energy Agency • Elektrodistribucija Skopje • Suppliers of electricity • End-users of electricity
Monitoring entity		Ministry of Economy, Energy Agency

Contribution for the achievement of the SDGs	direct	indirect
	7 AFFORDABLE AND CLEAN ENERGY	12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION

PAM 7 RES without incentives

Main objective: Increase of the domestic generation capacity from renewable energy sources
Description: Construction of wind, solar and biogas power plants on different location in Macedonia carefully selected in order to avoid the impact on environment compared to benefits of generated electricity

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Technical, regulatory	Energy supply	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Strategy for Energy Development of the Republic of Macedonia up to 2040 • Law on Energy • Bylaws for renewable energy
Methodology	Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
Assumptions	The following capacities by scenario without incentives are envisioned to be constructed by 2040: • Wind – 600 MW • Solar – 750 MW • Biogas – 10 MW
Status of implementation	Under implementation
- Steps taken	• Decree on the measures for support of electricity generation from renewable energy sources adopted (5.04.2019). • Decision on the total installed capacity for preferential producers of electricity adopted (5.04.2019). • Electricity grid code adopted • Construction of 10MW Oslomej PV started • Tender for Public Private Partnership for PV Oslomej of at least 80 MW
- Steps envisaged	• Development of methodology for selection of best for location construction of solar and wind PP

Indicators		Value in the last reporting year	Indicative trajectory		Target value
		2016-2018	2020	2025	2030
Progress	Installed capacity (MW)	2.7			515
Emissions reduction (Gg CO_2-eq)		3.0	/	11.8	202.8
Other	Primary energy savings (ktoe)	0.7	/	2.3	29.4

Finance	Budget	1325.4 M€
	Source of finance	Private, ESM
Implementing entity		• Government of the Republic of North Macedonia • Energy Regulatory Commission • Ministry of Economy, Energy Agency • JSC Macedonian Power Plants (ESM AD) • Private investors
Monitoring entity		Ministry of Economy, Energy Agency
Contribution for the achievement of the SDGs		direct: 7 AFFORDABLE AND CLEAN ENERGY; indirect: 12 RESPONSIBLE CONSUMPTION AND PRODUCTION, 13 CLIMATE ACTION

PAM 8 Development of the biofuels market

Main objective: the RES share in the transport sector is almost zero and it is the main reason for not achieving the country 2020 target. In order to fulfil the 2030 RES target in the transport sector, but also the overall RES target it is necessary to have a functional biofuels market.

Description: Increase the share of biofuels in line with the requirement of the recast on the RES Directive (2018/2001).

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Regulatory, policy	Energy	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Strategy for Energy Development of the Republic of Macedonia up to 2040 • Biennial report on the progress of increased utilization of renewable energy sources
Methodology	Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
Assumptions	• Law on biofuels as well as action plan will be adopted in line with the requirements of the RES Directive (2018/2001). • The share of biofuels in 2030 will be 10%
Status of implementation	Under implementation
- Steps taken	• Draft version of the Action Plan for Biofuels developed • Draft version of the Law on Biofuels developed • Development of study on RES target in transport in 2030 in EnC countries • Development of study on biofuels in Macedonia • The previous draft is from 2015, Development of law on biofuels started
- Steps envisaged	• Adoption of the Law on biofuels • The previous draft action plan is from 2015, development of new one should start

Indicators	Value in the last reporting year	Indicative trajectory		Target value
	2018	2020	2025	2030
Progress % of biofuels	0	0	5	10
Emissions reduction (Gg CO_2-eq)	0	0	96.0	211.0

Finance – Budget	n/a
Finance – Source of finance	Central government budget, consumers
Implementing entity	• Government of the Republic of North Macedonia • Ministry of economy • Companies that sell oil products
Monitoring entity	• Ministry of economy

direct	indirect
Contribution for the achievement of the SDGs	 

1.1.2 Residential and Non-specified

PAM 9 Energy efficiency obligation schemes

Main objective: Fulfilment of the obligation under Article 7 of the EE Directive

Description: To set up the scheme the average annual final consumption for the period 2014 – 2016 is used. The measure implements the possibilities from the Article 7 of the EE Directive to exclude the transport sector consumption (paragraph 1) from the sum of the average annual consumption and reduce the consumption in the industry sector (paragraph 2).

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Technical, regulatory	All sectors (excl. transport and part of the industry according to Annex I of the Directive 2003/87/EC)	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Law on energy efficiency • Directive for EE
Methodology	Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
Assumptions	1. Final energy savings targets of: - 0.5% in 2017 - 0.7% in 2018 – 2020 - 0.35% in 2021 – 2030 - 0.2% in 2031 – 2040 of the average annual energy sales to final customers in the period 2014 – 2016 excluding the customers in the transport sector as well as industries of Annex I of the Directive 2003/87/EC 2. Up to 30% of the costs will be covered through subsidies by the distribution companies or suppliers.
Status of implementation	Under implementation
- Steps taken	• Law on Energy Efficiency adopted
- Steps envisaged	• The process for development of the Decree for obligation scheme should start at the second half of 2020

Indicators		Value in the last reporting year	Indicative trajectory		Target value
		2018	2020	2025	2030
Progress	Final energy savings (ktoe)	/	13.2	27.1	44.4
	Primary energy savings (ktoe)	/	10.8	44.6	67.8
Emissions reduction (Gg CO_2-eq)		/	0	86.2	162.8

Finance – Budget	182 M€
Finance – Source of finance	Consumers through their bills
Implementing entity	• Ministry of economy • Distribution system operators • Suppliers and traders of electricity and gas
Monitoring entity	Ministry of Economy

Contribution for the achievement of the SDGs

direct	indirect
	

PAM 10 Solar thermal collectors

Main objective: Reduction of the energy costs and improvement of the efficiency

Description: Hot water electric heaters are one of the biggest energy consumers with a major impact on bills. On the other hand, the reduced investment cost for purchasing and installation of solar thermal collectors is of great importance because it can drop consumer bills for hot water. Also, these systems serve for energy savings and can satisfy at least 50% at annual level, depending on the hot water needs. Furthermore, solar thermal collectors can be used in combination with electricity and district heating systems.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Technical	Households and commercial sector	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Strategy for Energy Development of North Macedonia up to 2040 • Law on Energy • Law on Energy Efficiency • Bylaws for renewable energy • Program for the promotion of renewable energy
Methodology	Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
Assumptions	Share of solar thermal collectors in hot water useful demand by 2040 to be 45% in household sector and 30% in commercial sector
Status of implementation	Under implementation
- Steps taken	• Program for promotion of RES for 2020 adopted
- Steps envisaged	• Continuation of the incentive measures for solar thermal collectors installation

Indicators		Value in the last reporting year	Indicative trajectory		Target value
		2016-2018	2020	2025	2030
Progress	Number of new installed solar collectors	7195*			
	Average area per collector (m^2)	3			
Emissions reduction (Gg CO_2-eq)		18.1	0.7	10.3	21.5
Other	Final energy savings (ktoe)	1.2	1.5	4.1	7.5
	Primary energy savings (ktoe)	4.0	1.4	6.5	10.7

Finance	Budget	70 M€
	Source of finance	Private, EE fund, incentives from the central government budget, donors
Implementing entity		• Ministry of economy, Energy Agency • End-users
Monitoring entity		Ministry of Economy, Energy Agency
Contribution for the achievement of the SDGs		direct: 7 AFFORDABLE AND CLEAN ENERGY; indirect: 12 RESPONSIBLE CONSUMPTION AND PRODUCTION, 13 CLIMATE ACTION

*Just those that applied for subsidies from the Ministry of Economy

PAM 11 Labeling of electric appliances and equipment

Main objective: Penetration of appliances with higher efficiency (class A++, A+, A, B)

Description: Labelling 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 comply with the EU regulations

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Regulatory	Households and commercial sector	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Strategy for Energy Development of North Macedonia up to 2040 • Law on energy efficiency • Third Energy Efficiency Action Plan • Rulebook on labeling consumption of energy and other resources on devices using energy. • Regulation on eco-design of products
Methodology [for estimating the emissions]	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 2040 the share of energy efficient technologies will be 6% in the overall stock.
Status of implementation [idea, planning phase, under implementation]	Under implementation
- Steps taken	• Rulebook on labeling 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

Indicators		Value in the last reporting year	Indicative trajectory		Target value
		2016-2018	2020	2025	2030
Progress	Number of devices sold (A+++, A++, A+, A)	7789			
Emissions reduction (Gg CO_2-eq)		3.8	13.1	33.0	56.3
Other	Final energy savings (ktoe)	0.7	4.6	11.4	19.0
	Primary energy savings (ktoe)	2.2	4.1	18.8	28.1

Finance	Budget	71 M€
	Source of finance	Private, EE fund
Implementing entity		• Ministry of economy, Energy Agency • Producers and suppliers of electrical equipment and household appliances • End-users
Monitoring entity		Ministry of Economy, Energy Agency
Contribution for the achievement of the SDGs		direct:  indirect: 

PAM 12 Increased use of heat pumps

Main objective: More efficient use of electricity

Description: Phasing out heating devices with resistive heaters, as well as inefficient biomass stoves and their replacement with heat pumps in compliance with EU Climate and Energy Policy.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Regulatory, policy	Households and commercial sector	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Strategy for Energy Development of North Macedonia up to 2040 • Law on energy efficiency • Third Energy Efficiency Action Plan • EU Climate and Energy Policy
Methodology	Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
Assumptions	It is assumed that heating devices with resistive heaters will be gradually replaced with heat pumps. The share of heat pumps in useful heat demand in 2040 is 55%.
Status of implementation	Planning phase
- Steps taken	/
- Steps envisaged	• Adopting a Decision to ban the sale of heating devices with resistive heaters.

Indicators		Value in the last reporting year	Indicative trajectory		Target value
		2016-2018	2020	2025	2030
Progress	Number of heat pump sold	37226			
Emissions reduction (Gg CO_2-eq)		255.5	221.4	180.0	369.5
Other	Final energy savings (ktoe)	24.7	48	85.1	139.3
	Primary energy savings (ktoe)	56.5	46.5	86.5	186.1

Finance	Budget	474.4 M€
	Source of finance	Private, EE fund, incentives from the central and local government budget, donors
Implementing entity		• Ministry of Economy, Energy Agency • End-users
Monitoring entity		Ministry of Economy, Energy Agency
Contribution for the achievement of the SDGs		direct: 7 AFFORDABLE AND CLEAN ENERGY; indirect: 12 RESPONSIBLE CONSUMPTION AND PRODUCTION, 13 CLIMATE ACTION

PAM 13 Public awareness campaigns and network of energy efficiency (EE) info centers

Main objective: Implement information campaigns that will raise public awareness about the importance, effects and benefits energy efficiency

Description: Although a large number of campaigns for the promotion of energy efficiency by different stakeholders are provided, still there is a lack of knowledge about the benefits of the EE. Article 12 of the EE Directive stipulates that the country should takes appropriate measures to promote and facilitate an efficient use of energy by small energy customers, including domestic customer. This can be done using different mechanisms. One of them is the establishment of EE info centers in the local self-governments. Following the examples from the EU, besides this measure, several others should be implemented such as:

- Education, starting from the kindergarten,
- Training of the employees in the public institutions at the central and local level,
- Creation of calculation tool that will show the financial and environmental effects from the implementation of a certain measure.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Information	Households and commercial sector	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Strategy for Energy Development of North Macedonia up to 2040 • Law on energy efficiency
Methodology	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 efficiency), in the overall stock, by 2040 to 40%
Status of implementation	Under implementation
- 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.

Indicators		Value in the last reporting year	Indicative trajectory		Target value
		2016-2018*	2020	2025	2030
Progress	Number of devices sold (A+++, A++, A+, A)	31155			
Emissions reduction (Gg CO_2-eq)		15.1	56.6	109.7	201.5
Other	Final energy savings (ktoe)	3.8	24.3	45.5	67.8
	Primary energy savings (ktoe)	12.5	20.2	69.2	99.7

Finance	Budget	8 M€ + 704 M€ (investment in advanced technologies)
	Source of finance	Private sector, donors, central and local governments
Implementing entity		• Ministry of Economy, Energy Agency • Energy suppliers • End-users
Monitoring entity		Ministry of Economy, Energy Agency
Contribution for the achievement of the SDGs		direct: 7 AFFORDABLE AND CLEAN ENERGY; indirect: 12 RESPONSIBLE CONSUMPTION AND PRODUCTION, 13 CLIMATE ACTION

*In the 4th NEEAP this measure is reported as Public awareness campaigns and network of EE info centers and Increased use of more efficient biomass stoves

PAM 14 Retrofitting of existing residential buildings

Main objective: To meet the requirements under the Energy Efficiency Law

Description: The measure considers reconstructions of residential buildings including windows replacement, initiated by the owners and/or supported by commercial banks and funds. This measure will provide issuing of certificates for energy performance of buildings, as a prerequisite for putting the reconstructions into operation.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Technical, regulatory	Households	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Strategy for Energy Development of North Macedonia up to 2040 • Law on energy efficiency
Methodology	Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
Assumptions	The existing residential buildings, while meet the standard for at least C class (90 kWh/m2). The annual renovation rate considered is 2%.
Status of implementation	Under implementation
- 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. • Law on Energy Efficiency adopted.
- Steps envisaged	• National Building Renovation Strategy to be developed and adopted. • Establishment of an Energy Efficiency Fund.

Indicators		Value in the last reporting year	Indicative trajectory		Target value
		2016-2018*	2020	2025	2030
Progress	Area retrofitted (m^2)	1481469			
	Energy consumption per heated/cooled area (kWh/m^2)	158			
Emissions reduction (Gg CO_2-eq)		48.6	7.1	32.3	73.0
Other	Final energy savings (ktoe)	11.8	8.1	22.1	42.0
	Primary energy savings (ktoe)	19.9	8.3	27.5	50.4

Finance	Budget	1708.2 M€
	Source of finance	Private, donors through commercial EE loans, EE fund
Implementing entity		• Ministry of Economy, Energy Agency • Donors and financial institutions • Households
Monitoring entity		Ministry of Economy, Energy Agency
Contribution for the achievement of the SDGs		direct: 7 AFFORDABLE AND CLEAN ENERGY indirect: 1 NO POVERTY, 12 RESPONSIBLE CONSUMPTION AND PRODUCTION, 13 CLIMATE ACTION

*The savings are reported together with Retrofitting of existing commercial buildings and Construction of new buildings (in the 4th NEEAP reported as Replacement of windows, Retrofitting of existing buildings (res+com), Construction of new residential buildings and Construction of new commercial buildings)

PAM 15 Retrofitting of existing central government buildings

Main objective: Retrofitting of existing public buildings with aim to meet the objectives of the EE Directive and the Energy Efficiency Law

Description: Having in mind the situation with the energy performance of the public buildings at central level and the role that they should play, it is essential to boost their renovation. Article 5 of the EE Directive is of great importance because it can be a starting point for the retrofit expansion.

In absence of recent information about the public building stock, in the calculations the heated area of building stock from the National Program for EE in public buildings (Draft version) is considered (including health care sector, universities, student dormitories, science institutions, social care institutions, centers for social affairs, as well as state administrative sector – Ministry of Economy, Ministry of Education and Science, Ministry of Environment and Physical Planning and Ministry of Transport and Communications). In addition, the specific consumption given in the same document is used (average 214 kWh/m2).

This measure considers reconstruction including windows replacement of existing public buildings under jurisdiction of the central government. The measure will provide issuing of certificates for energy performance of buildings, as a prerequisite for putting the reconstructions into operation.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Technical, regulatory	Central government buildings	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Strategy for Energy Development of North Macedonia up to 2040 • Law on energy efficiency
Methodology	Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
Assumptions	Annual renovation rate of 3% of the existing central government buildings
Status of implementation	Under implementation
- 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..
- Steps envisaged	• National Building Renovation Strategy to be developed and adopted. • Establishment of an Energy Efficiency Fund.

Indicators		Value in the last reporting year	Indicative trajectory		Target value
		2016-2018*	2020	2025	2030
Progress	Area retrofitted (m^2)	151030			
	Energy consumption per heated/cooled area (kWh/m^2)	214			
Emissions reduction (Gg CO_2-eq)		11.6	1.1	9.4	19.2
Other	Final energy savings (ktoe)	1.4	0.4	2.6	4.8
	Primary energy savings (ktoe)	3.2	0.4	3.6	6.6

Finance	Budget	170 M€
	Source of finance	Central government budget, donors
Implementing entity		• Ministry of Economy, Energy Agency • Ministry of Finance • Local self-government • Municipal public enterprises • Donors and financial institutions
Monitoring entity		Ministry of Economy, Energy Agency
Contribution for the achievement of the SDGs		direct: 7 AFFORDABLE AND CLEAN ENERGY indirect: 12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION

*The savings are reported together with the measure Retrofitting of existing local self-government buildings (in the NEEAP reported as Retrofitting of existing central and local self-government buildings and Construction of new central and local self-government buildings)

PAM 16 Retrofitting of existing local self-government buildings

Main objective: Retrofitting of existing public buildings with aim to meet the objectives of the EE Directive and the Energy Efficiency Law

Description: Local self-government should be encouraged by the central government renovation strategy, so they can put special attention on buildings under their competence.

For the calculations, the heated area of building stock from the National Program for EE in public buildings (Draft version) is considered (including primary and secondary schools, kindergartens, pupils' dormitories, municipalities and the City of Skopje buildings). In addition, the specific consumption given in the same document is used (average 214 kWh/m2).

This measure considers reconstruction including windows replacement of existing public buildings under jurisdiction of the local self-government. The measure will provide issuing of certificates for energy performance of buildings, as a prerequisite for putting the reconstructions into operation

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Technical, regulatory	Local self-government buildings	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts		• Strategy for Energy Development of North Macedonia up to 2040 • Law on energy efficiency
Methodology		Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
Assumptions		Annual renovation rate of 1.5% of the existing local self-government buildings.
Status of implementation		Under implementation
- 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. • Law on Energy Efficiency adopted.
- Steps envisaged		• National Building Renovation Strategy to be developed and adopted. • Establishment of an Energy Efficiency Fund.

Indicators		Value in the last reporting year	Indicative trajectory		Target value
		2016-2018	2020	2025	2030
Progress	Area retrofitted (m^2)	See PAM 15			
	Energy consumption per heated/cooled area (kWh/m^2)	See PAM 15			
Emissions reduction (Gg CO_2-eq)		See PAM 15	1.1	8.8	19.8
Other	Final energy savings (ktoe)	See PAM 15	0.4	2.4	4.7
	Primary energy savings (ktoe)	See PAM 15	0.4	3.4	6.7

Finance	Budget	150 M€
	Source of finance	Local self-government budget, donors
Implementing entity		• Ministry of Economy, Energy Agency • Ministry of Finance • Local self-government • Municipal public enterprises • Donors and financial institutions
Monitoring entity		Ministry of Economy, Energy Agency
Contribution for the achievement of the SDGs		direct: 7 AFFORDABLE AND CLEAN ENERGY indirect: 12 RESPONSIBLE CONSUMPTION AND PRODUCTION, 13 CLIMATE ACTION

PAM 17 Retrofitting of existing commercial buildings

Main objective: Retrofitting of existing commercial buildings with aim to meet the objectives of the EE Directive and the Energy Efficiency Law

Description: There is lack of data for the commercial building stock, but according to third NEEAP the commercial building area is estimated to nearly 8 million m^2. This measure considers reconstructions of existing commercial buildings including windows replacement initiated by the owners and/or supported by commercial banks and funds. The measure will provide issuing of certificates for energy performance of buildings, as a prerequisite for putting the reconstructions into operation.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Technical, regulatory	Commercial sector	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Strategy for Energy Development of North Macedonia up to 2040 • Law on energy efficiency
Methodology [for estimating the emissions]	Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
Assumptions	Annual renovation rate of 1.5% of the existing commercial buildings.
Status of implementation [idea, planning phase, under implementation]	Under implementation
- Steps taken	• Law on Energy Efficiency adopted.
- Steps envisaged	• Annual renovation rate of 1% for the existing commercial buildings

Indicators		Value in the last reporting year	Indicative trajectory		Target value
		2016-2018	2020	2025	2030
Progress	Area retrofitted (m^2)	SEE PAM 14			
Emissions reduction (Gg CO_2-eq)		See PAM 14	30.6	63.1	98.2
Other	Final energy savings (ktoe)	See PAM 14	11.2	17.0	26.5
	Primary energy savings (ktoe)	See PAM 14	10.8	24.6	35.7

Finance	Budget	530 M€
	Source of finance	Private, donors through commercial EE loans, EE fund
Implementing entity		• Ministry of Economy, Energy Agency • Ministry of Finance • Commercial building owners
Monitoring entity		Ministry of Economy, Energy Agency

Contribution for the achievement of the SDGs	direct	indirect
		

PAM 18 Construction of new buildings

Main objective: Construction of new buildings that will meet the minimum criteria set in the Rulebook of energy performance in buildings

Description: An energy efficient building reduces maintenance and utility costs, but, in many cases, improves durability, lessens noise, increases comfort and creates a healthy and safe indoor environment. A further goal of energy efficient construction is to limit damage to the ecosystem and reduce the use of natural resources like energy, land, water, and raw materials. This measure will provide issuing of certificates for energy performance of buildings, as a prerequisite for putting the building into operation.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Technical, regulatory	Households	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Strategy for Energy Development of North Macedonia up to 2040 • Law on energy efficiency
Methodology [for estimating the emissions]	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/m^2)
Status of implementation [idea, planning phase, under implementation]	Under implementation
- Steps taken	• Financial support for construction of new buildings at municipality level • Law on Energy Efficiency adopted.
- Steps envisaged	• National Building Renovation Strategy to be developed and adopted • Establishment of an Energy Efficiency Fund

Indicators		Value in the last reporting year	Indicative trajectory		Target value
		2016-2018	2020	2025	2030
Progress	Area retrofitted (m^2)	See PAM 14			
Emissions reduction (Gg CO_2-eq)		See PAM 14	1.8	9.7	19.8
Other	Final energy savings (ktoe)	See PAM 14	2.0	6.5	12.0
	Primary energy savings (ktoe)	See PAM 14	2.1	8.1	14.3

Finance – Budget	282.7 M€
Finance – Source of finance	Private, donors through commercial EE loans, EE fund
Implementing entity	• Ministry of Economy, Energy Agency • Donors and financial institutions • Investors (households)
Monitoring entity	Ministry of Economy, Energy Agency
Contribution for the achievement of the SDGs	direct: 7 AFFORDABLE AND CLEAN ENERGY indirect: 1 NO POVERTY; 12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION

PAM 19 Construction of passive buildings

Main objective: After 31.12.2020 all new building should be nearly zero-energy buildings

Description: The measure considers 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.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Technical, regulatory	Households	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Strategy for Energy Development of North Macedonia up to 2040 • Law on energy efficiency
Methodology [for estimating the emissions]	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/m2) starting from 2020 and continuously increasing their number so that in 2040, 85% of new buildings are assumed to be passive.
Status of implementation [idea, planning phase, under implementation]	Under implementation
- Steps taken	• Law on Energy Efficiency adopted.
- Steps envisaged	• National Building Renovation Strategy to be developed and adopted • Establishment of an Energy Efficiency Fund

Indicators		Value in the last reporting year	Indicative trajectory		Target value
		2016-2018*	2020	2025	2030
Progress	Area retrofitted (m^2)				
Emissions reduction (Gg CO_2-eq)		3.1	0.3	4.5	17.0
Other	Final energy savings (ktoe)	1.0	0.4	2.6	8.5
	Primary energy savings (ktoe)	1.5	0.4	3.4	10.5

Finance	Budget	1068 M€
	Source of finance	Private, donors through commercial EE loans, EE fund, financial support at municipality level
Implementing entity		• Ministry of Economy, Energy Agency • Donors and financial institutions • Investors (households)
Monitoring entity		Ministry of Economy, Energy Agency

Contribution for the achievement of the SDGs	direct	indirect
		

* In the 4th NEEAP reported as Construction of passive buildings and EE certificates for buildings

PAM 20 Phasing out of incandescent lights

Main objective: Improve the efficiency of lighting following the EU policies

Description: Governments around the world have passed measures to phase out incandescent light bulbs for general lighting in favour of more energy-efficient lighting alternatives. The goal is to improve energy efficiency, rather than forbid the use of incandescent technology. This measure includes replacing conventional incandescent light bulbs with halogen ones (at the beginning) and later with compact fluorescent (CFL) and LED.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Regulatory, policy	Households and commercial sector	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Strategy for Energy Development of North Macedonia up to 2040 • Law on Energy Efficiency • 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
Methodology	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 2020, and it is assumed that there will be 2-3 years of transition period.
Status of implementation	Under implementation
- Steps taken	/
- Steps envisaged	• Adoption of a Regulation that will prohibit sales of incandescent light bulbs.

Indicators		Value in the last reporting year	Indicative trajectory		Target value
		2016-2018	2020	2025	2030
Progress	Number of light bulbs sold (LED, CFL)				
	Installed capacity (MW)				
	Electricity consumption (MWh)				
Emissions reduction (Gg CO_2-eq)		156.5	99.9	132.7	401.8
Other	Final energy savings (ktoe)	10.1	20.7	42.5	66.0
	Primary energy savings (ktoe)	34.7	15.9	57.6	118.4

Finance	Budget	558.0 M€
	Source of finance	Central government budget, private
Implementing entity		• Government of the Republic of North Macedonia • Ministry of Economy, Energy Agency • End-users
Monitoring entity		Ministry of Economy, Energy Agency
Contribution for the achievement of the SDGs		direct: 7 AFFORDABLE AND CLEAN ENERGY; indirect: 12 RESPONSIBLE CONSUMPTION AND PRODUCTION, 13 CLIMATE ACTION

PAM 21 Improvement of the street lighting in the municipalities

Main objective: Reduce the costs and increase the quality of street lighting

Description: The cost of street lighting, including electricity and maintenance, can have a huge impact on the budget of the municipalities. In addition, having in mind that a lot of manufactories work on daily bases on the improvement of the light bulbs, new opportunities are being opened for the municipalities. The inefficient light bulbs should be replaced, purchasing new ones that comply with the criteria of belonging to the highest EE class possible (CFL and LED lamps).

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Technical	Local self-government	CO_2, CH_4, N_2O	Local

Relevant planning documents, legal and regulatory acts	• Strategy for Energy Development of North Macedonia up to 2040 • Law on Energy Efficiency
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	Improvement rate of 100% of street lighting by 2040.
Status of implementation	Under implementation
- 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

Indicators		Indicator value in the last reporting year	Indicative trajectory		Indicator target value
		2016-2018	2020	2025	2030
Progress	Number of light bulbs replaced (LED, CFL)				
	Installed capacity (MW)				
	Electricity consumption (MWh)				
Emissions reduction (Gg CO_2-eq)		26.1	8.9	27.7	37.9
Other	Final energy savings (ktoe)	1.7	3.2	5.7	7.8
	Primary energy savings (ktoe)	5.8	2.7	12.1	14.2

Finance – Budget	25.3 M€
Finance – Source of finance	Central and local government budget, ESCO
Implementing entity	• Government of the Republic of North Macedonia • Energy Regulatory Commission • Ministry of Environment and Physical Planning • Ministry of Economy, Energy Agency • Local self-government
Monitoring entity	Ministry of Economy, Energy Agency

Contribution for the achievement of the SDGs	direct	indirect
	7 AFFORDABLE AND CLEAN ENERGY	12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION

PAM 22 “Green procurements”

Main objective: Application of energy efficiency criteria (“greening”) in public procurement procedures

Description: According to Article 6 from the EE Directive, central governments can purchase only products, services and buildings with high energy-efficiency performance. Intensified activities should take place 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.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Regulatory	Public bodies	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Strategy for Energy Development of North Macedonia up to 2040 • Law on Energy Efficiency
Methodology	Implementation of energy efficiency criteria. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
Assumptions	Increased rate of advanced energy efficiency technology due to public procurement by 7%
Status of implementation	Under implementation
- Steps taken	• Law on Energy Efficiency adopted • Law on Public procurements
- Steps envisaged	• By laws from the Law on Energy efficiency to be developed

Indicators		Indicator value in the last reporting year	Indicative trajectory		Indicator target value
		2016-2018	2020	2025	2030
Progress	Number of devices purchase (A++, A+, A)				
Emissions reduction (Gg CO_2-eq)		3.1	0.8	4.0	9.4
Other	Final energy savings (ktoe)	0.2	0.3	1.2	2.5
Other	Primary energy savings (ktoe)	0.7	0.3	1.6	2.4

Finance	Budget	24 M€
	Source of finance	Central and local government budget
Implementing entity		• Ministry of Economy, Energy Agency • Public Procurement Bureau • Local self-government
Monitoring entity		Ministry of Economy, Energy Agency

Contribution for the achievement of the SDGs	direct	indirect
		

PAM 23 Increased use of central heating systems

Main objective: Reduction of local air pollution, as household heating is one of the main sources for local pollution

Description: Increased use of the existing central heating systems through the implementation of information campaigns for connecting new consumers, including those who have been disconnected from the system in the past.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Technical, information	Households and commercial	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Strategy for Energy Development of North Macedonia up to 2040 • Law on Energy Efficiency • 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
Methodology	Implementation of information campaigns. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
Assumptions	Information campaigns will contribute to maximize the utilization of the existing network as well as to enable construction of new network, which will increase the heat consumption for at least 40%.
Status of implementation	Under implementation
- 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 • Reduced the VAT from 18% to 5%
- Steps envisaged	• Continuing the implementation of the information campaigns

Indicators		Indicator value in the last reporting year	Indicative trajectory		Indicator target value
		2016-2018	2020	2025	2030
Progress	Number of new consumers				
Emissions reduction (Gg CO_2-eq)		19.5	4.0	6.6	9.3
	Final energy savings (ktoe)	0.5	0.4	0.9	1.3
Other	Primary energy savings (ktoe)	8.4	0.7	1.5	2.1

Finance	Budget	3.2 M€
	Source of finance	Private, EE fund, incentives from the central and local government budget
Implementing entity		• Ministry of Economy, Energy Agency • Balkan energy Dooel Skopje • JSC Skopje Sever • "Energetika" –Skopje, subsidiary to JSC Macedonian Power Plants (ESM AD) • Private investors
Monitoring entity		• Energy Regulatory Commission Ministry of Economy, Energy Agency

Contribution for the achievement of the SDGs	direct	indirect
		

1.1.3 Industry

PAM 24 Energy management in manufacturing industries

Main objective: Efficient management of manufacturing processes in industry aiming to increase production using the same energy consumption.

Description: This measure considers implementation of obligatory energy audits of large companies and implementation of ISO 50001 standard, as well as advanced measurement and introduction of new IT technologies. This will enable prevention of defects, better process control and quicker response times in manufacturing using advanced data analysis and predictive technologies.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Regulatory, technical	Industry	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Strategy for Energy Development of the Republic of Macedonia up to 2040 • Law on energy efficiency
Methodology	Implementation of information campaigns . 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%.
Status of implementation	Under implementation
- 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 • 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.

Indicators		Indicator value in the last reporting year	Indicative trajectory		Indicator target value
		2016-2018	2020	2025	2030
Progress					
Emissions reduction (Gg CO_2-eq)		11.2	2.9	28.4	67.8
	Final energy savings (ktoe)	1.5	0.9	7.3	15.7
Other	Primary energy savings (ktoe)	2.7	0.9	9.6	18.8

Finance	Budget	Negligible (the implementation of ISO 500001 is 0.15 mill. EUR/big company*)
	Source of finance	Private, donors through commercial EE loans
Implementing entity		• Ministry of Economy, Energy Agency • Private companies
Monitoring entity		• Energy Regulatory Commission • Ministry of Economy, Energy Agency
Contribution for the achievement of the SDGs		direct: 7 AFFORDABLE AND CLEAN ENERGY; indirect: 12 RESPONSIBLE CONSUMPTION AND PRODUCTION, 13 CLIMATE ACTION

*Study of the Industry Sector - Analysis of Mitigation Policies and Measures (SUTIND), 2020, MANU

PAM 25 Introduction of efficient electric motors

Main objective: Increase the competitiveness of the industrial products through improvement of the efficiency in the production process and reducing the resources.

Description: Electric motors are responsible for a high share of the total electricity consumption in industries. This measure considers replacement of the obsolete machines currently in use, with new more efficient motors

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Technical	Industry	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts		• Strategy for Energy Development of the Republic of Macedonia up to 2040 • Law on energy efficiency
Methodology		Implementation of information campaigns . Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
Assumptions		It is envisaged that the share of efficient electric motors by 2040 will be 60%.
Status of implementation		Under implementation
- Steps taken		• New efficient electric motors installed in a number of companies
- Steps envisaged		• Replacement of the existing electric motors from the production processes • in the industry facilities in Macedonia with more efficient ones

Indicators		Indicator value in the last reporting year	Indicative trajectory		Indicator target value
		2016-2018	2020	2025	2030
Progress					
Emissions reduction (Gg CO_2-eq)		9.3	0.7	9.8	28.8
	Final energy savings (ktoe)	0.6	0.3	2.2	5.0
Other	Primary energy savings (ktoe)	2.1	0.3	4.3	7.8

Finance	Budget	113.0 M€
	Source of finance	Private, donors through commercial EE loans
Implementing entity		• Ministry of Economy, Energy Agency • Private companies
Monitoring entity		• Energy Regulatory Commission • Ministry of Economy, Energy Agency

Contribution for the achievement of the SDGs	direct	indirect
		

PAM 26 Introduction of more advanced technologies

Main objective: Introduction of more advanced technologies in the industrial processes that will also enable use of more environmental friendly fuels.

Description: Advanced industrial technologies present major opportunities for further reduction of the energy consumption and potentially lower costs as well as environmental benefits. In addition, they can help various industries to progress at a much faster rate

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Technical	Industry	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Strategy for Energy Development of the Republic of Macedonia up to 2040 • Law on energy efficiency
Methodology	Implementation of information campaigns . Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
Assumptions	The share of more advanced technologies by 2040 is 60% from all technologies.
Status of implementation	Under implementation

- Steps taken	• Construction of gas network in Macedonia
	  • Klechovce-Valve station 5 (Stip), finished in 2016
	  • Valve station 5(Stip)-Negotino, finished in 2019

- Steps envisaged	• Finishing the construction of gas network in Macedonia
	  • Negotino (Kavadarci)-Bitola, 76.36% realized November 2019
	  • Skopje-Tetovo-Gostivar, 53.1% realized November 2019
	  • Gostivar-Kicevo, in a process of obtaining building permit (by 2022)
	  • Kicevo-Ohrid (to be finished by 2025)
	  • Valve station 5 (Stip)-Radovis-Strumica

Indicators		Indicator value in the last reporting year	Indicative trajectory		Indicator target value
		2016-2018	2020	2025	2030
Progress	Gas energy consumption				
Emissions reduction (Gg CO_2-eq)		40.3	20.0	125.2	206.0
	Final energy savings (ktoe)	5.4	6.7	37.6	59.4
Other	Primary energy savings (ktoe)	9.6	6.7	39.8	62.5

Finance	Budget	438.6 M€
	Source of finance	Private, donors through commercial EE loans, EE fund
Implementing entity		• Government of the Republic of North Macedonia • Ministry of Environment and Physical Planning • Ministry of Economy, Energy Agency • Private investors
Monitoring entity		• Ministry of Economy, Energy Agency
Contribution for the achievement of the SDGs		direct: 7 AFFORDABLE AND CLEAN ENERGY indirect: 12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION

1.1.4 Transport

PAM 27 Increased use of the railway

Main objective: Improve the energy efficiency in the transport sector using cheap and efficient railway transport.

Description: Although the rail transport is cheap, official statistical data show that in the last three years there is a downward trend. Using this mode of transport as one of the most efficient can also improve the competitiveness of the companies. Therefore, at least several listed measures should be implemented, aiming to return the utilization level of this transport as of three years ago, and further increase it. The measure includes:

- implement raising awareness campaigns
- invest in stations and improve the "access to the stations"
- increase the network security and expand the network coverage

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Technical, information	Transport	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• National Transport Strategy • Strategy for Energy Development of the Republic of Macedonia up to 2040
Methodology	Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
Assumptions	By 2040, 3% of the passenger kilometers of cars, 1% of passenger kilometers of busses and 6.6% of tonnes kilometers of heavy duty vehicles will be realized by railway transport.
Status of implementation	Under implementation
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	• Implement promotional campaigns for raising public awareness • Continuing the campaigns for cheaper/free driving • Enabling additional conditions for companies

Indicators		Indicator value in the last reporting year	Indicative trajectory		Indicator target value
		2016-2018	2020	2025	2030
Progress	Increase of passenger km in railway transport (pkm)				
	Increase of tonnes km in railway transport (tkm)				
Emissions reduction (Gg CO_2-eq)		6.6	25.7	31.4	37.2
Other i	Final energy savings (ktoe)	2.1	7.9	11.2	14.8
	Primary energy savings (ktoe)	2.1	7.9	8.7	12.3

Finance	Budget	180.6 M€
	Source of finance	Central government budget
Implementing entity		• Government of the Republic of North Macedonia • Ministry of Transport and Communications • Ministry of Economy, Energy Agency • JSC Macedonian Railway Transport • End-users • Private companies
Monitoring entity		Ministry of Economy, Energy Agency
Contribution for the achievement of the SDGs		direct: 12 RESPONSIBLE CONSUMPTION AND PRODUCTION indirect: 7 AFFORDABLE AND CLEAN ENERGY, 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE, 11 SUSTAINABLE CITIES AND COMMUNITIES, 13 CLIMATE ACTION

PAM 28 Renewing of the national car fleet

Main objective: Use of more advanced technologies in order to slow down the growing energy consumption in the transport sector, which is complex and with limited capabilities of energy use reduction.

Description: The measures recommended in the Study on the transport sector analysis of policies and measures should be implemented: Reduction of VAT from 18% to 5% for hybrid and electric vehicles; Direct subsidizing of hybrid vehicles, Excise duties of diesel fuel and petrol need to be gradually equaled.

Obligations of public institutions to purchase vehicles with low CO_2 emissions (up to 90 gCO_2/km by 2020 and 50 gCO_2/km by 2025).

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Regulatory, policy, information	Transport	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• National Transport Strategy • Strategy for Energy Development of the Republic of Macedonia up to 2040 • Law on vehicles • Law on vehicle tax
Methodology	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 eight 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. In addition, advanced technologies such as diesel and gasoline HEV will be used with a share of 35% in the total passenger km from cars by 2040.
Status of implementation	Under implementation
Steps taken	• Law on vehicles adopted (August 2019) • Law on vehicle tax bylaws to be adopted
Steps envisaged	• Implementation of the program for subsidizing for purchasing vehicles stipulated in the Law on vehicles, • Revision of the Law on excise duty to be prepared (excise duties of diesel fuel and petrol need to be gradually equaled).

Indicators		Indicator value in the last reporting year	Indicative trajectory		Indicator target value
		2016-2018	2020	2025	2030
Progress	Number of vehicles per type				
Emissions reduction (Gg CO_2-eq)		17.1	33.3	108.1	43.1
Other	Final energy savings (ktoe)	5.5	10.2	35.2	13.9
	Primary energy savings (ktoe)	5.5	10.2	35.2	13.9

Finance	Budget	2167.7 M€
	Source of finance	Private, EE fund, incentives from the central government budget
Implementing entity		• Government of the Republic of North Macedonia • Ministry of Transport and Communications • Ministry of Economy, Energy Agency • End-users
Monitoring entity		• Ministry of Economy, Energy Agency • Ministry of interior
Contribution for the achievement of the SDGs		direct: 12 RESPONSIBLE CONSUMPTION AND PRODUCTION indirect: 7 AFFORDABLE AND CLEAN ENERGY, 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE, 13 CLIMATE ACTION

PAM 29 Renewing of other national road fleet

Main objective: Reduction of the local air pollution.
Description: This measure anticipates introduction of a regulation that will enable renewal of the vehicle fleet of light duty and heavy goods vehicles and buses.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Regulatory, policy	Transport	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• National Transport Strategy • Strategy for Energy Development of the Republic of Macedonia up to 2040 • Law on vehicles • Law on vehicle tax
Methodology [for estimating the emissions]	Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
Assumptions	It is assumed that only new advanced vehicles such as HEVs that meet EU standards for exhaust fumes will be sold.
Status of implementation [idea, planning phase, under implementation]	Under implementation
Steps taken	• Law on vehicles adopted (August 2019) • Law on vehicle tax bylaws to be adopted
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

Indicators		Indicator value in the last reporting year	Indicative trajectory		Indicator target value
		2016-2018	2020	2025	2030
Progress	Number of vehicles per type				
Emissions reduction (Gg CO_2-eq)		2.9	1.2	32.1	66.4
Other	Final energy savings (ktoe)	0.9	0.2	10.0	20.8
	Primary energy savings (ktoe)	0.9	0.2	10.0	20.8

Finance	Budget	2.300 M€
	Source of finance	Private
Implementing entity		• Government of the Republic of North Macedonia • Ministry of Transport and Communications • Ministry of Economy, Energy Agency • Private companies
Monitoring entity		• Ministry of Transport and Communications • Ministry of Economy, Energy Agency

Contribution for the achievement of the SDGs	direct	indirect
	12 RESPONSIBLE CONSUMPTION AND PRODUCTION	7 AFFORDABLE AND CLEAN ENERGY; 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE; 13 CLIMATE ACTION

PAM 30 Advanced mobility

Main objective: Reduction of the local air pollution.

Description: The measure includes conducting campaigns/providing subsidies and systems for use of new or rented bicycles, electric scooters, promoting walking, and introduction of parking policies that would reduce the use of cars in the city area. People, especially in smaller towns where a lot of them use cars for short distances, would increase the use of bicycles/electric scooters or walking.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Regulatory, technical, information	Transport	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• National Transport Strategy • Strategy for Energy Development of the Republic of Macedonia up to 2040 • Decisions made by municipalities to subsidize buying of new bicycles
Methodology	Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
Assumptions	By 2040, 3% of short distance passenger kilometres will be replaced by walking, using bicycles or electric scooters
Status of implementation	Under implementation
Steps taken	• Subsidies and campaigns for buying new bicycles/electric scooters 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

Indicators		Indicator value in the last reporting year	Indicative trajectory		Indicator target value
		2016-2018	2020	2025	2030
Progress	Number of bicycles/electric scooters	12660*			
Emissions reduction (Gg CO_2-eq)		2.7	2.1	3.0	3.6
Other	Final energy savings (ktoe)	0.7	0.7	1.0	1.2
	Primary energy savings (ktoe)	0.7	0.7	1.0	1.2

Finance	Budget	/
	Source of finance	Private, EE fund, incentives from the central and local government budget, donors
Implementing entity		• Ministry of Economy, Energy Agency • Local self-government • End-users
Monitoring entity		• Ministry of Economy, Energy Agency • Local self-government
Contribution for the achievement of the SDGs		direct: 7 AFFORDABLE AND CLEAN ENERGY; indirect: 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE, 12 RESPONSIBLE CONSUMPTION AND PRODUCTION, 13 CLIMATE ACTION

*Only those that applied for subsidies

PAM 31 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.

Timeframe	Type	Sector	Gases	Scope
2023 – 2040	Technical, policy	Transport	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Work Program of the Government of the Republic of North Macedonia • National Transport Strategy
Methodology [for estimating the emissions]	Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
Assumptions	By 2040 up to 5% of the tonne kilometers (to the Republic of Bulgaria) of the heavy goods vehicles will be replaced by the railroad transport.
Status of implementation [idea, planning phase, under implementation]	Under implementation
Steps taken	• First phase (Kumanovo - Beljakovce) is under construction, 67% constructed at the end of 2019 • Tender for the second phase is announced.
Steps envisaged	• First phase (Kumanovo - Beljakovce) to be finished by the end of 2020 • Tender for the third phase to be announced.

Indicators		Indicator value in the last reporting year	Indicative trajectory		Indicator target value
		2016-2018	2020	2025	2030
Progress	Increase of the tonnes km in the railway transport (tkm)				
Emissions reduction (Gg CO_2-eq)		0	0	21.6	24.6
Other	Final energy savings (ktoe)	0	0	5.8	10.2
	Primary energy savings (ktoe)	0	0	5.8	8.2

Finance	Budget	720 M€ (infrastructure+trains)
	Source of finance	Central government budget
Implementing entity		• Government of the Republic of North Macedonia • Ministry of Transport and Communications • Ministry of Economy, Energy Agency
Monitoring entity		• Ministry of Transport and Communications • Ministry of Economy, Energy Agency

Contribution for the achievement of the SDGs	direct	indirect
		

PAM 32 Electrification of the transport

Main objective: Transition from society based on fossil fuels to low carbon society, where the renewable energy and electrification of the transport will play the most important role.

Description: At least the following measures recommended in the "Study on the transport sector, analysis of policies and measures" should be implemented:

- Direct subsidizing of electric vehicles, 5000 EUR in the period 2020-2023
- Obligation to place fast chargers at all gas stations on motorways (at every 100 km by 2020)

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Regulatory, policy, information	Transport	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• National Transport Strategy • Strategy for Energy Development of the Republic of Macedonia up to 2040 • Law on vehicles • Law on vehicle tax
Methodology	Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
Assumptions	It is envisaged that by 2040 the share of electric vehicles and "plug-in" hybrid electric vehicles in the total passenger km from cars will be 45%.
Status of implementation	Under implementation
Steps taken	• Chargers installed at specific locations in the City of Skopje • Law on vehicles adopted (August 2019) • Law on vehicle tax and bylaws adopted • Exemption from paying excise duty for electric vehicles
Steps envisaged	• Development of studies for determining the best locations for installation of electric vehicles chargers from the aspect of the power grid. • Money from the budget should be allocated for the realization of the Program for subsidizing new vehicles

Indicators		Indicator value in the last reporting year	Indicative trajectory		Indicator target value
		2018	2020	2025	2030
Progress	Increase of the tonnes km in the railway transport (tkm)				
Emissions reduction (Gg CO_2-eq)		0.1	11.3	52.6	61.6
Other	Final energy savings (ktoe)	0.04	3.4	20.6	30.5
	Primary energy savings (ktoe)	0.04	3.4	13.6	20.9

Finance	Budget	5058.5 M€
	Source of finance	Private, EE fund, incentives from the central government budget
Implementing entity		• Government of the Republic of North Macedonia • Ministry of Transport and Communications • Ministry of Economy, Energy Agency
Monitoring entity		• Ministry of Economy, Energy Agency • Ministry of interior
Contribution for the achievement of the SDGs		direct: 12 RESPONSIBLE CONSUMPTION AND PRODUCTION; indirect: 7 AFFORDABLE AND CLEAN ENERGY, 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE, 11 SUSTAINABLE CITIES AND COMMUNITIES, 13 CLIMATE ACTION

*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

1.2 AFOLU

1.2.1 Livestock

PAM 33 Reduction of CH_4 emissions from enteric fermentation in dairy cows by 3%

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 30% in 2040. 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.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Education, Technical	AFLOU-Livestock	CH_4	National

Relevant planning documents, legal and regulatory acts	• Strategy for Agriculture Development • IPARD program
Methodology	Regression model, IPCC methodology
Assumptions	• Increased number of highly productive dairy cows under intensive farming, • Introduced modified TMR and nutrition management. • Expected to be on organized in farms with more than 50 heads
Status of implementation	Under implementation
- 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.

Indicators	Indicator value in the last reporting year	Indicative trajectory		Indicator target value
	2018	2020	2025	2030
Progress: Number of farms (dairy cows as a percentage of the total population) used TMR modified feed and nutrition management on biannual base	1%			
Emissions reduction (Gg CO_2-eq)		3.2		35.0

Finance – Budget	0.2 mil. EUR
Finance – Source of finance	Private sector, IPARD programme
Implementing entity	Ministry of Agriculture Forestry and Water Economy
Monitoring entity	Ministry of Agriculture Forestry and Water Economy

Contribution for the achievement of the SDGs	direct	indirect
	2 ZERO HUNGER	13 CLIMATE ACTION

PAM 34 Reduction of N_2O emissions from manure management in dairy cows by 20%

Main objective: Decrease level of N_2O emission from manure management in highly productive dairy cows

Description: By modification of the manure management in dairy cows, the emission of N_2O can be reduced up to 20%. 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 30% in 2040. 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 considers 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.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Education, Technical	AFLOU-Livestock	N_2O	National

Relevant planning documents, legal and regulatory acts	• Law for Nature Protection • IPARD program, • Agro-ecology measures in national program
Methodology	Regression model, IPCC methodology
Assumptions	• Target group are the farms with more than 50 heads. The manure management practice is expected to be change from solid fraction (N loss factor 40), to below animal (N loss factor 28). It can be applied to 10% of the population and shift toward practice is expected to be done in 15% of the farms by 2025. The proportion of the high productive dairy cows is expected to reach 25% in 2040. In such action the reduction of the N_2O emissions in manure management on dairy cows will be up to 25% by 2040. • Increased number of highly productive dairy cows under intensive farming, • On farm modified manure management.
Status of implementation	Planning phase
- Steps taken	• None
- 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.

Indicators	Indicator value in the last reporting year	Indicative trajectory		Indicator target value
	2018	2020	2025	2030
Progress: Number of farms (dairy cows as a percentage of the total population) used modified manure management on 2-5 years base.	0%			
Emissions reduction (Gg CO_2-eq)	0	0.2		2.1

Finance: Budget	1 mil. EUR
Finance: Source of finance	Private sector, IPARD programme
Implementing entity	Ministry of Agriculture Forestry and Water Economy
Monitoring entity	Ministry of Agriculture Forestry and Water Economy

Contribution for the achievement of the SDGs	direct	indirect
	2 ZERO HUNGER	13 CLIMATE ACTION

PAM 35 Reduction of N_2O emissions from manure management in swine farms by 13%

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 N_2O 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 1000 fatteners and/or 350 sows will also increase, and they need to adapt improved manure management system, in order to reduce N loss. In 2040 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.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Education, Technical	AFLOU-Livestock	N_2O	National

Relevant planning documents, legal and regulatory acts	• Law for Nature Protection • IPARD program, • Agro-ecology measures in national program
Methodology	Regression model, IPCC methodology
Assumptions	• Swine production system is expected to shift towards intensification that will bring modification of the swine farms. The management practice is supposed to shift form solid manure towards below animal (practice that already exists on large swine farms). Then the fraction of N loss will be reduced by 50%. The implementation of shift will be slightly over years in category sows and finishing pigs (e.g. sows from 55% in 2020 to 75% in 2040; finishing pigs from 70% in 2020 to 92% in 2040 • Increased number of highly productive swine farms with more than 1000 fatteners and/or 350 sows, • On farm modified manure management.
Status of implementation	Under implementation
- Steps taken	• Existing swine farms with more than 1000 fatteners and/or 350 sows are working on modification in manure management system
- Steps envisaged	• Adaption in manure management on intensive swine farms with more than 1000 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

Indicators		Indicator value in the last reporting year	Indicative trajectory		Indicator target value
		2018	2020	2025	2030
Progress	Number of farms (fatteners and sows as a percentage of the total population) used modified manure management on 2-5 years base.	0%			
Emissions reduction (Gg CO_2-eq)			0.0		0.4

Finance	Budget	1 mil. EUR
	Source of finance	Private sector, IPARD programme
Implementing entity		Ministry of Agriculture Forestry and Water Economy
Monitoring entity		Ministry of Agriculture Forestry and Water Economy

Contribution for the achievement of the SDGs	direct	indirect
	2 ZERO HUNGER	13 CLIMATE ACTION

PAM 36 Reduction of N_2O emissions from manure in dairy cows by 20% for farms below 50 Livestock Units

Main objective: Decrease level of N_2O emission from manure management in dairy cows on farm farms below 50 Livestock Units

Description: By modification of the manure management in dairy cows, the emission of N_2O can be reduced up to 30%. In discussion with farmers, the most common system is dry manure management, where manure together with bedding (mostly wheat or barley straw) are taken out of the barn daily or within week. The manure than is composting on pile near the farm. Farmers do not use any cover of manure nor tanks for collecting liquid drainage of the pile. Fermentation is usually mixed where in bottom parts is anaerobic, but on the surface, due to aeration it is aerobic. Manure is used as fertilizer mostly within 2-3 months (depending on storage capacity on the farm and field availability). Depending on manure fermentation the loss of N can be up to 60%. The N loss and reduction of the N_2O emissions can be reached by prolonging fermentation period up to 6 months and covering the pile. Hence the measure is to support farmers with less than 50 cows to provide proper manure storage places for longer period.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Education, Technical	AFLOU-Livestock	N_2O	National

Relevant planning documents, legal and regulatory acts	• IPARD program, • Agro-ecology measures in national program
Methodology	Regression model, IPCC methodology
Assumptions	• Replaced low productive with high productive dairy cows, • On farm modified manure management for farms with 10 to 50 cows. • Dairy cow produce manure about 7% of the life weight per day. Milking cows are weighted between 500 and 650 kg, depending on breed and conditions. Heifers 1-2 year, calves 3-12 months and young calves 0-3 months are transformed into adult cow by coefficient 2, 4 and 10, respectively. For simplicity, animal units (AU) should be used as a base (1 AU = 500 kg). Based on usual feed consumption, bedding material (annual average use of 8% wheat/barley straw) it can be expected about 0.04 m^3 manure per AU/day. • The manure has about 40% moisture and during the storage reduce volume for 40%. For the period of 6 months total volume of 5 m^3 per AU should be expected. For pile composting, a trench with clay or concreate floor with inclination of 4% is required. The pile needs to be protected from rainfall (either by roof or covered by plastic foil. Aeration is occurring when fresh manure is adding, taking care that old and already fermented one should be always on top. By prolonging manure storage and covering period the reduction of N_2O emission will be for 30% is expected.
Status of implementation	Planning phase
- Steps taken	• None
- Steps envisaged	• Provide incentives to build on farm manure storage place, • Train farmers for BAT in manure management, • Monitoring of the effect modified manure management

Indicators	Indicator value in the last reporting year	Indicative trajectory		Indicator target value
	2018	2020	2025	2030
Progress: Number of farms (dairy cows as a percentage of the total population) used modified manure management in 7 years.	0%			
Emissions reduction (Gg CO_2-eq)		0.1		0.7

Finance – Budget	1 mil. EUR
Finance – Source of finance	Private sector, IPARD programme
Implementing entity	Ministry of Agriculture Forestry and Water Economy
Monitoring entity	Ministry of Agriculture Forestry and Water Economy

Contribution for the achievement of the SDGs	direct	indirect
	2 ZERO HUNGER	13 CLIMATE ACTION

1.2.2 Forestry

PAM 37 Establishing integrated management of forest fires

Main objective: Reducing the average annual burned area for 6000 ha

Description: Forest fires are already detected as a very significant problem of forest loss and source of GHG emissions. In the period from 1999 to 2019 year the average annual number of forest fires is 229 fires, average annual burned area is 10,985 ha and average annual damage is estimated on 6,9 million Euro. The total burned forest area in the same period is around 219,163 ha with the total damage of around 138 million. This measure includes the protection of the forest area by preventing the forest fires and the damages resulting from forest fires.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Technical	AFLOU-Forestry	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Law on forest, • Special rule book for forest fire protection, • Strategy for development of the forest fire protection, diseases and insects with action plan for realization of the projects and procurements for the needs of PE "Makedonski sumi"
Methodology	Regression model, IPCC methodology
Assumptions	• Up to 3000 ha will be burned annually on average
Status of implementation	Under implementation
- Steps taken	• The location for building and establishment of a forest fire training center in the frame of the PE "National forests" is already chosen, the plan prepared and 8 vehicles are purchased.
- Steps envisaged	• **Phase I** - Procurement of vehicles for initial attack, had tools and personal protective equipment (PPE) o Duration: one year o Vehicles procurement: 25 specialized vehicles for initial attack o 25 vehicles x 40,000 € = 1,000,000 € o 50 sets of hand tools and PPE for 50 crews of five fire fighters (two per vehicle) o 1 set of hand tools and PPE = 4,000 € o 50 sets x 5,000 € = 250,000 € • **Phase II** - Specialized training for fire fighters (six days) o 50 craws x 5 persons = 250 fire fighters o 250 fire fighters x 800 € = 200,000 €

Indicators	Indicator value in the last reporting year	Indicative trajectory		Indicator target value
	2018	2020	2025	2030
Progress – Forest area (ha)				
Emissions reduction (Gg CO_2-eq)		345.0	345.0	345.0

Finance – Budget	1.45 mil. EUR
Finance – Source of finance	PE “National forests”, other forest enterprises
Implementing entity	Ministry of Agriculture Forestry and Water Economy, through PE "National forests"
Monitoring entity	Ministry of Agriculture Forestry and Water Economy, through PE "National forests"

Contribution for the achievement of the SDGs	direct	indirect
		

PAM 38 Afforestation

Main objective: Afforestation of 5000 ha of barren land with Oak (Quercus spp.)

Description: Afforestation and reforestation may change landscapes and may have an impact on the provision of landscape-related goods and services. The supply with goods and services benefiting people and societies and the conservation of traditional cultural landscapes, as well as landscape ecology, need to be taken into account. According to the many strategic documents there are about 1,500,000 ha barren land aimed for afforestation or reforestation.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Technical	AFLOU-Forestry	CO_2,	National

Relevant planning documents, legal and regulatory acts	• Law on forest
Methodology	Regression model, IPCC methodology
Assumptions	• The oak is species resistant on high air temperature and small amount of precipitations-dry conditions (conditions that are expected in agreement with the official national scenarios on climate change for Macedonia) and lees sensitive to forest fires, as well. Besides, the economic and technical value of the timber mass is high. The afforestation could be done on one location (all 5,000 ha) or distributed but not to more than five location. • Minimum 80 % of the seedlings have to be alive after third year of the afforestation and with good health and morphological condition should be maintained
Status of implementation	Under implementation
- Steps taken	• There are already existed nurseries for production of more than 8.000.000 seedlings annually

- Steps envisaged	• Area for afforestation should be chosen, around 7.5 million Oak seedlings should be produced, afforestation to be done with proper care in the next 5 years
	• **Phase I** – seedling production
	  • Duration: 3 years
	  • Number of seedlings: 2,500 seedlings/ha x 5,000 ha = 12,500,000 seedlings
	  • Costs for seedling production: 12,500,000 seedlings x 20 den. = 250,000,000=4,100,000 €
	• **Phase II** – soil preparation and afforestation
	  • Sub phase - soil preparation
	  • Duration: four months
	  • Costs: 5,000 ha x 15,000 den = 75,000,000 den = 1,250.000 €
	  • Sub phase - afforestation
	  • Duration: six months
	  • Costs: 5,000 ha x 20,000 den = 100,000,000 den = 1,650,000 €
	• **Phase III** – maintenance and protection
	  • Duration: five years
	  • Costs: 5.000 ha x 10.000 den = 50.000.000 den = 800.000 €

Indicators		Indicator value in the last reporting year	Indicative trajectory		Indicator target value
		2018	2020	2025	2030
Progress	Forest area (ha)				
	Forest planted/covered with new seedlings (ha)				
Emissions reduction (Gg CO_2-eq)			0	156.3	312.5

Finance	Budget	7.8 mil. EUR
	Source of finance	PE “National forests”, other forest enterprises
Implementing entity		Ministry of Agriculture Forestry and Water Economy
Monitoring entity		Ministry of Agriculture Forestry and Water Economy

Contribution for the achievement of the SDGs	direct	indirect
		

1.2.3 Land use change

PAM 39 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. These processes lead 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. This conversion supposes land use change and change of the production system, which might influence the net annual income of primary producers. Due to this, its implementation should be supported with incentives, especially in the first years of conversion, in order to bridge possible loss of incomes in farm holds.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Education, Technical	AFLOU-Land	CO_2,	National

Relevant planning documents, legal and regulatory acts	• Law on agricultural land • Rulebook on GAP • Rulebook on cross compliance for minimum requirements of GAP and environmental protection
Methodology	Regression model, IPCC methodology
Assumptions	• The total area of almost 3000ha is intensively cultivated which leads to decreasing of SOM as a result of its intensive decomposition and intensive soil erosion processes. If conversion to grass land is implemented, the estimated SOM increase is for more than 2% which for the total converted area of 2975 ha. 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
Status of implementation	Under implementation
- 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

Indicators		Indicator value in the last reporting year	Indicative trajectory		Indicator target value
		2018	2020	2025	2030
Progress	Area converted on yearly base (ha/year)				
Emissions reduction (Gg CO_2-eq)			1.0	2.2	3.7

Finance	Budget	1.5 mil. EUR
	Source of finance	Private sector, IPARD programme
Implementing entity		Ministry of Agriculture Forestry and Water Economy
Monitoring entity		Ministry of Agriculture Forestry and Water Economy

Contribution for the achievement of the SDGs	direct	indirect
		13 CLIMATE ACTION

PAM 40 Contour cultivation on areas under field crops on inclined terrains (5-15%)

Main objective: To reduce erosion of top soil and conservation of soil organic mater

Description: Regular cultivation in crop production means a massive disturbance of top soil layer, which cause intensive mineralization of soil organic matter (SOM) and CO_2 emissions. 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 require a 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.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Education, Technical	AFLOU-Land	CO_2,	National

Relevant planning documents, legal and regulatory acts	• Law on agricultural land • Law on water • Rulebook on Good Agricultural Practices • Rulebook on cross compliance for minimum requirements of GAP and environmental protection
Methodology [for estimating the emissions]	Regression model, IPCC methodology
Assumptions	• 14,000 ha (30%) of the total 47,090 ha of no-irrigated land on inclined terrines (above 5%) are planned for this measure • 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
Status of implementation [idea, planning phase, under implementation]	Under implementation
- 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 an 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

Indicators	Indicator value in the last reporting year	Indicative trajectory		Indicator target value
	2018	2020	2025	2030
Progress: Area in ha with contour cultivation				
Emissions reduction (Gg CO_2-eq)		5.0	16.4	28.0

Finance: Budget	1.0 mil. EUR
Finance: Source of finance	Private sector, IPARD programme
Implementing entity	Ministry of Agriculture Forestry and Water Economy
Monitoring entity	Ministry of Agriculture Forestry and Water Economy
Contribution for the achievement of the SDGs	direct: indirect: 

PAM 41 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, an 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.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Education, Technical	AFLOU-Land	CO_2,	National

Relevant planning documents, legal and regulatory acts	• Law on agricultural land • Law on water • Rulebook on GAP • Rulebook on cross compliance for minimum requirements of GAP and environmental protection
Methodology [for estimating the emissions]	Regression model, IPCC methodology
Assumptions	• 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.
Status of implementation [idea, planning phase, under implementation]	Under implementation
- 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 an 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 an 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

Indicators	Indicator value in the last reporting year	Indicative trajectory		Indicator target value
	2018	2020	2025	2030
Progress: Area of vineyards and orchards under perennial grass (ha)				
Emissions reduction (Gg CO_2-eq)		1.6	5.2	8.9

Finance: Budget	1 mil. EUR
Finance: Source of finance	Private sector, IPARD programme
Implementing entity	Ministry of Agriculture Forestry and Water Economy
Monitoring entity	Ministry of Agriculture Forestry and Water Economy

Contribution for the achievement of the SDGs	direct	indirect
		

PAM 42 Use of biochar for carbon sink on agricultural land

Main objective: Carbon sink by negative emission technology

Description: The agricultural soils in the country are characterized as soils with relatively low carbon content and with average to low fertility. The application of biochar can improve soil water holding capacity, nutrients storage into the soil, and increase yield. Biochar can capture even 3 times more CO_2 compared to its weight, because of its high carbon concentration. Biochar was included for the first time as a promising negative emission technology in the new IPCC special report "An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty" published in 2018. The process of application of biochar should go through several steps: i) research, ii) development the suitable technology for various soil/crop combination iii) experimental/demonstrative sites iv) development the measure for support from national programs for support of agriculture v) promotion of measure. This is new measure, need some research, therefore, in period 2017 – 2040 we predict only 15 years of active use of the measure.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Research, Education, Technical	AFLOU-Land/Agriculture	CO_2,	National

Relevant planning documents, legal and regulatory acts	• Biochar is not present in any strategic document in the country
Methodology	Regression model, IPCC methodology
Assumptions	• Sinking the amount of 330.3 Gg-eq CO2-eq and removing that amount from the atmosphere • Increasing of soil carbon content with adding of biochar as persistent carbon source. Most of the biochar will remain in the in the top soil layer due to available application technology incorporation biochar by plow on the plowing depth. • The positive effects on the soil fertility and soil health • Local production of the biochar by using residual biomass that is usually burnt in open fires.
Status of implementation	Idea
- Steps taken	• None
- Steps envisaged	• To conduct experimental research and to determine optimal biochar application rates for different soil/crop combinations • To foresee application of biochar on arable land as an agro-ecological measure into strategic documents, • To promote the effects of biochar on soil health, yield and environment, • Institutional support to primary producers with subsiding the process of implementing the measure

Indicators	Indicator value in the last reporting year	Indicative trajectory		Indicator target value
	2018	2020	2025	2030
Progress: Area of vineyards and orchards under perennial grass (ha)				
Emissions reduction (Gg CO_2-eq)		0	0	110.0

Finance: Budget	30 mil. EUR
Finance: Source of finance	Private sector, IPARD programme
Implementing entity	Ministry of Agriculture Forestry and Water Economy
Monitoring entity	Ministry of Agriculture Forestry and Water Economy
Contribution for the achievement of the SDGs	direct: 13 CLIMATE ACTION; indirect

PAM 43 Photovoltaic Irrigation

Main objective: Mitigation by replacing the non-renewable energy sources for water pumping with renewable, thus reducing the CO_2 emission

Description: Installation of photovoltaic system for irrigation purposes with 2.4 kW installed capacity, capable to run 1.1 kW 3 phase pump. The two cases are considered as mitigation practice, replacing the petrol pump with consumption of 0,3l petrol per hour (one of the most popular pumps in the country) with 3 phase AC pump and adding photovoltaic and replacing 1.1 kW electricity pump with 3 phase AC pump and adding the photovoltaic. The measure is suitable for already established on farm irrigation systems, but also for new establishing of the irrigation systems with on-farm water source. The measure is compatible with IPARD 2 measure "Production of energy from renewable resources for self-consumption, through processing of plant and animal products from primary and secondary biomass (except biomass from fishery products) for production of biogas and/or biofuels, use of solar energy, windmills, geo-thermal energy etc".

Timeframe	Type	Sector	Gases	Scope
2021 – 2040	Research, Education, Technical	AFLOU-Land/Agriculture	CO_2,	National

Relevant planning documents, legal and regulatory acts	• Law on Agriculture and Rural Development • National strategy on Agriculture and Rural Development • IPARD2
Methodology [for estimating the emissions]	Regression model, IPCC methodology
Assumptions	• About 1000 installations annually in the period of 20 years, reaching about than 20 000 hectares irrigated by photovoltaic as energy source.
Status of implementation [idea, planning phase, under implementation]	Planning phase
- Steps taken	• There is possibility for getting support from IPARD2 funds. The measure provides up to 65% of co-financing and promoting of photovoltaic irrigation if the frame of this measure is feasible
- Steps envisaged	• To promote the photovoltaic irrigation as mitigation measure • To include the measure in agri-environmental scheme • To investigate possibilities for diversification of farm incomes trough distributing the excess of electricity produced into the network,

Indicators	Indicator value in the last reporting year	Indicative trajectory		Indicator target value
	2018	2020	2025	2030
Progress: Increase in installed capacity (MW)				
Emissions reduction (Gg CO_2-eq)		0	46.7	93.3

Finance: Budget	47 mil. EUR
Finance: Source of finance	Private sector, IPARD programme
Implementing entity	Ministry of Agriculture Forestry and Water Economy
Monitoring entity	Ministry of Economy, Energy Agency

Contribution for the achievement of the SDGs	direct	indirect
	7 AFFORDABLE AND CLEAN ENERGY	12 RESPONSIBLE CONSUMPTION AND PRODUCTION 13 CLIMATE ACTION

1.3 WASTE

PAM 44 Landfill gas flaring

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 eight waste management regions, as well as opening of regional landfills. The rehabilitation includes covering on the existing non-compliant landfills, supplemented by gas extraction and flaring.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Technical	Waste – Solid waste disposal	CO_2, CH_4	Regional

Relevant planning documents, legal and regulatory acts	• National Waste Management Plan 2020-2030 • Strategy for Waste Management in the Republic of Macedonia • Regional Waste Management Plans (Northeast, East, Southeast, Southwest, Pelagonia, Polog, Vardar and Skopje region)
Methodology	Regression model, IPCC methodology
Assumptions	Closing of existing and opening of new landfills by waste management regions in the following order: • Skopje – 2023 • East and Northeast – 2025 • Polog – 2026 • Southeast – 2029 • Pelagonia and Southeast – 2029 • Vardar 2029
Status of implementation	Planning phase
- Steps taken	• Regional waste management plans developed and adopted, • 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. • Discussions started with EBRD for involvement in financing regional waste management projects.
- Steps envisaged	• Obtaining funds for the other regions • Starting the construction of the new regional landfill for the East and Northeast planning region • Covering on the existing non-compliant landfills and installation of gas flaring systems where it is feasible

Indicators		Indicator value in the last reporting year	Indicative trajectory		Indicator target value
		2018	2020	2025	2030
Progress	Amount of CH_4 burned (kt)	0	0		22.0
Emissions reduction (Gg CO_2-eq)		0	0		489.7

Finance	Budget	10.5 mil. EUR
	Source of finance	Local self-government through Public Utilities, Public Private Partnership, EU funds, IFIs
Implementing entity		• Ministry of Environment and Physical Planning • Municipalities (Public municipal enterprises for waste management) • Regional waste management companies / Inter-Municipal Waste Management Board
Monitoring entity		Ministry of Environment and Physical Planning State Environmental Inspectorate Authorized Inspectors of Environment (Municipalities)
Contribution for the achievement of the SDGs		direct: indirect 

PAM 45 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.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Technical	Waste – Solid waste disposal	CO_2, CH_4, N_2O	Regional

Relevant planning documents, legal and regulatory acts	• National Waste Management Plan 2020-2030 • Strategy for Waste Management in the Republic of Macedonia • Regional Waste Management Plans (Northeast, East, Southeast, Southwest, Pelagonia, Polog, Vardar and Skopje region) – final and draft versions
Methodology [for estimating the emissions]	Regression model, IPCC methodology
Assumptions	Opening of the regional landfills in the following order: • Skopje – 2023 • East and Northeast – 2025 • Polog – 2026 • Southeast – 2029 • Pelagonia and Southeast – 2029 • Vardar 2029
Status of implementation [idea, planning phase, under implementation]	Planning phase
- Steps taken	• Regional waste management plans developed and 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

Indicators		Indicator value in the last reporting year	Indicative trajectory		Indicator target value
		2018	2020	2025	2030
Progress	Amount of compost (kt)	0	0		78
Emissions reduction (Gg CO_2-eq)		0	0		-12.2 (108*)

Finance	Budget	36.1 mil. EUR
	Source of finance	Local self-government through Public Utilities, Public Private Partnership, EU funds
Implementing entity		• Ministry of Environment and Physical Planning • Municipalities / Public municipal enterprises for waste management • Regional waste mgmt companies / Inter-Municipal Waste Management Board •
Monitoring entity		Ministry of Environment and Physical Planning State Environmental Inspectorate Authorized Inspectors of Environment (Municipalities)
Contribution for the achievement of the SDGs		direct: 11 SUSTAINABLE CITIES AND COMMUNITIES; 12 RESPONSIBLE CONSUMPTION AND PRODUCTION indirect: 13 CLIMATE ACTION

* Total reduction when including the emissions realized after 2040

PAM 46 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

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Technical	Waste – Solid waste disposal	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• National Waste Management Plan 2020-2030 • Strategy for Waste Management in the Republic of Macedonia • Regional Waste Management Plans (Northeast, East, Southeast, Southwest, Pelagonia, Polog, Vardar and Skopje region)
Methodology [for estimating the emissions]	Regression model, IPCC methodology
Assumptions	• Gradual increase of paper selection compared to WOM, starting from 2% upto 50% in 2040.
Status of implementation [idea, planning phase, under implementation]	Planning phase
- 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)

Indicators	Indicator value in the last reporting year	Indicative trajectory		Indicator target value
	2018	2020	2025	2030
Progress – Amount of paper waste (kt)		2		22
Emissions reduction (Gg CO_2-eq)		0		10.1

Finance – Budget	2 mil. EUR
Finance – Source of finance	Local self-government through Public Utilities, Public Private Partnership, EU funds
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)
Monitoring entity	Ministry of Environment and Physical Planning

Contribution for the achievement of the SDGs	direct	indirect
	11 SUSTAINABLE CITIES AND COMMUNITIES; 12 RESPONSIBLE CONSUMPTION AND PRODUCTION	13 CLIMATE ACTION

PAM 47 Improved waste and materials management at industrial facilities

Main objective: Set targets for reduction of generation, selection, reuse, recycling and treatment of waste at industrial installations

Description: On an individual assessment, each IPPC installation operator shall submit proposals for 1) waste generation, 2) waste selection, 3) waste reuse, 4) waste recycling, 5) waste treatment. Goals are set in integrated environmental permits.

Goals are set for a 5 year framework (progressive goals for each year) that will be updated as appropriate after the deadline.

Two levels of goals: mandatory and higher incentives (through tax or financial incentives).

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Regulation, Technical	Waste – Solid waste disposal	CO_2, CH_4	National

Relevant planning documents, legal and regulatory acts	• National Waste Management Plan 202-2030 • Strategy for Waste Management in the Republic of Macedonia • Law on Waste Management and bylaws • Law on Finance and bylaws • Regional Waste Management Plans (Northeast, East, Southeast, Southwest, Pelagonia, Polog, Vardar and Skopje region)
Methodology [for estimating the emissions]	Regression model, IPCC methodology
Assumptions	• Conducted substantive analysis, international experiences analyzed. The percentage of industrial waste treatment will increase from 5% in 2024 up to 30% in 2040.
Status of implementation [idea, planning phase, under implementation]	Planning phase
- Steps taken	•
- Steps envisaged	• Analysis of possible tax and financial options to encourage the achievement of higher goals • Analysis done; opportunities/mechanisms identified • Modified and issued environmental permits • Regular annual implementation oversight • Regular annual reporting by IPPC operators

Indicators	Indicator value in the last reporting year	Indicative trajectory		Indicator target value
	2018	2020	2025	2030
Progress – Industrial waste collected (kt)	0	0		302
Emissions reduction (Gg CO_2-eq)	0	0		3.3

Finance – Budget	n/a
Finance – Source of finance	Ministry of Environment and Physical Planning, Municipalities and city of Skopje, Industrial facilities, EU funds
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)
Monitoring entity	Ministry of Environment and Physical Planning
Contribution for the achievement of the SDGs	direct:  indirect: 

1.4 Additional PAMs (enablers of mitigation action)

PAM 48 Introduction of CO_2 tax

Main objective: Incentivize lowering CO2 emissions
Description: Introduction of CO_2 tax in order to stimulate the investments in RES and to increase the penetration of energy efficiency measures

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Regulatory	Energy	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Strategy for Energy Development of the Republic of Macedonia up to 2040 • Law on Energy • Bylaws for renewable energy • Law on Climate Change
Methodology	Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
Assumptions	• Gradual introduction of CO_2 tax (2023 in WAM) based on the projected prices from WEO 2017.
Status of implementation	Under implementation
- Steps taken	• Draft version of the Law on Climate Change • Strategy for Energy Development of the Republic of Macedonia up to 2040
- Steps envisaged	• Adoption of the Law on Climate Change • Adoption of the Strategy on Climate Action • Adoption of the National Energy and Climate Plan

Indicators	Value in the last reporting year	Indicative trajectory		Target value
	2018	2020	2025	2030
Progress kt CO_2 emissions paid under carbon tax	0	0	3772	3223

Finance – Budget	n/a
Finance – Source of finance	n/a
Implementing entity	• Government of the Republic of North Macedonia • Ministry of Environment and Physical Planning • Ministry of Economy, Energy Agency • Ministry of Finance
Monitoring entity	Ministry of environment and physical planning

Contribution for the achievement of the SDGs	direct	indirect
	7 AFFORDABLE AND CLEAN ENERGY	12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION

PAM 49 Program for just transition

Main objective: Developing programs for socially responsible and just transition

Description: Depending on selected level of transition from conventional energy, it is important to develop programs for socially responsible and just transition to mitigate negative effects of associated job losses. Such programs should provide an answer how to redeploy employees to other jobs and stimulate new job opportunities by investing in low carbon technologies and services.

Timeframe	Type	Sector	Gases	Scope
2020 – 2030	Regulatory	Energy	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Strategy for Energy Development of the Republic of Macedonia up to 2040 • Law on Energy • Documents from project which are working in this area
Methodology	TBC
Assumptions	• Oslomej is decommissioned in 2021 • Bitola is decommissioned in the period 2025-2027
Status of implementation	Under implementation
Steps taken	• EBRD project of just transition in Oslomej region • NGO project of just transition in Oslomej region • 100 MW PV power plant in Oslomej • 20 MW PV power plant in Oslomej • 20 MW PV power plant in Bitola
Steps envisaged	•

Indicators		Value in the last reporting year	Indicative trajectory		Target value
		2018	2020	2025	2030
Progress	Program adopted	no	no	yes	yes

Finance	Budget	n/a
	Source of finance	JSC ESM, state budget, donors
Implementing entity		• Government of the Republic of North Macedonia • Ministry of Economy • JSC Macedonian Power Plants (ESM AD) • Ministry of labor and social policy
Monitoring entity		Ministry of Economy
Contribution for the achievement of the SDGs		direct:  indirect: 

PAM 50 Identification of the proper location for solar and wind power plants

Main objective: Development of methodology for selection of the most appropriate location foe solar and wind power plants

Description: Avoid excessive damage to nature, Government, energy companies and NGOs can prioritize land areas that have already been disturbed by industrial activity such as mines or quarries. In territories that have been historically dependent on coal production, depleted coal and other mines can be used for this purpose. In addition, for the wind warms it is important to find appropriate locations, not environmentally sensitive (e.g habitats of birds and bats).

Timeframe	Type	Sector	Gases	Scope
2020 – 2023	Technical	Energy	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Strategy for Energy Development of the Republic of Macedonia up to 2040 • Law on Energy • Law on environmental protection • Documents from project which are working in this area
Methodology	TBC
Assumptions	• Oslomej is decommissioned in 2021 • Bitola is decommissioned in the period 2025-2027
Status of implementation	Planning
- Steps taken	• 100 MW PV power plant in Oslomej • 20 MW PV power plant in Bitola • 20 MW PV power plant in Bitola
- Steps envisaged	•

Indicators		Value in the last reporting year	Indicative trajectory		Target value
		2018	2020	2025	2030
Progress	Methodology developed	no	no	yes	yes

Finance	Budget	n/a
	Source of finance	State budget, donors
Implementing entity		• Government of the Republic of North Macedonia • Ministry of Economy • JSC Macedonian Power Plants (ESM AD) • Ministry of labor and social policy • Donors
Monitoring entity		• Ministry of Economy
Contribution for the achievement of the SDGs		direct:  indirect: 

PAM 51 Smart communities

Main objective: Develop pilots for smart communities

Description: Smart academic campuses could have an exemplary role where all advanced concepts and principles from smart energy systems can be tested with the goal for roll-out on larger scale.

Timeframe	Type	Sector	Gases	Scope
2020 – 2030	Education, Technical	Education, Energy	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	/
Methodology	TBC
Assumptions	/
Status of implementation	Planning
- Steps taken	• PV power plants are installed at the Faculty of Electrical Engineering and Information Technologies
- Steps envisaged	•

Indicators		Value in the last reporting year	Indicative trajectory		Target value
		2018	2020	2025	2030
Progress	Number of smart communities	1	1		

Finance	Budget	Depends on the type of smart community
	Source of finance	• Donors • Horizon 2020 and other research programs
Implementing entity		• Universities (or high schools)
Monitoring entity		• Ministry of Education and Science • Ministry of Economy

Contribution for the achievement of the SDGs	direct	indirect
		

PAM 52 Construction of 400 kV electricity transmission interconnection Macedonia-Albania (Bitola-Elbasan)

Main objective: Improve the interconnectivity level

Description: this project is the last segment of the Corridor 8 for transmission of electricity between Bulgaria, Macedonia, Albania and Italy. The project is included in the List of Projects of Energy Community Interest (PECI).

Timeframe	Type	Sector	Gases	Scope
2020 – 2023	Technical	Energy	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• PECI list • Plan for development of the transmission system, 2020-2029, MEPSO • Infrastructure Capacity Project, Technical Assistance Window (IPA) Western Balkans
Methodology	Calculation of interconnectivity level, using MARKAL results from the Strategy for energy development up to 2040 and ENTSO-E Winter outlook
Assumptions	Interconnectivity level will be increased for at least 7%
Status of implementation	Under implementation
- Steps taken	• an agreement for construction signed
- Steps envisaged	•

Indicators		Value in the last reporting year	Indicative trajectory		Target value
		2018	2020	2025	2030
Progress	Interconnectivity level	85	85	78	51

Finance – Budget	34 Mil. €
Finance – Source of finance	EBRD (17.2 Mil. €), Grand from Western Balkan Investment Fund (16.9 Mil. €)
Implementing entity	• MEPSO
Monitoring entity	• Ministry of economy

Contribution for the achievement of the SDGs	direct	indirect
	7 AFFORDABLE AND CLEAN ENERGY	12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION

PAM 53 Develop natural gas cross-border infrastructure to diversify supply routes and increase market competitiveness

Main objective: Develop natural gas cross-border infrastructure to diversify supply routes and increase market competitiveness

Description: On 10 July 2015 the Republic of North Macedonia became a signatory to the Memorandum of understanding on a common approach to address the natural gas diversification and the challenges of security of supply within the Central and Southeastern Europe Gas Connectivity Initiative (CESEC).

NER JSC Skopje has started implementing the obligations under this Initiative aimed at promoting the diversification of natural gas supply and ensuring security in the supply of the region, which should take place by improving the regional infrastructure and integration of markets through the joint engagement of all EU Member States and Contracting Parties of the Energy Community. This initiative should provide the supply of the necessary quantities of natural gas to all consumers in the region of Central and South-Eastern Europe (CESEC), including the Republic of North Macedonia.

In addition, there are two other initiatives - pipelines to Kosovo* and Serbia. The pipeline to Serbia could provide additional alternative source and transit opportunity to the Macedonian system, while the connection with Kosovo* could provide transit opportunity. Both can increase the utilization rate of the system, thus have the potential to decrease tariffs and help the gasification efforts in Macedonia. The projects for gas pipelines to Kosovo* and Serbia are on the preliminary PECI 2020 list that should be adopted by the Ministerial council at the end on 2020, while the gas project to Greece is already included on the PMI list, verified on 14 October 2016 by the Ministerial council of the Energy Community.

Furthermore, Macedonia and Albania have signed a Memorandum of understanding and a working group is established and it is expected that by the end of 2020 more concrete activities will start.

Timeframe	Type	Sector	Gases	Scope
2020 – 2025	Technical, Regulatory	Energy	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• List of Projects of Mutual Interest • List of Project of Energy Community Interest
Methodology	/
Assumptions	/
Status of implementation	Under implementation
- Steps taken	Macedonia – Greece pipeline • Project application after the fourth open call for co-financing of infrastructure projects within the IPA instrument Investment Framework of the Western Balkans, November 2018 and update of the same in April 2019. The investment grant application has a positive screening status and the final decision was made in December 2019; • A letter was submitted with a request for expression of interest for financing the Project submitted to the European Investment Bank (EIB), October 2018. The EIB submitted a positive response to this request in November 2018. Intensive negotiations have started for the financing procedure. • Mutual Feasibility Study is prepared by DESFA and NER in January 2019 and it is submitted and accepted by EIB • A request for technical assistance (100% grant) has been submitted for the preparation of an Environmental Impact Assessment Study and a general design project to Connect (Technical Assistance for Connectivity in the Western Balkans). The application was approved in January 2019. The study and the general design project are being prepared by Konnekta. According to the plans, the Study (EIA) has already been prepared and submitted to the EIB for comments, while the project documentation should be completed by the middle of 2020. • A request for technical assistance (100% grant) for preparation of tender documentation for construction and construction supervision has been submitted. The same has been approved, but due to the coronavirus situation it is postponed. Macedonia – Kosovo* pipeline • Memorandum of Understanding is signed, February 2019 • A letter with a request for expression of interest for financing the Project was submitted to the EBRD. At the beginning of 2019, the EBRD submitted a positive response to this request and the bank supported the implementation of this project; • A project application was submitted after the 21st open call for technical assistance for preparation of a Feasibility Study and Environmental Impact Assessment Study within the IPA Instrument Investment Framework of the Western Balkans, November 2018 and update of the same in April 2019. The technical assistance application was approved in July 2019; The TOR (Terms of Reference) has been developed. A Feasibility Study and an Environmental Impact Assessment Study are expected to be completed by the middle of 2020. Macedonia – Serbia pipeline: • Activities for signing a Memorandum of Understanding.
- Steps envisaged	• Start with the construction of Macedonia-Greece pipeline

Indicators		Value in the last reporting year	Indicative trajectory		Target value
		2018	2020	2025	2030
Progress	Natural gas interconnection capacity (Mill. Nm^3)	800	800	800	3300
Finance	Budget	n/a			
	Source of finance	Grant – 10 Mil. €, Central government budget			
Implementing entity		• National Energy Resources of Macedonia			
Monitoring entity		Ministry of Economy			
Contribution for the achievement of the SDGs		direct	indirect		
					

PAM 54 Develop gas transmission network

Main objective: Increase the access to the transmission network

Description: Macedonia has an ambitious gasification plan and a detailed list of planned infrastructure project of the gas network in Macedonia with timeline is given in Chapter 4, Energy transmission infrastructure. The increased level of transmission network access is especially aimed at the industrial consumers (which are most affected by the green scenario), as natural gas is one of the fuels that will significantly contribute to the energy transition in the industry sector. In addition, with the implementation of this measure the air quality will be significantly improved.

Timeframe	Type	Sector	Gases	Scope
2020 – 2025	Technical	Energy	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Gasification plan of Macedonia
Methodology	Bottom-up modeling and least-cost optimization using the MARKAL model.
Assumptions	/
Status of implementation	Under implementation
- Steps taken	• Klechovce-Valve station 5(Stip), with length of 61 km and diameter of 500mm, finished in 2016 (light blue line in Figure 78), and • Valve station 5(Stip)-Negotino, with length of 38 km and diameter of 500mm, finished in 2019 (purple line in Figure 78).
- Steps envisaged	• Negotino (Kavadarci)-Bitola, with length of 92 km and diameter of 500mm, 90% realized up to June 2020 (green line in Figure 78) • Skopje-Tetovo-Gostivar, with length of 76 km and diameter of 500mm, and additional branch to Tetovo with length of 10 km and diameter of 150 mm, 53.1% realized at the beginning of November 2019 (yellow line in Figure 78). It is expected that in the near future the construction of three additional gas pipelines will be started: • Gostivar-Kicevo, with length of 34 km, in a process of obtaining building permit (to be finished by 2022) • Sveti Nikole – Veles, with length of 32 km, in a process of preparing project documentation (to be finished by 2023) • Kicevo-Ohrid (to be finished by 2025) • Bitola – Ohrid (to be finished by 2025) • Valve station 5 (Stip)-Radovis-Strumica, with length of 60 km

Indicators		Value in the last reporting year	Indicative trajectory		Target value
		2018	2020	2025	2030
Progress	Final energy consumption of natural gas in Industry (ktoe)	36	37	140	216

Finance	Budget	~200 Mil. €
	Source of finance	State budget
Implementing entity		• National Energy Resources of Macedonia
Monitoring entity		Ministry of Economy

Contribution for the achievement of the SDGs

direct: 7 AFFORDABLE AND CLEAN ENERGY

indirect: 12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION

PAM 55 Develop a gas distribution network

Main objective: Diversification of the energy resources

Description: Macedonia has an ambitious gasification plan and natural gas is one of the fuels that will significantly contribute to the energy transition up to 2040. In addition, with the implementation of this measure the air quality will be significantly improved.

Timeframe	Type	Sector	Gases	Scope
2020 – 2025	Technical	Energy	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Gasification plan of Macedonia • Feasibility study about gasification (revised version in 2020)
Methodology	Bottom-up modeling and least-cost optimization using the MARKAL model.
Assumptions	Development of a cost benefit analyses for each city
Status of implementation	Under implementation
- Steps taken	• Tender announced • EBRD support for procurement and installation of household equipment (50 mill. EUR) • Tender for technical and legal support for preparation and implementation of a tender procedure is announced in June 2020 by EBRD
- Steps envisaged	

Indicators		Value in the last reporting year	Indicative trajectory		Target value
		2018	2020	2025	2030
Progress	Final energy consumption of natural gas except Industry (ktoe)	7	3	26	38

Finance	Budget	/
	Source of finance	Grant, Central governmental budget, Local self-government budgets
Implementing entity		• Ministry of economy, • National Energy Resources of Macedonia, • Local self-government
Monitoring entity		Ministry of Economy

Contribution for the achievement of the SDGs	direct	indirect
	7 AFFORDABLE AND CLEAN ENERGY	12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION

PAM 56 Pursue regional electricity market integration

Main objective: Increase the electricity price competitiveness and affordability.

Description: It is anticipated that day ahead market coupling, and development of power exchange is playing an important role in the future for North Macedonia and EnC market integration initiatives (WB6). Future potential domestic capacities for electricity generation are considered in the context of integrated regional and European market. In addition, a well-integrated regional market will serve as a control indicator for price competitiveness and steer future capital investment decisions.

In order to have competitive natural gas market in Macedonia, the interconnection agreement between Macedonian and Bulgarian TSOs is of crucial importance.

Timeframe	Type	Sector	Gases	Scope
2020 – 2023	Regulatory,	Energy	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Energy Law and bylaws
Methodology	/
Assumptions	/
Status of implementation	Under implementation
Steps taken	• The decree for the operation of the organized electricity market and the necessary technical, staff and financial conditions that should be fulfilled, is adopted by the Government
Steps envisaged	•

Indicators	Indicator value in the last reporting year	Indicative trajectory		Indicator target value
	2018	2020	2025	2030
Progress – Coupled with Bulgaria	no	no	yes	yes
Progress – Macedonian and Bulgarian gas TSOs agreement signed	no	no	yes	yes

Finance – Budget	/
Finance – Source of finance	National electricity market operator (MEMO), GAMA
Implementing entity	• National electricity market operator (MEMO), • GAMA
Monitoring entity	• Energy Regulatory Commission

Contribution for the achievement of the SDGs

direct: 

indirect: 

PAM 57 Develop further distribution system network to integrate more RES, including prosumers and more electric vehicles (EVs), as well as continuously improve network reliability

Main objective: Develop further distribution system network to integrate more RES, as well as continuously improve network reliability..

Description: The RES policies and measures envisage a huge number of solar PVs up to 1,400 MW, out of which 250 – 400 MW being rooftop PVs. Such trend indicates an important role of the distribution network system to service growing decentralised systems. In addition, European practice shows that regulators are imposing additional pressure and incentive to improve the operational performance and results of distribution system operators. The key changes that should be considered in the future are related in introducing new quality indicators in the tariff methodology (voltage quality, quality of supply, customer relationship quality etc.), as well as additional revisions on investment decisions (CAPEX and regulated asset base), operating efficiency and expected returns for distribution system operators. These changes in the regulatory framework will indirectly contribute to improvements in asset management, workforce management, automation and roll out of "behind the meter" services in the future.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Regulatory,technical	Energy	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Energy Law and bylaws • Plan for development of the distribution network
Methodology	/
Assumptions	The potential for distributed RES, prosumers and electric vehicles will be increased
Status of implementation	Under implementation
Steps taken	• Chargers for Electric vehicles are being installed • Old meters are being replaced with smart meters
Steps envisaged	•

Indicators	Indicator value in the last reporting year	Indicative trajectory		Indicator target value
	2018	2020	2025	2030
Progress: Number of prosumers Capacity of distributed PV Number of electric vehicles	/	n/a	n/a	n/a

Finance: Budget	/
Source of finance	EVN, consumers through their electricity bills
Implementing entity	• EVN • Energy Regulatory Commission
Monitoring entity	• Energy Regulatory Commission

Contribution for the achievement of the SDGs	direct	indirect
		

PAM 58 Price signal demand response

Main objective: Introduce price signals to consumers in order to implement demand response.

Description: Demand response is one of the main methods that are used in order to reduce the maximum electricity consumption in the system, and thus reduce its peak load and integrate higher level of RES in the system. Price signalling provided by the electricity suppliers can significantly contribute towards achieving these goals. By implementing the new Energy Law, and by the liberalized market it is envisioned that the role of the universal supplier will be reduced, and that the concurrency of the suppliers will be increased. Therefore, each of them may introduce different pricing signals for different type of consumers.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Regulatory	Energy	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Energy Law and bylaws • Study on automated demand response, MEPSO
Methodology	/
Assumptions	Price signal demand response will reduce the peak load and enable higher integration of RES
Status of implementation	Under implementation
Steps taken	/
Steps envisaged	•

Indicators	Indicator value in the last reporting year	Indicative trajectory		Indicator target value
	2018	2020	2025	2030
Progress – Number of suppliers on the market with price signals	/	n/a	n/a	n/a

Finance – Budget	/
Finance – Source of finance	Electricity suppliers/traders, Consumers
Implementing entity	• Electricity suppliers/traders • Consumers
Monitoring entity	• Energy Regulatory Commission

Contribution for the achievement of the SDGs	direct	indirect
		

PAM 59 Adoption of annual program for vulnerable consumers

Main objective: Protect vulnerable customers .

Description: The Implementation of the GHG and RES targets will increase the price of electricity as it is described in Chapter 4 Internal energy market. Having this in mind a program for vulnerable costumers is needed that will protect them from the price shocks.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Regulatory	Energy	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Energy law • Separate rules for electricity, gas and heat supply • Program for vulnerable consumers for 2020
Methodology	/
Assumptions	This early program should define the categories of vulnerable costumers and associated measures, including financial supports and responsible institutions for realization of the program.
Status of implementation	The first program is adopted by the Government
Steps taken	/
Steps envisaged	•

Indicators	Indicator value in the last reporting year	Indicative trajectory		Indicator target value
	2018	2020	2025	2030
Progress – Program adopted	no	yes	yes	yes

Finance – Budget	Different for each year
Finance – Source of finance	Budget and potential donors
Implementing entity	• Ministry of economy • Suppliers of electricity, gas and heat
Monitoring entity	• Energy Regulatory Commission
Contribution for the achievement of the SDGs	direct:  indirect: 

PAM 60 Participation in development of energy transition technologies and measures

Main objective: Streamline energy transition technologies and measures into national R&I priorities

Description: The development of sectoral strategies and plans for science and R&I should be realized in cooperation between Ministry of Education and Science and relevant energy stakeholders, in order to prioritize energy transition technologies and measures. Same is needed for the programmes in the Fund for Innovation and Technology Development.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Research	Energy, Research, Economy	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Innovation Strategy, 2012-2020 • Law on Innovation Activity • Annual programs of the Fund for Innovation and Technology Development
Methodology	/
Assumptions	/
Status of implementation	The Fund for Innovation and Technology Development has already announced two public calls for research in climate change and local pollution
Steps taken	/
Steps envisaged	/

Indicators		Indicator value in the last reporting year	Indicative trajectory		Indicator target value
		2018	2020	2025	2030
Progress	Number of research projects development of energy transition technologies and measures		n/a	n/a	n/a

Finance	Budget	/
	Source of finance	• Fund for Innovation and Technology Development • Horizon 2020 • Donors
Implementing entity		• Ministry of Education and Science • Fund for Innovation and Technology Development • Chamber of Commerce
Monitoring entity		• Ministry of Education and Science

Contribution for the achievement of the SDGs	direct	indirect
		 

PAM 61 Increased level of education of sustainable energy needs

Main objective: Adjust energy related curricula at all educational levels to make them responsive to energy transition trends

Description: The development of consciousness for sustainable energy needs to be addressed from the earliest education levels and incorporated in the curricula of all primary, secondary and tertiary educational levels. Moreover, stimulating science and education in energy transition will help mobilization of the existing and building of new research capacities, as well as better integration into European Research Area (ERA) in energy themes.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Education, Regulatory	Education	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Law on primary education • Law on secondary education • Law on higher education
Methodology	/
Assumptions	/
Status of implementation	/
Steps taken	/
Steps envisaged	/

Indicators	Indicator value in the last reporting year	Indicative trajectory		Indicator target value
	2018	2020	2025	2030
Progress – Number of curricula for sustainable energy needs		n/a	n/a	n/a

Finance – Budget	/
Finance – Source of finance	/
Implementing entity	• Universities, High and Primary schools
Monitoring entity	• Ministry of Education and Science
Contribution for the achievement of the SDGs	direct: 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE; indirect: 7 AFFORDABLE AND CLEAN ENERGY, 13 CLIMATE ACTION

PAM 62 Inter-sectoral and geographical mobility of researchers

Main objective: Encourage inter-sectoral and geographical mobility of researchers

Description: Knowledge and experience transfer among researchers from industry and academia, as well as incoming and outgoing mobility is needed to build internal capacities. For example, at highest educational level, industrial doctorates can be promoted as a tool to support industry driven science..

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Education, Regulatory	Education, Energy	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	• Law on primary education • Law on secondary education • Law on higher education
Methodology	/
Assumptions	/
Status of implementation	Faculty of Electrical Engineering and Information Technologies has established INNOFEIT, which is a place where the faculty staff, students and company representatives can interact, network and transfer technologies and innovations. The goal of INNOFEIT is to improve, strengthen and stimulate the transfer of knowledge.
Steps taken	/
Steps envisaged	/

Indicators		Indicator value in the last reporting year	Indicative trajectory		Indicator target value
		2018	2020	2025	2030
Progress	Number of industrial doctorates		n/a	n/a	n/a

Finance	Budget	/
	Source of finance	• Industry companies • Donors
Implementing entity		• Universities • Industry companies
Monitoring entity		• Ministry of Education and Science • Ministry of Economy

Contribution for the achievement of the SDGs	direct	indirect
		 

PAM 63 Increase the role of SME sector in energy transition

Main objective: Encourage SME sector to diversify their portfolio of services and products in RES and EE

Description: To support greater involvement of local SME in energy transition, it is necessary to promote further expansion of RES projects and EE measures overall, especially via financial mechanisms, as well as green public procurement for innovative products. Private investments in RES and EE will be encouraged by structuring financing instruments with grant components to lower the risk of private investments in untested but promising clean energy technologies or business models. In addition, provision of technical assistance for SMEs in order to facilitate the access of enterprises to external services is needed. This covers the areas of external research and development, testing, design, instruction and training, market research, business consulting, etc.

Timeframe	Type	Sector	Gases	Scope
2020 – 2040	Research, Technical, Voluntary	Energy	CO_2, CH_4, N_2O	National

Relevant planning documents, legal and regulatory acts	/
Methodology	/
Assumptions	/
Status of implementation	/
Steps taken	/
Steps envisaged	/

Indicators		Indicator value in the last reporting year	Indicative trajectory		Indicator target value
		2018	2020	2025	2030
Progress	Number of innovations/patents in the field of clean energy	/	n/a	n/a	n/a

Finance	Budget	/
	Source of finance	• Grants • Private investments
Implementing entity		• SMEs
Monitoring entity		• Ministry of Economy

Contribution for the achievement of the SDGs	direct	indirect
	9 INDUSTRY, INNOVATION AND INFRASTRUCTURE	7 AFFORDABLE AND CLEAN ENERGY, 13 CLIMATE ACTION

1.5 Regional approach

After the adoption of the Strategy for energy development until 2040 in December 2019 and the preparation of the draft version of Mitigation report on climate change as a part of TBUR, the Ministry of Local Self-Government started with the preparation of the Strategy for regional development for the period 2019-2029. The Strategy was prepared in the second half of 2020 and in December 2020 is submitted to the Assembly of the Republic of North Macedonia for adoption.

The Strategy for regional development analyzes the disparity of the eight planning regions in North Macedonia in different areas, including the energy sector. For the needs of this strategy, a special document was prepared with a detailed analysis of the energy sector in relation to the eight planning regions. In addition, five measures have been elaborated in detail, which are based on the measures defined in the Energy strategy, TBUR and NECP, but a regional context is given. The following are the most important observations that are presented in the Strategy for regional development:

1. Energy consumption in households per capita,
2. Energy consumption in industry per added value,
3. Participation of the regions in RES for heating and cooling,
4. Participation of the RES regions in electricity production.

For each of the four parameters, a ranking of the regions from 1 to 8. was made. Each of the parameters is assigned the same weight factor and it turns out that in terms of these four parameters the best is the Southwest planning region, followed by the Polog and Skopje planning region (Table 8). The lowest ranked regions are the Pelagonija and Vardar planning region. The GHG emissions are not considered because there is no information by region, but given that TPP Bitola is in the Pelagonija region, this region is convincingly the worst of all other regions. Additionally, the analysis of the impact of the energy system on climate change shows that the most affected regions, i.e. the largest reductions of the GHG emissions will be in the Pelagonija and Southwest planning region where TPP Bitola and TPP Oslomej are located.

Table 8: Ranking of regions

Planning region	Energy consumption in households per capita (kWh/жител)	Energy consumption in industry at added value (kWh/EUR)	Participation of the regions in RES for heating and cooling	Participation of the RES regions in electricity production	Ranking
Vardar	2737	7.3	7.7%	8.6%	**8**
East	2855	0.8	14.3%	1.8%	**6**
Southwest	2585	0.6	12.8%	35.0%	**1**
Southeast	2509	2.3	13.7%	5.5%	**4**
Pelagonija	2840	1.4	12.7%	3.3%	**7**
Polog	2615	1.1	14.5%	31.1%	**2**
Northeast	2400	0.6	7.0%	0.0%	**5**
Skopje	2841	1.8	17.2%	14.7%	**3**

Source: Strategy for regional development for the period 2019-2029

It is obvious that there is disparity between the regions and in order to reduce it, i.e. to have improvement of those planning regions that are lagging behind, but at the same time to ensure those planning regions that are developed to continue their development, five priority measures are proposed.

1. ***Just transition***: In the Pelagonija and Southwest planning region the decommissioning of the TPP on coal is more that obvious since large investments are needed to meet the obligations of the Large Combustion Plants Directive and the Industrial Emissions Directive which are mandatory from 2025 and 2028, respectively. Second reason for their potential decommission is the introduction of a CO_2 tax, which would make the production price of these plants uncompetitive to the market. The third factor is the challenge related to coal supply, i.e. depletion of current facilities and the possibility of opening new ones. As a possible solution, it is proposed to create conditions for investment in new facilities for electricity production, primarily from RES that would be built on mines or coal landfills. This already started on the coal landfill in Oslomej where it is planned to build 120 MW solar power plants. This approach should be applied to Bitola as well, because in the Pelagonija planning region,

except for TPP Bitola, there are almost no other production facilities. It is also necessary to develop transition programs that will include mechanisms in which employees can be exploited. It is planned to build about 320 MW of photovoltaic power plants in these two regions. The investment is projected to about 200 mill EUR.
Connection with the PAMs from NDC: PAM 4, PAM 7, PAM 48, PAM 49.

2. ***Increasing the participation of the Southeast, East and Northeast planning region in the electricity production form RES***: There is almost no production of electricity from RES in the Northeast Planning Region. At the same time, solar radiation data show that these regions are among the most favorable for the installation of photovoltaic power plants. One of the ways to solve this problem is to use the existing mechanisms for support of electricity from RES (feed-in tariffs or premiums). It is recommended the mayors in these regions to find land that would be suitable for the construction of photovoltaic power plants and together with the competent bodies of the state administration to announce tenders for the construction of photovoltaic power plants on state land. Additionally, the possibility of announcing a tender for construction of photovoltaic power plants on private land, which would apply only to these regions, could be considered. On the other hand these regions are rich in biomass, but its consumption in the households will be reduced, as a result of local pollution, so small cogeneration biomass power plants can be built. This measure envisages construction of at least 100 MW photovoltaic power plants, 20 MW photovoltaic power plants on the roof, 5 MW small hydro power plants and 5 MW TPP on biomass (with the possibility for heat production). A total of 90 mill. EUR are projected for the implementation of this measure.
Connection with the PAMs from NDC: PAM 3, PAM 4, PAM 5, PAM 6, PAM 7, PAM 57, PAM 50

3. ***Increasing energy efficiency in the industry***: The main problem with the industry is the use of coal and oil derivatives, especially in the Skopje, Polog and Vardar planning regions. The solution to this problem is the construction of a gas network that will significantly contribute to the use of more efficient technologies. At the same time the gas network can be used by the other planning regions to attract investors. The fuel switch (from coal to natural gas) will improve the air quality, too. The realization of this measure would cost around 100 mill. EUR.
Connection with the PAMs from NDC: PAM 24, PAM 45, PAM 26, PAM 54, PAM 55, PAM 63.

4. ***Energy efficiency in households***: The East, Pelagonija, Vardar and Skopje are the planning regions that have the highest energy consumption in households per capita. This is mostly due to the use of firewood in inefficient stoves, but if the consumption of firewood is reduced, the share of renewable sources in the gross final energy consumption will be reduced, too. To prevent this, it is necessary to increase energy efficiency by insulating homes, which will reduce the energy needs for heating and cooling and the introduction of more efficient technologies for household heating such as heat pumps (under the Renewable Energy Directive they are considered as RES).
Connection with the PAMs from NDC: PAM 9, PAM 10, PAM 11, PAM 12, PAM 13, PAM 14, PAM 18, PAM 19, PAM 20, PAM 23, PAM 55, PAM 59.

5. ***Mitigation of climate change through landfill gas burning.*** The GHG emission in the waste sector increasing continualsy. This is due to the increasing amount of waste that is deposited. In addition, its inadequate treatment at non-standard landfills contributes to air pollution. Regarding the waste sector, except for the Skopje planning region, almost all other planning regions are identical and lag behind European practices. For that purpose, during the construction of regional landfills, where mechanical and biological treatment of waste by composting will be performed, landfill gas combustion systems should be introduced. The investment for the realization of this measure is around 36 mill. EUR.
Connection with the PAMs from NDC: PAM 44, PAM 45.

In addition to these measures, in the Strategy for regional development it is recommended to improve the statistics at the regional level in order to be able to make analyzes in a simpler way, but also to monitor the implementation of the proposed measures. Additionally, the following four considerations are common for all measures:

- mobilization of financial resources and quality human resources;
- establishing solid forms of organization and efficient coordination;
- preparation of the public and
- implementation of an inclusive process of amendments to the normative framework in order to introduce fiscal instruments that will increase the source revenues of the municipalities for environmental protection and sustainable management and development of the related infrastructure

ASSESSMENT OF MITIGATION POLICIES AND MEASURES

1.1 Economic and environmental aspects

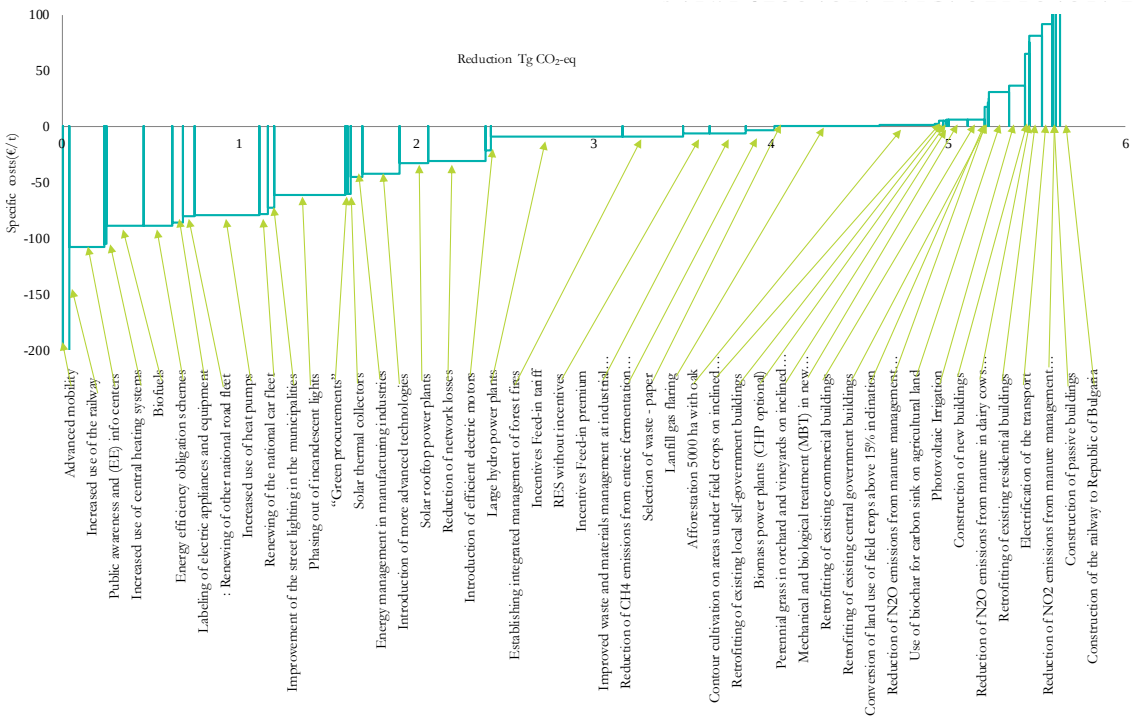
The economic and environmental aspects of the climate change mitigation policies and measures are analyzed through the following two parameters:

- Economic effectiveness or specific cost - shows the number 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 is created for the WAM scenario for 2030 (as target year) and it shows that the total reduction from the proposed measures is estimated to around 5.6 Tg CO2-eq (Figure 49) 70% of the reduction can be achieved with a “win-win” policies and measures, which means that these measures are reducing the emissions by a negative specific costs (total cost of the proposed measure are lower compared to the costs of the WOM scenario). Furthermore, additional 20% of the reduction is realized by measures with specific costs in range from 0-5 €/t CO2-eq. It is crucial to underline that this is not the total amount of GHG emission reduction, because there is one more measure which is very important, but its independent contribution can not the estimated. This measure is the Introduction of CO_2 tax, which depends to a high extent on the other measures (such as the measures for RES, energy efficiency, fuel switch etc.) which are needed to replace the CO^2 emitters.

Figure 49. The marginal abatement cost curve for 2030



From a reduction point of view the best measure is the construction of Large hydropower plants (including all hydropower plants that are part from the measure), which in 2030 can reduce the emissions for 741 Gg CO_2-eq (Figure 50). On the second place is Landfill gas flaring with a reduction of 490 Gg CO_2-eq. On the other hand, Advance mobility and Increased use of railway are measures with lower specific costs (Figure 51).

Figure 50. Reduction of CO2-eq emissions in 2030 (in Gg)

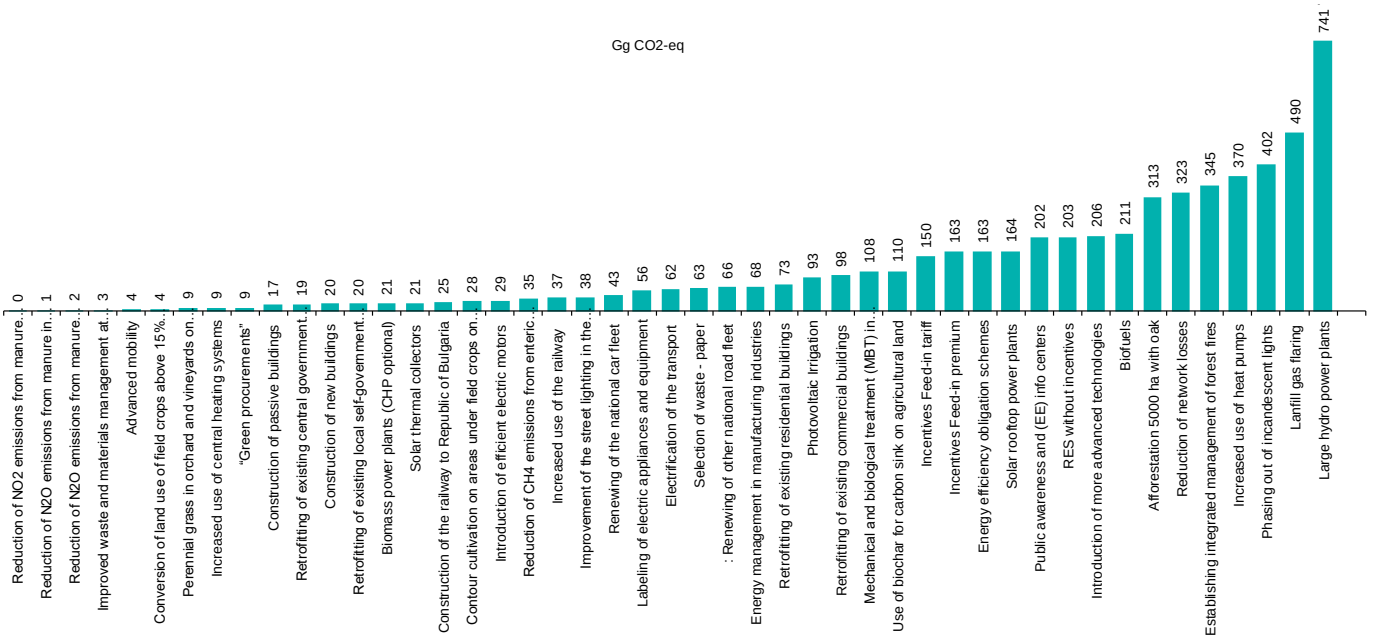
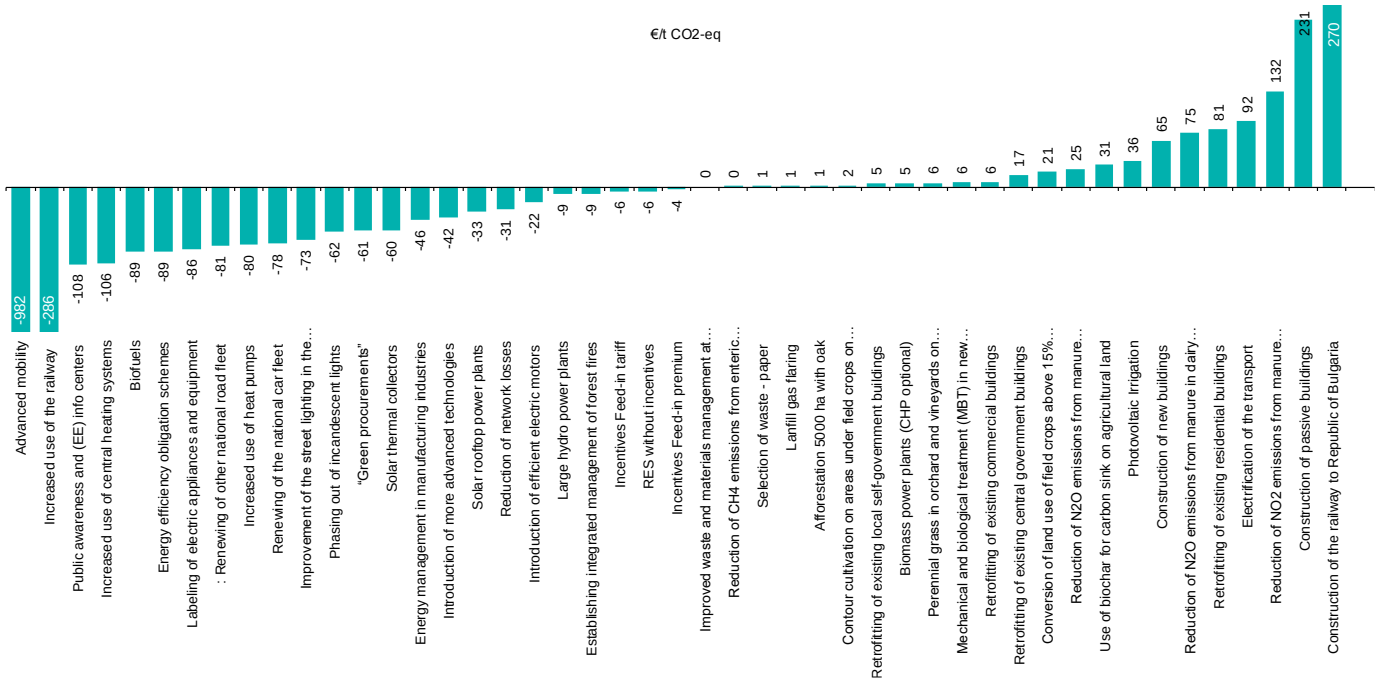


Figure 51. Specific costs for 2030 (in EUR/tCO2-eq)



1.2 Social aspects - Jobs

In addition to the economic and environmental effectiveness of the proposed policies and measures, their social aspect is also very important and should be considered for the overall process of sustainable development. In this study the social aspect is analyzed through the number of newly created green jobs. The methodology that was developed for the Intended Nationally Determined Contributions and also used in the FBUR and SBUR is implemented in TBUR too. In addition, in TBUR the number of green jobs is calculated for the policies and measures of each of the scenarios. The number of green jobs in each year depends on the time (year) of implementation of the policies and measures in each scenario. In general, in all scenarios the share of green jobs the field of Energy efficiency green jobs is higher compared to RES green jobs (Figure 52). The maximal number in the WAM scenario is in 2035 with 9895 green jobs, from which 77% are from the energy efficiency and the remaining are from RES.

Furthermore, the technologies which contribute most to the creation of new domestic green jobs is Retrofitting with almost 50% in 2035 in WAM scenario, followed by Building of new houses, including passive houses (23%), PV (10%) and Solar thermal collectors (8%). After 2036 there is a decrease in the creation of domestic green jobs mainly because of the reduced number of PV installations, as well as retrofit of existing buildings (Figure 53).

Figure 52.Number of domestic green jobs from RES and energy efficiency, by scenario

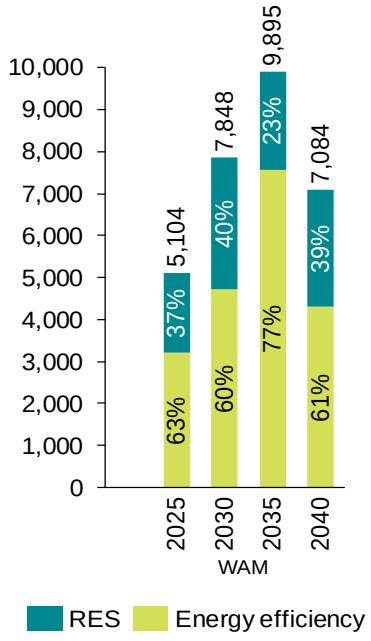
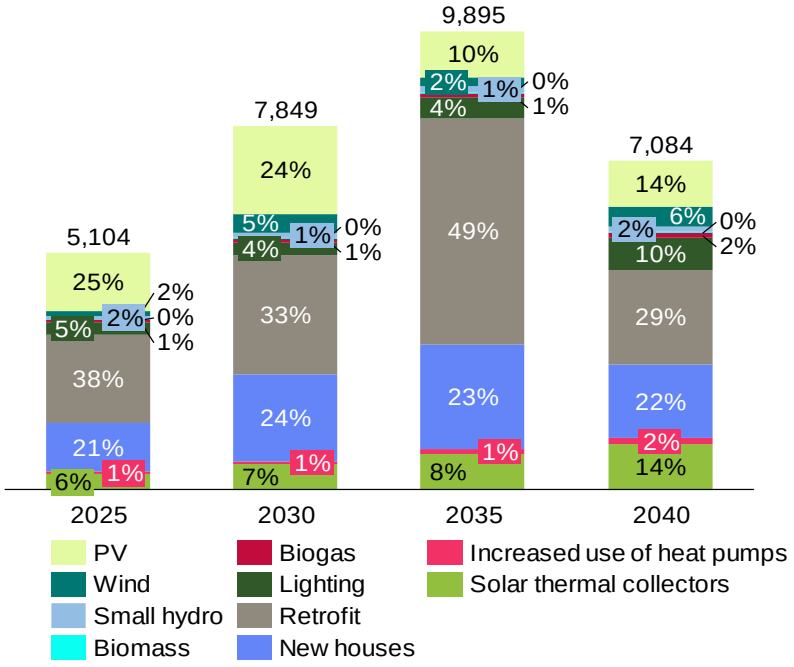
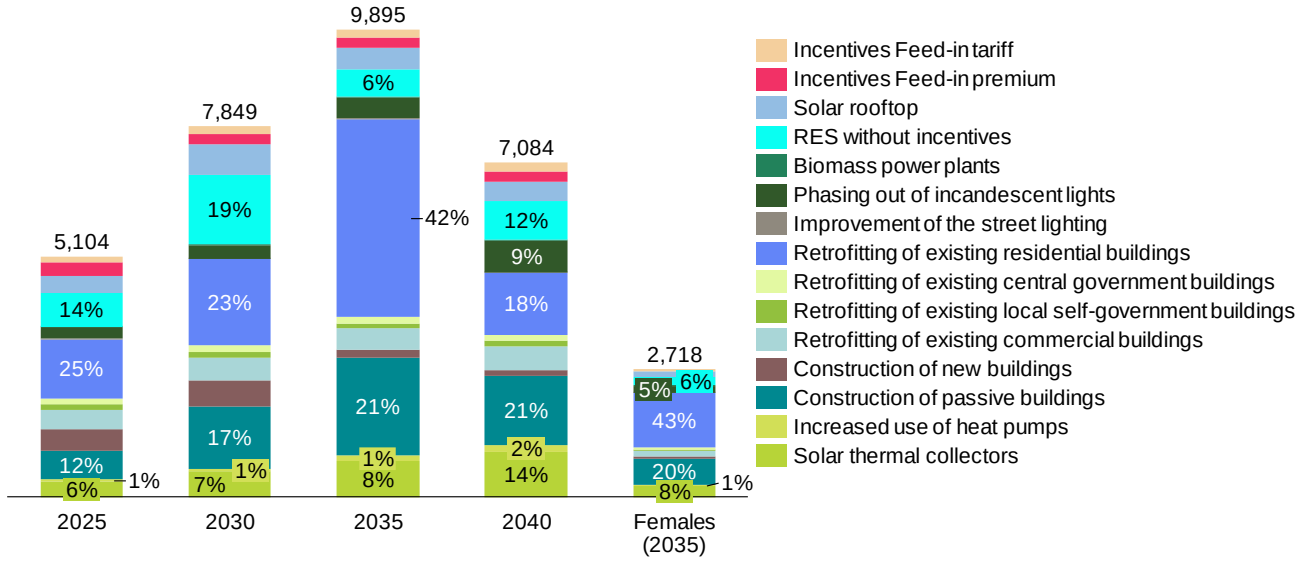


Figure 53. Number of domestic green jobs by technologies in WAM



Regarding the contribution by measures, the ones that have the highest share in the number of new domestic green jobs are: Retrofit of existing residential buildings (42%), Construction of passive houses (21%), RES without incentives (6%) and Solar thermal collectors (8%), in the WAM scenario in 2035 (Figure 54). Based on the types of jobs, very basic analyses are done concerning the gender issue. It is found that at least around 27% of the maximum number of job positions in 2035 can be assigned to women (Figure 54).

Figure 54. Number of domestic green jobs by measure in WAM



1.3 The role of the private sector

The role of the private sector in the mitigation action is particularly analyzed in the Study on Industry Analysis of Policies and Measures (STUIND). In this study more disaggregated and additional PAMs in the Industry sector that contribute to (i) increasing energy efficiency, (ii) increasing renewable sources utilization for electricity production and (iii) improving waste management are considered. With this study it was shown that the mitigation potential in the Industry is even higher compared to the results from TBUR. The final energy consumption can be reduced by additional 4% compared to the reduction in TBUR (24%). The main goal of this study was to improving the productivity of the companies and reducing their emissions. The results show that the total GHG emissions can be reduced by 10.6%, while the local emissions (SOx) by 98%.

The main conclusion from the study is that first, within each of the companies, the ISO 50001 standard should be introduced, or regular energy audit should be implemented, especially in large companies. Based on this, goals should be set for each company individually and a series of measures should be taken to achieve them. When implementing the measures, it is recommended to start with the measures that have the least investment and the least risk, such as the Soft measures. These measures can often be ignored, as their individual effect may be small, but if implemented together, their potential is shown to reach up to 8% of the total reductions in GHG emissions from the proposed measures in the Industry. On the other hand, the biggest potential for reducing energy consumption, and thus GHG and local emissions, is the measure Process change and the introduction of CO_2 tax. As a result of these measures the consumption of coal in the Industry is completely replaced by natural gas and renewable energy sources (biomass). However, the implementation of this measure is accompanied by large investments, and thus carries the greatest risk

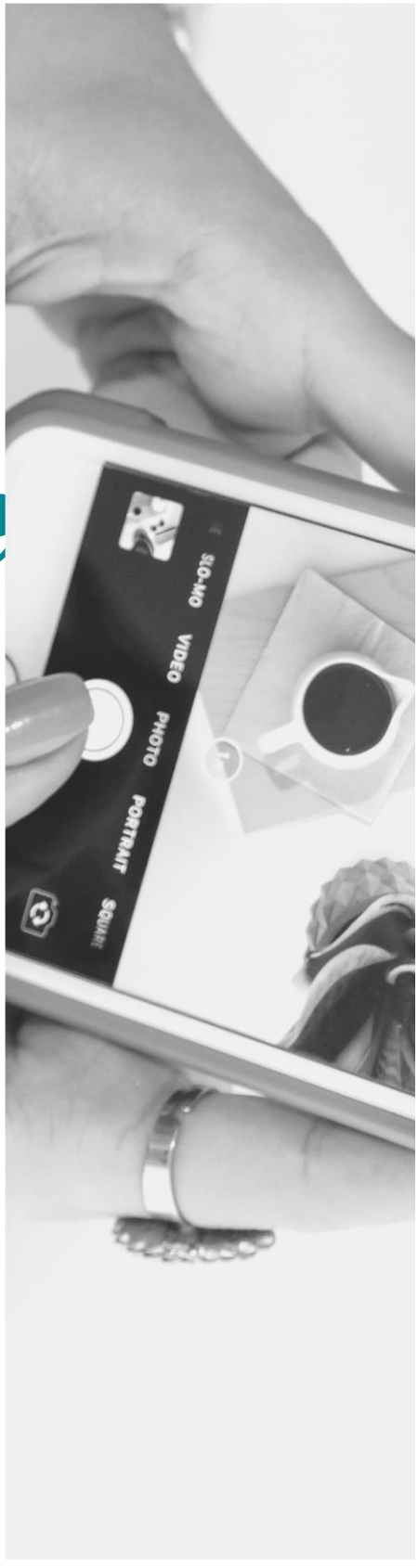
Regarding investments, the private sector has a dominate role as it participates with 85% in total investments needed for realization of the PAMs. So far, supported by feed-in tariff mechanism, 110 private companies have invested in 140 MW RES capacities (dominantly solar and small hydro). According to the official data from the State Statistical Office, the number of companies in the sector “Electricity, gas, steam and air conditioning supply” in 2018 is doubled compared to 2017 (224 vs. 107) which is mainly a result of the companies which invested in renewables. Having in mind that more than 2,000 MW (solar, wind, small hydro, biomass and biogas) are projected by 2040, it is expected that this prominent role of the private sector will be sustained and even enhanced.

The role of the private sector is very important in meeting the objectives set out in this document. However, the measures presented in this document are minimum that should be achieved. Any additional investment by the private sector, but also by state-owned companies, which contributes to additional reductions in GHG emissions, is more than welcome. On the other hand, it should be borne in mind that additional investments in any type of fossil fuels will contribute to increasing GHG emissions, and thus will drive the country away from meeting the set goals, as analyzed in details in the Programme for the Implementation of the National Strategy for Energy Development.

MITIGATION SCENARIO

Compared to the WOM scenario, the Mitigation Scenario includes 63 measures/policies from the measures given in the previous chapter. 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.



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 (Gg CO_2-eq). 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.

1.1 Energy

In the Energy sector, 32 measures/policies are proposed as presented in Table 9.

Table 9. Review of the measures/policies included in the Mitigation scenario of the energy sector

#	Policy/measure	Competent entity for realization	Budget (mil. €)	Source of finance	Indicative emissions reduction ($Gg\ CO_2$-eq)		
					2020	2030	2040
1	Reduction of network losses	► Electricity distribution companies ► Heat distribution companies ► Energy Agency, Ministry of Economy	170	Distribution and transmission companies	201.8	323.4	701.8
2	Large hydropower plants	► JSC ESM ► Ministry of Environment and Physical Planning ► Ministry of Economy, Energy Agency	1716.2	JSC ESM, Public Private Partnership, Independent power producers	0	740.7	1868.2
3	Incentives Feed-in tariff	► Government of the Republic of North Macedonia ► Energy Regulatory Commission ► Ministry of Environment and Physical Planning ► Ministry of Economy, Energy Agency ► Private investors	356.9	Independent power producers Consumers of electricity through bills	11.7	149.5	431.6
4	Incentives feed-in premium	► Government of the Republic of North Macedonia ► Energy Regulatory Commission ► Ministry of Economy ► Private investors	240.6	Independent power producers, incentives from the central government budget	0	162.6	377.4
5	Biomass power plants (CHP optional)	► Government of the Republic of North Macedonia ► Energy Regulatory Commission ► Ministry of Environment and Physical Planning ► Ministry of Economy, Energy Agency ► Private investors	24.3	Independent power producers Consumers of electricity through bills	0	21	91.1
6	Solar rooftop power plants	► Government of the Republic of North Macedonia ► Energy Regulatory Commission ► Ministry of Economy, Energy Agency ► Elektrodistribucija Skopje ► Suppliers of electricity ► End-users of electricity	263.4	Independent power producers, donors, subsidies from national and local budget, EE fund	0	164.3	627.2
7	RES without incentives	► Government of the Republic of North Macedonia ► Energy Regulatory Commission ► Ministry of Economy, Energy Agency ► JSC Macedonian Power Plants (ESM AD) ► Private investors	1325.4	Public private partnership, Independent power producers, ESM	0	202.8	2040.2
8	Development of the biofuels market	► Government of the Republic of North Macedonia ► Ministry of economy ► Companies that sell oil products	n/a	Central government budget, consumers	0		
9	Energy efficiency obligation schemes	► Ministry of economy ► Distribution system operators ► Suppliers and traders of electricity and gas	182	Consumers through their bills	0	162.8	592.5
10	Solar thermal collectors	► Ministry of Economy, Energy Agency ► End-users	70	Private, EE fund, incentives from the central government budget, donors	0.7	21.5	165.4
11	Labeling of electric appliances and equipment	► Ministry of Economy, Energy Agency ► Producers and suppliers of electrical equipment and household appliances ► End-users	71	Private, EE fund	13.1	56.3	236.7
12	Increased use of heat pumps	► Ministry of Economy, Energy Agency ► End-users	474.4	Private, EE fund, incentives from the central and local government budget, donors	725.4	584.6	623.5
13	Public awareness campaigns and network of EE info centers	► Ministry of Economy, Energy Agency ► Energy suppliers ► End-users	712	Private sector, donors, central and local governments	56.6	201.5	716.4
14	Retrofitting of existing residential buildings	► Ministry of Economy, Energy Agency ► Donors and financial institutions ► Households	1708.2	Private, donors through commercial EE loans, EE fund	7.1	73.0	352.5
15	Retrofitting of existing central government buildings	► Ministry of Economy, Energy Agency ► Ministry of Finance ► Local self-government ► Municipal public enterprises ► Donors and financial institutions	170	Central government budget, donors	1.1	19.2	66.8

16	Retrofitting of existing local self-government buildings	► Ministry of Economy, Energy Agency ► Ministry of Finance ► Local self-government ► Municipal public enterprises ► Donors and financial institutions	150	Local self-government budget, donors	1.1	19.8	78.3
17	Retrofitting of existing commercial buildings	► Ministry of Economy, Energy Agency ► Ministry of Finance ► Commercial buildings owners	530	Private, donors through commercial EE loans, EE fund	30.6	98.2	359.2
18	Construction of new buildings	► Ministry of Economy, Energy Agency ► Donors and financial institutions ► Investors (households)	282.7	Private, donors through commercial EE loans, EE fund	1.8	19.8	40.4
19	Construction of passive buildings	► Ministry of Economy, Energy Agency ► Donors and financial institutions ► Investors (households)	1068	Private, donors through commercial EE loans, EE fund	0.3	17	123.2
20	Phasing out of incandescent lights	► Government of the Republic of North Macedonia ► Ministry of Economy, Energy Agency End-users	558	Central government budget, private	99.9	401.8	1417.3
21	Improvement of the street lighting in the municipalities	► Government of the Republic of North Macedonia ► Energy Regulatory Commission ► Ministry of Environment and Physical Planning ► Ministry of Economy, Energy Agency ► Local self-government	25.3	Central and local government budget, ESCO	8.9	37.9	117.1
22	Green procurements	► Ministry of Economy, Energy Agency ► Public Procurement Bureau ► Local self-government	24	Central and local government budget	0.8	9.4	32.7
23	Increased use of central heating systems	► Ministry of Economy, Energy Agency ► Balkan energy Dooel Skopje ► JSC Skopje Sever ► "Energetika" –Skopje, subsidiary to JSC Macedonian Power Plants (ESM AD) ► Private investors	3.2	Private, EE fund, incentives from the central and local government budget	4	9.3	560
24	Energy management in manufacturing industries	Ministry of Economy, Energy Agency Private companies	n/a	Private, donors through commercial EE loans	2.9	67.8	259.3
25	Introduction of efficient electric motors	Private companies Ministry of Economy, Energy Agency	113	Private, donors through commercial EE loans	0.7	28.8	83.8
26	Introduction of more advanced technologies	Government of the Republic of North Macedonia Ministry of Environment and Physical Planning Ministry of Economy, Energy Agency Private investors	438.6	Private, donors through commercial EE loans, EE fund	20	206	474.4
27	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	180.6	Central government budget	25.7	37.2	24.3
28	Renewing of the national car fleet	Government of the RM Ministry of Transport and Communication Ministry of Economy, Energy Agency End-users	2167.7	Private, EE fund, incentives from the central government budget	33.3	43.1	98.6
29	Renewing of other national road fleet	Government of the Republic of North Macedonia Ministry of Transport and Communications Ministry of Interior Affairs Ministry of Economy, Energy Agency Private companies	2300	Private sector	1.2	66.4	147.3
30	Advanced mobility	Ministry of Economy, Energy Agency Local self-government End-users	n/a	Private, EE fund, incentives from the central and local government budget, donors	2.1	3.6	6.4
31	*Construction of the railway to the Republic of Bulgaria*	*Government of the Republic of North Macedonia* *Ministry of Transport and Communications* *Ministry of Economy, Energy Agency*	*720*	*Central government budget*	*16.7*	*24.6*	*32.3*
32	Electrification of the transport	Government of the Republic of North Macedonia Ministry of Transport and Communications Ministry of economy	8292.3	Private, EE fund, incentives from the central government budget	11.3	61.6	-78.8
		Total	24,571.8		1278.8	4035.5	12667.1

For the implementation of the Mitigation measures in the Energy sector, investments of **24,571.8 mil. €** are needed, for the period from **2020 to 2040**. If the investments from the private sector are exempted, the remaining investments amount to around 3,570 mil. € or an average of 170 mil. € annually, (referring to the budget of Macedonia, the local self-governments, the City of Skopje, JSC ESM).

It is important to emphasize that the investments in the WAM scenario contribute to reducing the total system costs (€ 35,958 million discounted in 2012) compared to the reference scenario costs (€ 39,786 million), which is a reduction of 9.6%. If all of the measures are implemented in parallel and the "Energy efficiency first" principal is applied, then the total investment can be reduced by about 25%. Measures with the **most significant** potential for greenhouse gas emissions reduction are the RES without incentives, Large hydro power plants and Phasing out of incandescent lights.

The main indicators by which the Extended mitigation scenario is described are shown in (

Table 10) and they indicate that the average annual increase by 2040 is:

- 1.2% of the final energy or a total increase of 31.8% in 2040 (2.8 Mtoe) compared to 2017 (1,8 Mtoe);
- 1.6 % of electricity consumption or a total increase of 44.6% in 2040 (10 TWh) compared to 2017 (7.1 TWh);
- 3.7% of the total installed capacity or an increase of 130.4% in 2040 (3.8 GW) compared to 2017 (1,8 GW);
- 0.1% of the gross inland consumption or a total increase of 2.6% in 2040 compared to 2017;
- -2.4% of greenhouse gas emissions or a decrease of 42.2% in 2040 compared to 2017

Table 10. Indicators for the Extended mitigation scenario

					Annual increase rate (%)			*Total increase (%)*		
	2017	**2020**	**2030**	**2040**	**2017/ 2020**	**2017/ 2030**	**2017/ 2040**	**2017/ 2020**	**2017/ 2030**	**2017/ 2040**
Final energy (ktoe)	1.8	1.9	2.0	2.4	1.0%	0.9%	1.2%	2.9%	12.3%	31.8%
Electricity consumption (TWh)	6.2	6.4	7.7	9.0	0.8%	1.7%	1.6%	2.5%	23.9%	44.6%
Electricity production (GWh)	7.0	7.0	8.8	10.2	-0.2%	1.7%	1.6%	-0.7%	25.1%	44.4%
Installed capacity (TW)	1.8	1.8	3.1	4.1	0.0%	4.3%	3.7%	-0.1%	73.6%	130.4%
Gross inland consumption (Mtoe)	2.6	2.6	2.3	2.6	1.0%	-0.8%	0.1%	2.9%	-10.2%	2.6%
GHG emissions (Tg CO_2-eq)	8.9	8.7	5.0	5.2	-1.0%	-4.4%	-2.4%	-3.0%	-44.1%	-42.2%

1.2 Agriculture, Forestry and Other Land Use

In the Mitigation scenario, 11 measures/policies are included from the Agriculture, Forestry and Other land use sector, from which four are from Livestock, two from Forestry, and five form Agriculture and Other land use (Table 11).

Table 11. 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	Budget (mil. €)	Source of finance	Indicative emissions reduction (Gg CO_2-eq)		
					2020	2030	2040
1	Reduction of CH4 emissions from enteric fermentation in dairy cows by 3%	▶ Ministry of Agriculture, Forestry and Water Economy	0.2	Private sector	3.2	35.0	63.6
2	Reduction of N2O emissions from manure management in dairy cows by 20%	▶ Ministry of Agriculture, Forestry and Water Economy	1	Private sector	0.2	2.1	3.9
3	Reduction of NO2 emissions from manure management in swine farms by 13%	▶ Ministry of Agriculture, Forestry and Water Economy	1	Private sector	0	0.4	0.7
4	Reduction of N2O emissions from manure in dairy cows by 20% for farms below 50 Livestock Units	▶ Ministry of Agriculture, Forestry and Water Economy	1	Private sector	0.1	0.7	1.2
5	Establishing integrated management of forest fires	▶ PE "National forests" Ministry of Agriculture, Forestry and Water Economy	1.5	PE "National forests", other forest enterprices	345	345	345
6	Afforestation	▶ PE "National forests" Ministry of Agriculture, Forestry and Water Economy	7.8	PE "National forests", other forest enterprices	0	312.5	312.5
7	Conversion of land use of field crops above 15% inclination	▶ Ministry of Agriculture, Forestry and Water Economy	1.5	Private sector	1.0	3.7	5.3
8	Contour cultivation on areas under field crops on inclined terrains (5-15%)	▶ Ministry of Agriculture, Forestry and Water Economy	1	Private sector	5.0	28.0	39.7
9	Perennial grass in orchard and vineyards on inclined terrains (>5%)	▶ Ministry of Agriculture, Forestry and Water Economy	1	Private sector	1.6	8.9	12.6
10	Use of biochar for carbon sink on agricultural land	▶ Ministry of Agriculture, Forestry and Water Economy	30	Private sector	0	110.0	330.3
11	Photovoltaic irrigation	▶ Ministry of Agriculture, Forestry and Water Economy	47	Private sector	0	93.3	186.6
		Total	93		356.1	939.6	1,301.4

Using the proposed measures in the Agriculture, Forestry and Other land use sector in 2040, a greenhouse gas emissions reduction of 1,301Gg CO_2-eq can be achieved. The measures from the **Forestry category** contribute the most to the reduction of greenhouse gas emissions, i.e. **they account for 50.5% of the total emission reduction** from the Agriculture, Forestry and Other Land use sector in 2040. In order to obtain this reduction, it is necessary to invest **93 € mil. for the period from 2020-2040**. 90% of the investments are from the private sector. Measures with the **most significant** potential for greenhouse gas emissions reduction are the **Use of biochar for carbon sink on agricultural land** and **Afforestation.**

1.3 Waste

From the Waste sector, four measures/policies are included (Table 12).

Table 12. Review of the measures/policies included in the Mitigation scenario of the Waste sector

#	Policy/ measure	Competent entity for realization	Budget (mil. €)	Source of finance	Indicative emissions reduction ($Gg\ CO_2$-eq)		
					2020	2030	2040
1	Landfill gas flaring	► 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)	20.5	Local self-government through Public Utilities, Public Private Partnership, Grants from the EU	0	489.7	552.3
2	Mechanical and biological treatment (MBT) in new landfills with composting	► Ministry of environment and physical planning ► Public utilities for waste management ► State Environmental Inspectorate ► Inter-municipal board for waste management ► Authorized Inspectors of Environment (Municipalities)	36.1	Local self-government through Public Utilities, Public Private Partnership, Grants from the EU	0	108.0*	109.3*
3	Selection of waste - paper	► Ministry of environment and physical planning ► Public utilities for waste management ► State Environmental Inspectorate ► Inter-municipal board for waste management ► Authorized Inspectors of Environment (Municipalities)	2	Local self-government through Public Utilities, Public Private Partnership, Grants from the EU	0	62.5*	109.5*
4	Improved waste and materials management at industrial facilities	► Ministry of Environment and Physical Planning ► Public utilities for waste management ► State Environmental Inspectorate ► Inter-Municipal Waste Management Board ► Authorized Inspectors of Environment (Municipalities)	0	Ministry of Environment and Physical Planning Municipalities and city of Skopje Industrial facilities	0	3.3	17.5
		Total	58.6		0	663.5	788.6

* Total reduction when including the emissions realized after 2040

For the implementation of the Mitigation scenario in the Waste sector, investments of **58.6 mil. €** are needed, for the period from **2020 to 2040**. All investments are covered by the central budget of Macedonia or the local self-governments and the City of Skopje. A measure with the **most significant** potential for greenhouse gas emissions reduction is the **Landfill gas flaring**.

1.4 Additional PAMs (enablers of mitigation action)

In addition, 16 measures are considered, that help in achieving the goals for reducing GHG emissions (Table 13).

Table 13. Review of the additional measures/policies included in the Mitigation scenario

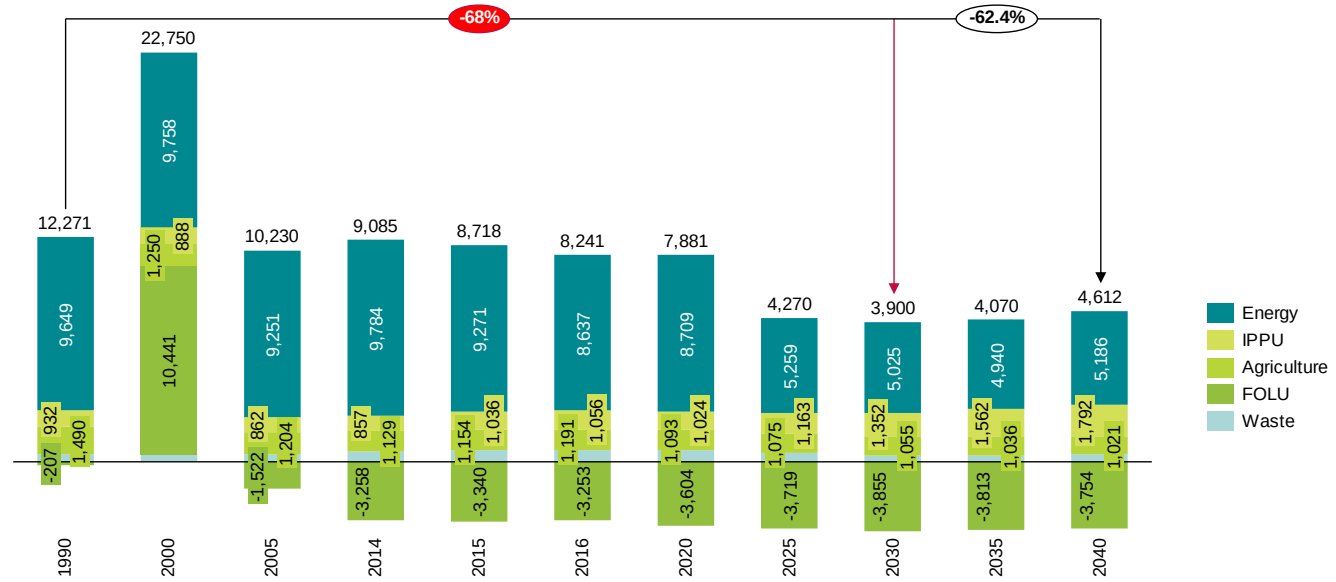
#	Policy/ measure	Competent entity for realization	Budget (mil. €)	Source of finance	Indicative emissions reduction (Gg CO_2-eq)	#	Policy/ measure
1	Introduction of CO_2 tax	► Government of the Republic of North Macedonia ► Ministry of Environment and Physical Planning ► Ministry of Economy, Energy Agency Ministry of Finance	n/a	n/a	n/a	n/a	n/a
2	Program for just transition	Government of the Republic of North Macedonia Ministry of Economy JSC Macedonian Power Plants (ESM AD) Ministry of labor and social policy	n/a	JSC ESM, state budget, donors	n/a	n/a	n/a
3	Identification of the proper location for solar and wind power plants	Government of the Republic of North Macedonia Ministry of Economy JSC Macedonian Power Plants (ESM AD) Ministry of labor and social policy Donors	n/a	State budget, donors	n/a	n/a	n/a
4	Smart communities	Universities (or high schools)	n/a	Donors Horizon 2020 and other research programs	n/a	n/a	n/a
5	Construction of 400 kV electricity transmission interconnection Macedonia-Albania (Bitola-Elbasan)	MEPSO	34	EBRD (17.2 Mil. €), Grand from Western Balkan Investment Fund (16.9 Mil. €)	n/a	n/a	n/a
6	Develop natural gas cross-border infrastructure to diversify supply routes and increase market competitiveness	National Energy Resources of Macedonia	n/a	Grant – 10 Mil. €, Central government budget	n/a	n/a	n/a
7	Develop gas transmission network	National Energy Resources of Macedonia	200	State budget			
8	Develop a gas distribution network	Ministry of economy, National Energy Resources of Macedonia, Local self-government	n/a	Grant, Central governmental budget, Local self-government budgets	n/a	n/a	n/a
9	Pursue regional electricity market integration	National electricity market operator (MEMO), GAMA	n/a	National electricity market operator (MEMO), GAMA	n/a	n/a	n/a
10	Develop further distribution system network to integrate more RES, including prosumers and more electric vehicles (EVs), as well as continuously improve network reliability	EVN Energy Regulatory Commission	n/a	EVN, consumers through their electricity bills	n/a	n/a	n/a
11	Price signal demand response	Electricity suppliers/traders Consumers	n/a	Electricity suppliers/traders Consumers	n/a	n/a	n/a
12	Adoption of annual program for vulnerable consumers	Ministry of economy Suppliers of electricity, gas and heat	n/a	Budget and potential donors	n/a	n/a	n/a
13	Participation in development of energy transition technologies and measures	Ministry of Education and Science Fund for Innovation and Technology Development Chamber of Commerce	n/a	Fund for Innovation and Technology Development Horizon 2020 Donors	n/a	n/a	n/a
14	*Increased level of education of*	*Universities, High and Primary schools*	n/a		n/a	n/a	n/a

	sustainable energy needs						
15	Inter-sectoral and geographical mobility of researchers	Universities Industry companies	n/a	Industry companies Donors	n/a	n/a	n/a
16	Increase the role of SME sector in energy transition	SMEs	n/a	Grants Private investments	n/a	n/a	n/a

1.5 Total emissions

The overall emissions of all sectors, when adding all of the measures that are part of the WAM scenario, show that there is a reduction in the total net GHG emissions by 62% in 2030 and 62% compared to 1990 (Figure 55. The largest amount of emissions remains in the Energy sector, with a share of 62% in 2040 (excluding the FOLU sector, where sinks occur). During the whole planning period (2017-2040), the FOLU category has an absorption of emissions, which is increasing by 15% compared to 2016 (or 147% compared to 2005).

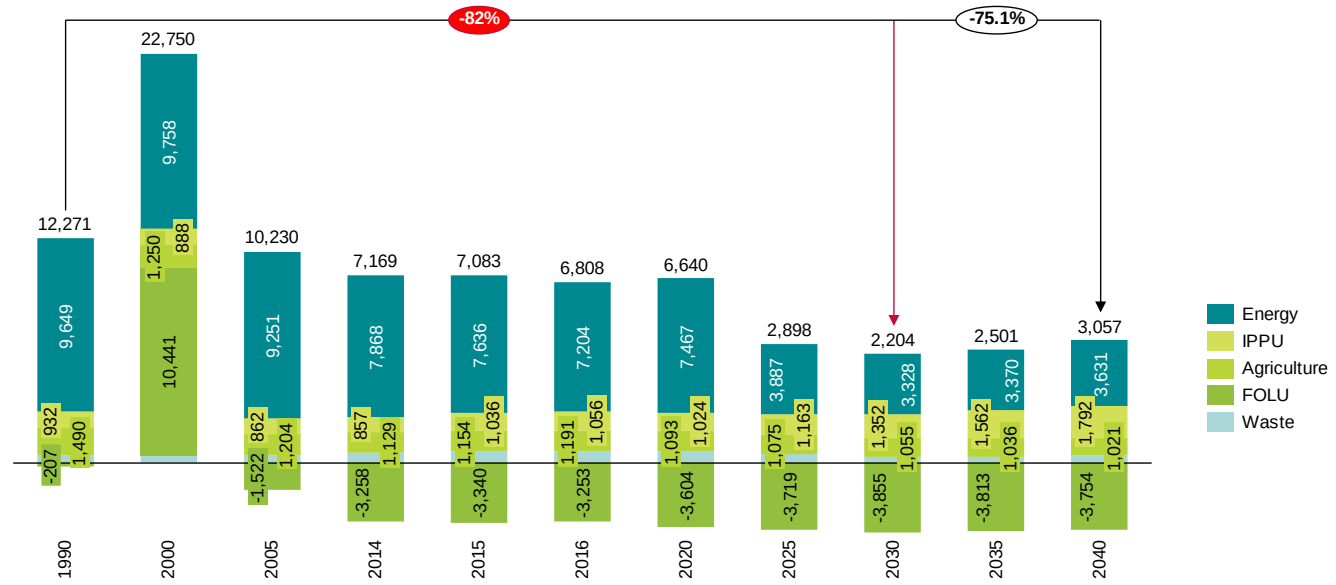
Figure 55. Total GHG emissions by sectors – WAM scenario (in Gg CO_2-eq)



Note: Due to the large area affected by fires in 2000, FOLU instead of sinks, contributed to the increase of the GHG emissions.

The results for the emissions without MEMO are also presented (Figure 56) and they show even higher reduction in the total net emissions by 82 in 2030 and 75 in 2040 compared to 1990. This higher reduction is again mainly caused by the exclusion of the emissions coming from the import of electricity.

Figure 56. Total GHG emissions by sectors without MEMO – WAM scenario (in Gg CO_2-eq)



Note: Due to the large area affected by fires in 2000, FOLU instead of sinks, contributed to the increase of the GHG emissions.

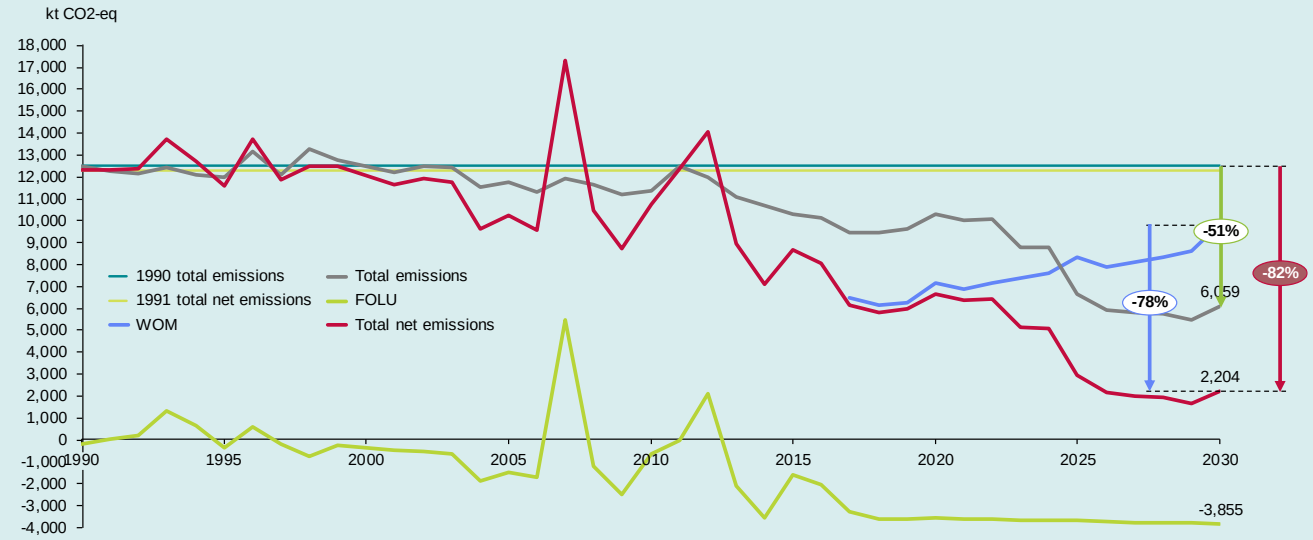
Overall and sectoral targets

The target for climate change mitigation in Macedonia is expressed as a reduction of greenhouse gas emissions and a reduction of net greenhouse gas emissions. The difference is that the FOLU sector is included in the GHG net emissions. The targets are expressed in relation to 1990, as a base year and are:

- 51% GHG emissions reduction
- 82% net GHG emissions reduction

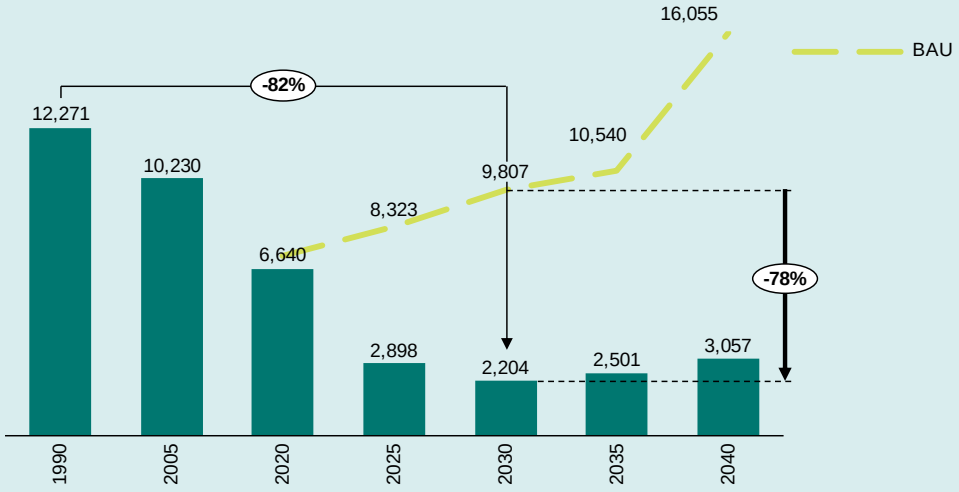
Additionally, compared to the WOM scenario the economy-wide GHG emission reduction **target** for Macedonia is 78% in 2030 (Figure 57). The indicative trajectory shows that by 2020, Macedonia will reach a reference point of 56% of the total GHG reduction target (which means that more than half of the emission reductions will be achieved by 2020), and 93% in 2025 (Figure 58). After 2030, there is an increase in the GHG emissions, that are mainly result of the transport sector (increase in the transport of goods).

Figure 57. Trajectory of GHG emissions (in Gg CO_2-eq) and indicative reduction targets (in %)



Note: 2000 is removed from the figure for better presentation of the results

Figure 58. Trajectory of net GHG emissions (in Gg CO2-eq) and indicative reduction targets (in %)

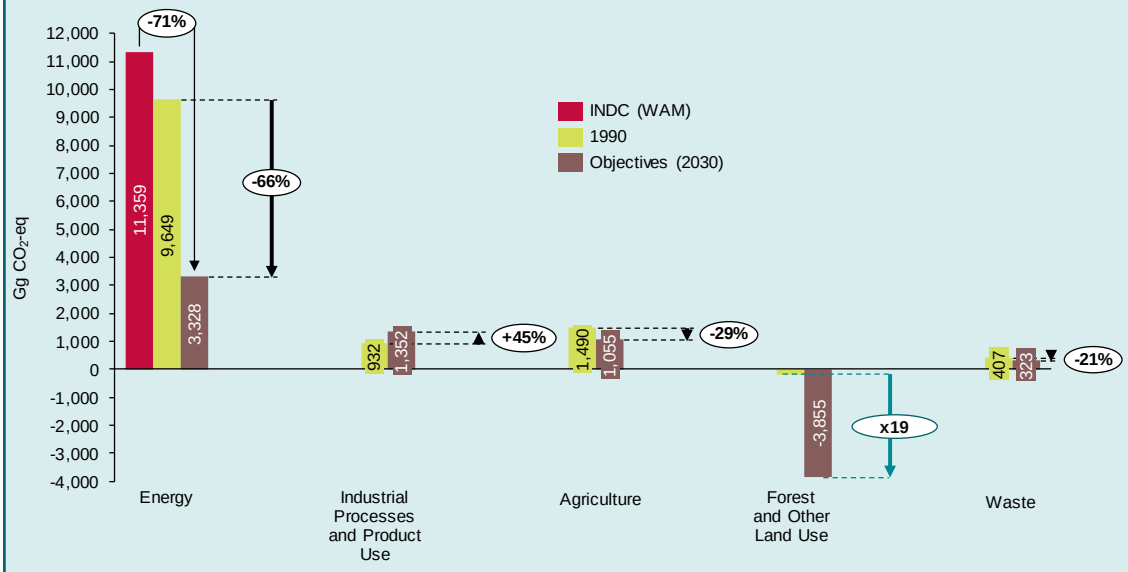


Source: Results from the Strategy for energy development up to 2040 and TBUR, project team analyses

In order to achieve the target for GHG emissions reduction, sectoral **objectives** are set for 2030 relative to 1990 level (Figure 59):

- Energy sector – 66% (6,321 Gg CO2-eq) GHG emissions reduction (mainly through decommissioning of coal-fired
- TPP Oslomej in 2021 and TPP Bitola up to 2027)
- Industrial Processes and Product Use – 45% (420 Gg CO2-eq) GHG emissions increase
- Agriculture – 29% (435 Gg CO2-eq) GHG emissions reduction
- Forest and Other Land Use – 18 times (2,647 Gg CO2-eq) GHG removals increase
- Waste – 21% (84 Gg CO2-eq) GHG emissions reduction

Figure 59. Sectoral objectives for 2030 relative to 1990 level, and comparison with INDC target



Source: Results from the Strategy for energy development up to 2040 and TBUR, project team analyses

The reduction in net emissions of 82% seems big and frightening, but a detailed review of emissions in the period until 2016 must be made to see how this goal of 82% is obtained. The 1990s sinks from the Forestry sector are quite low, i.e. they amount to about 200 kt CO_2-eq. Over the years, the sinks in this sector have increased, with the exception of 2000, 2007 and 2012 when, as a result of large forest fires, instead of sinks in this sector, there are greenhouse gas emissions. Starting from 2004 until 2016, the sinks on average amounted to around 2000 kt-CO_2-eq, reaching a maximum in 2014 (3,597 kt-CO_2-eq), followed by 2009 (2,598 kt-CO_2-eq) and 2013 (2,146 kt-CO_2-eq). The projected sinks in 2030, that are assumed to be realized with the implementation of the planned measures are only 7% higher than the sinks in 2014.

At the same time, as a result of the reduction of electricity production from coal, almost complete reduction of use of fuel oil and the introduction of natural gas, emissions from the energy sector in 2016 compared to 1990 decreased by 23%. Energy is the sector that is expected to contribute the most in order to meet the goals for reducing emissions and net emissions.

Because there are major changes in greenhouse gas emissions during the years 1990-2016, and in order to be clearer to the general public, the emissions and net emissions targets in 2030, in addition to 1990 are expressed in relation to other years . The years that are most often used to express emissions are 2005 and 2010. Additionally, in this document 2014 will also be used, as well as 2016 as the last year of the greenhouse gas inventory.

The results of the comparison show that emissions in 2030 will decrease by:

- 48% in relation to 2005
- 47% in relation to 2010
- 43% in relation to 2014
- 40% in relation to 2016

The results of the comparison show that net emissions in 2030 will decrease by:

- 78% in relation to 2005
- 79% in relation to 2010
- 69% in relation to 2014

- 73% in relation to 2016

Figure 60. 2030 GHG emission target compared to 2005, 2010, 2014 and 2016

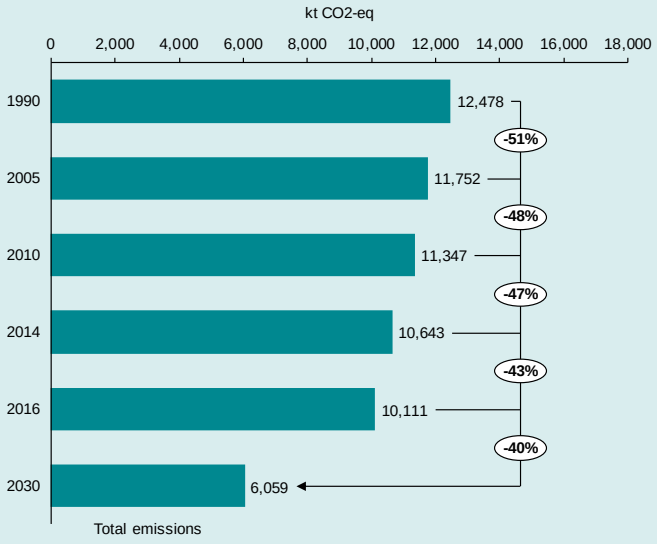
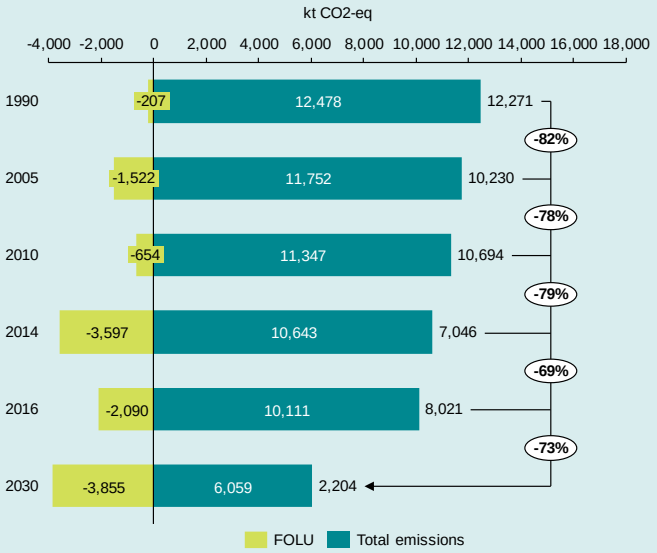
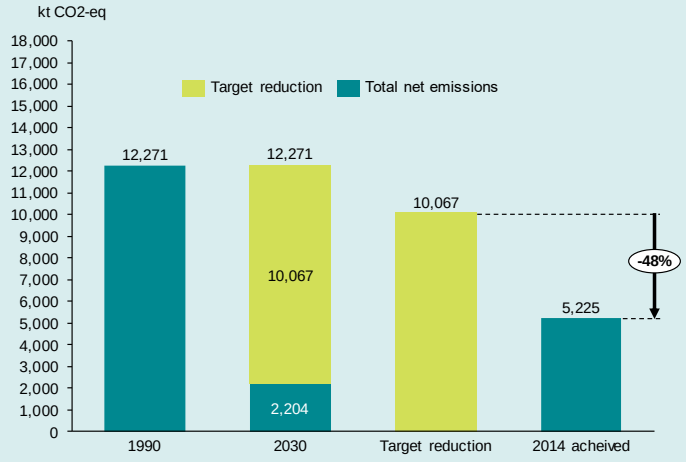
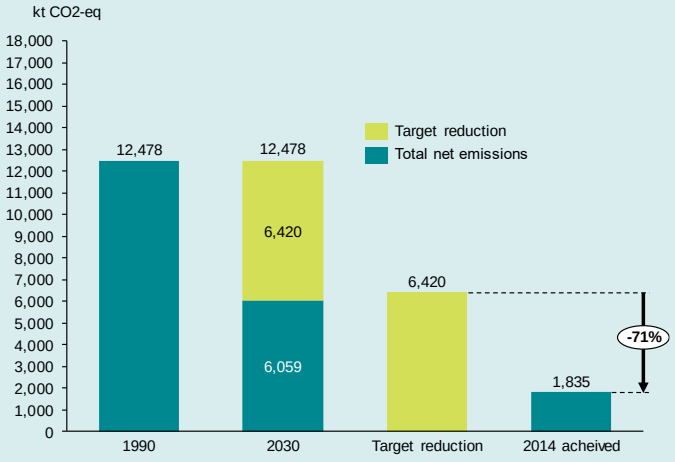


Figure 61. 2030 net GHG emission target compared to 2005, 2010, 2014 and 2016



If comparisons are made with 1990 in terms of net emissions, it should be noted that in 2014 about 52% of the target for 2030 has already been achieved. The comparison in terms of only emissions shows that in 2014 about 29% of the goal was achieved.





Regardless of the year in which the comparisons of emissions and net emissions are made, what is important is that a **green agenda** is planned that will contribute to the continuation of the downward trend of emissions that has already begun and additionally intensify it, especially in the period after 2025. Particular attention needs to be paid to sectors where emissions are expected to increase, such as the Transport sector.

1.1 Comparison with other countries by using SDG indicators

The contribution of Macedonia in global efforts for achieving sustainable development, in this report, is measured through the global indicator framework for Sustainable Development Goals (SDG). On one hand, SDG indicators are used to track the progress of implementation of each of the policies and measures proposed. On the other hand, in this chapter some of the indicators are used for comparing the Macedonian overall planned progress with the countries in the regions, as well as with some of the EU countries. With the proposed policies and measures six Sustainable Development Goals are covered. The relevant indicators that contribute towards achieving each of the goals comply with the mapping made by EU and EUROSTAT (Table 14).

Table 14. SDG indicators used in TBUR

Goal	Code	Indicator
	sdg_07_60	Population unable to keep home adequately warm by poverty status
	sdg_01_60	Population living in a dwelling with a leaking roof, damp walls, floors or foundation or rot in window frames of floor by poverty status
	sdg_02_60	Ammonia emissions from agriculture
	sdg_07_10	Primary energy consumption
	sdg_07_11	Final energy consumption
	sdg_07_20	Final energy consumption in households per capita
	sdg_07_30	Energy productivity
	sdg_07_40	Share of renewable energy in gross final energy consumption by sector
	sdg_07_50	Energy import dependency by products
	sdg_07_60	Population unable to keep home adequately warm by poverty status*
	sdg_13_20	Greenhouse gas emissions intensity of energy consumption
	sdg_09_50	Share of buses and trains in total passenger transport
	sdg_09_60	Share of rail and inland waterways in total freight transport
	sdg_12_30	Average CO2 emissions per km from new passenger cars
	sdg_11_60	Recycling rate of municipal waste
	sdg_09_50	Share of buses and trains in total passenger transport
	sdg_12_30	Average CO2 emissions per km from new passenger cars
	sdg_12_50	Generation of waste excluding major mineral waste by hazardousness
	sdg_07_10	Primary energy consumption
	sdg_07_11	Final energy consumption
	sdg_07_30	Energy productivity
	sdg_07_40	Share of renewable energy in gross final energy consumption by sector
	sdg_13_10	GHG emissions
	sdg_13_20	Greenhouse gas emissions intensity of energy consumption
	sdg_07_10	Primary energy consumption
	sdg_07_11	Final energy consumption
	sdg_07_40	Share of renewable energy in gross final energy consumption by sector

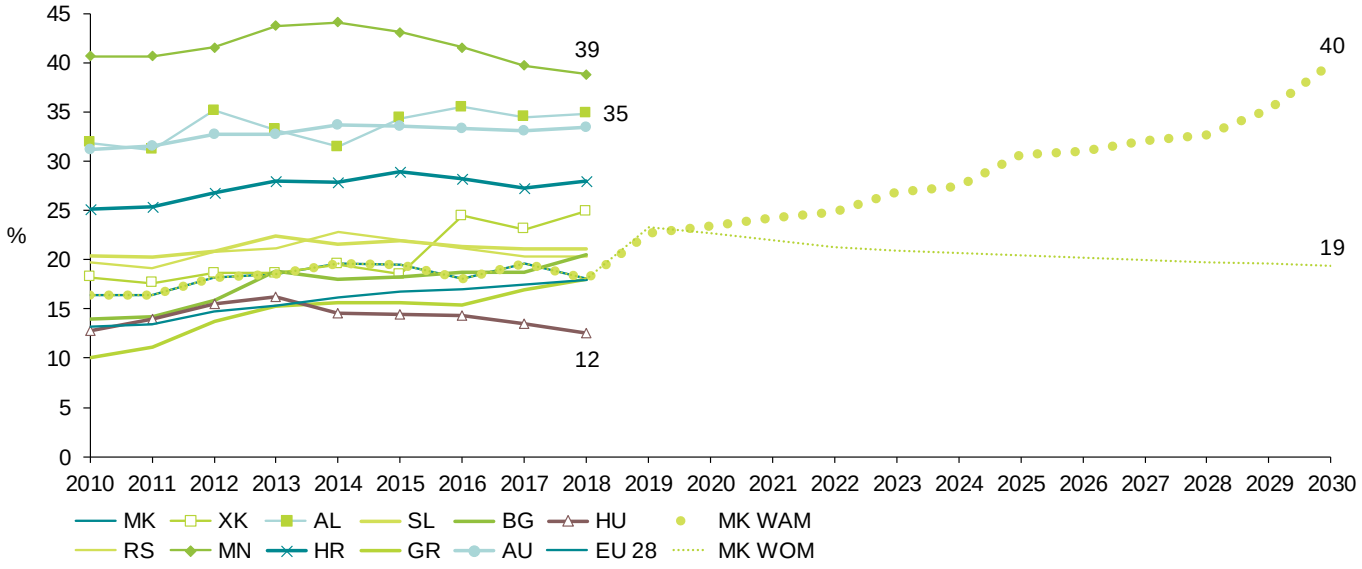
sdg_15_10 Share of forest area

For comparing Macedonian projected progress with the countries from the West Balkan region (Serbia, Kosovo, Montenegro, Bosnia and Herzegovina and Albania), as well as, with some of the EU countries (Greece, Bulgaria, Croatia, Slovenia, Hungary, Austria and EU28) the following indicators are used:

- 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
- final energy consumption in households per capita
- greenhouse gas emissions intensity of energy consumption
- greenhouse gas emissions per capita

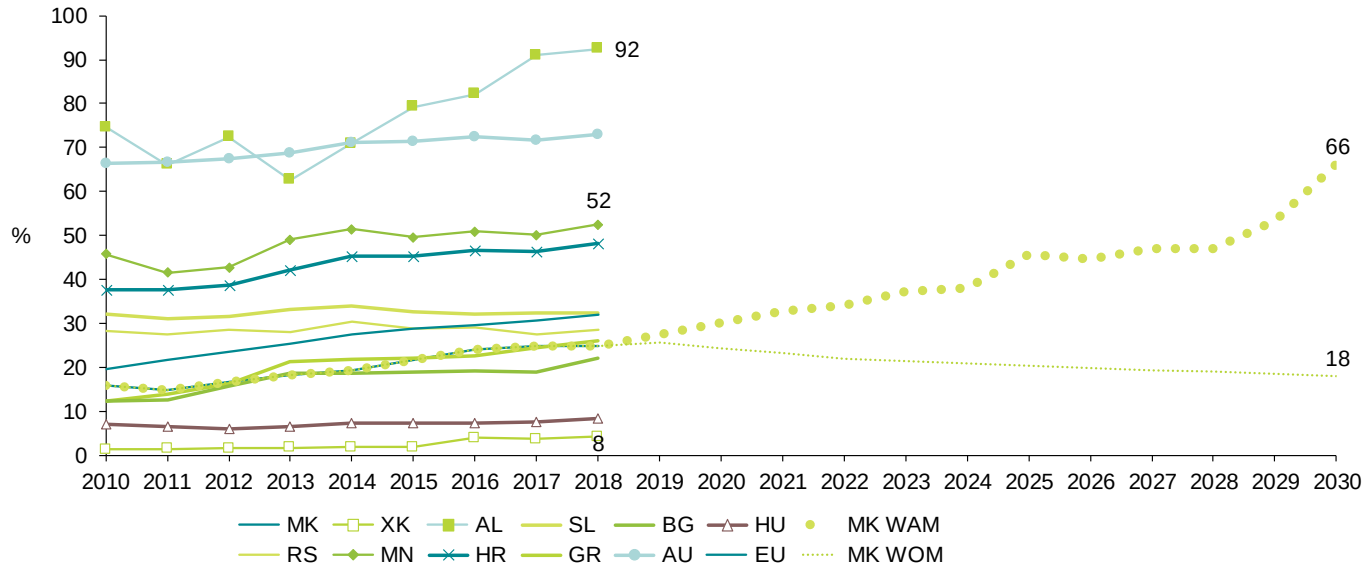
In 2018, the share of RES in the gross final energy consumption in Macedonia is around 18%, which is similar to the RES share at EU28 level (Figure 62), but it has decreased compared to 2017, mainly as a result of the increased consumption in the transport sector. However, the projected investments in RES and energy efficiency will increase the share of RES in the gross final energy consumption up to 40% in the WAM scenario in 2030, which is almost at the same level as Montenegro in 2018 (a country with the highest share in the considered region).

Figure 62. Renewable energy share in the gross final energy consumption (in %)



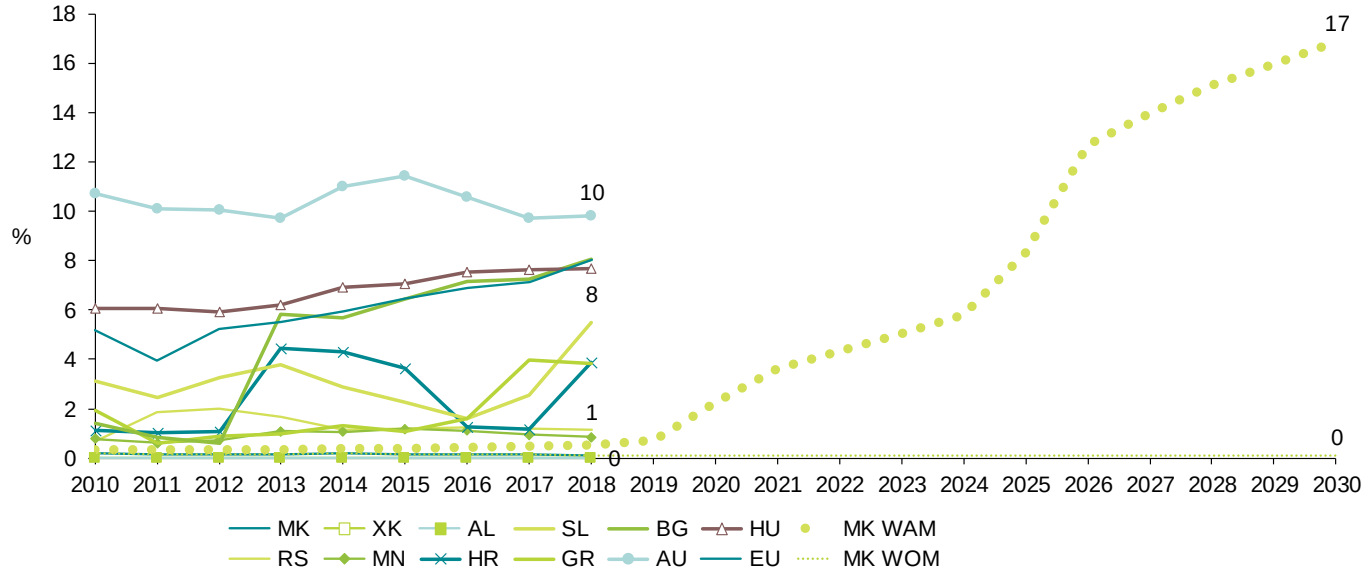
It is projected that the electricity generation in Macedonia will be driven mainly by RES power plants. The investments mainly in PV and wind supported by the hydropower plants, biogas and biomass will significantly increase the RES share in electricity generation, leading to zero carbon from electricity generation. In 2030, this share will achieve 66% in WAM (25% in 2018), which is higher than the share of any of the considered countries in 2018 except Albania and Austria (Figure 63).

Figure 63. Electricity generated from renewable energy sources (in %)



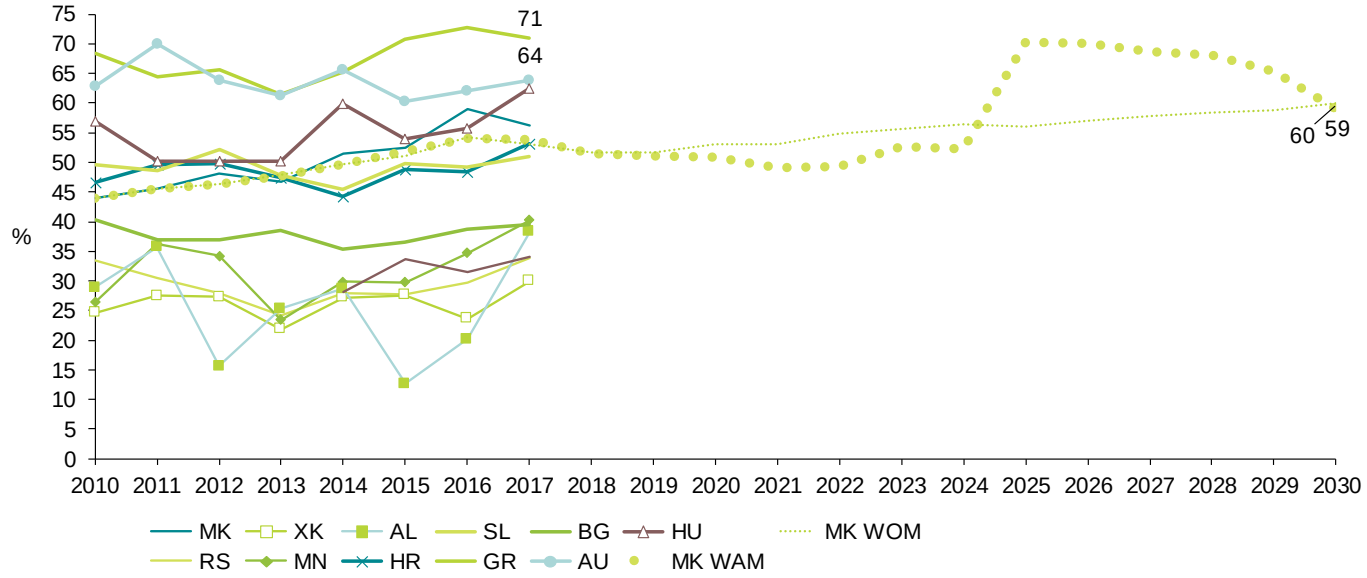
The RES share in the transport, sector, which in 2018 is almost zero, will achieve at maximum 17% in 2030, as a result of biofuels, but also electrification of the transport sector, Figure 64. It is obvious that the consumption in the transport sector is increasing and therefore it is necessary to find appropriate mechanisms to implements these measures, because otherwise the transport sector will be the main problem in reaching the overall RES share in gross final energy consumption. At the moment, the best country in EU is Austria with 10% share of RES in fuel consumption in transport.

Figure 64. Share of renewable energy in fuel consumption of transport (in %)



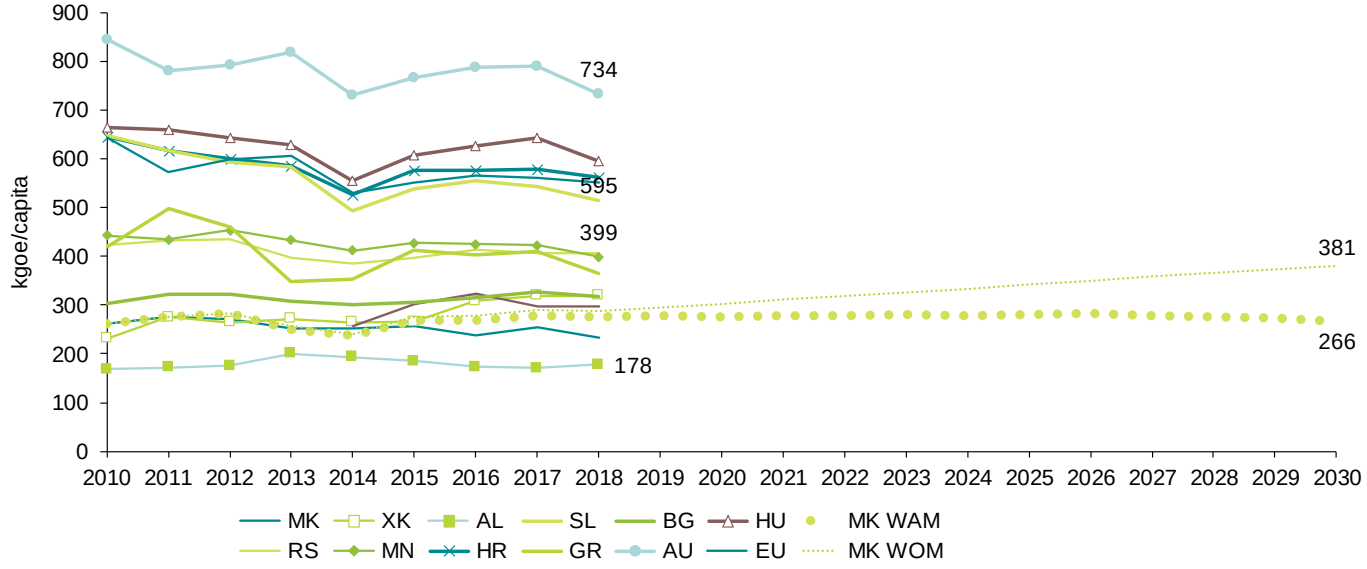
One of the indicators that is important for the security of supply is Energy dependence. The goal of the Energy development strategy up to 2040 is to maintain the energy dependence at the 2017 level (54%). The introduction of CO2 tax with a price higher than 30 €/t can significantly contribute to the decommissioning of the lignite power plants in Macedonia. That will increase the import dependence if the investments in RES are not realized. The realization of RES investment will decrease the import dependence to 59% in the WAM scenario (Figure 65), which is similar to the level of Hungary in 2018.

Figure 65. Energy dependence (in %)



Another important indicator, which helps in following the implementation of the energy efficiency measures in the residential sector is the Final energy consumption in households per capita. Macedonia in 2018 has two times lower final energy consumption in households per capita compared to the EU28 level (552 kgoe/capita) (Figure 66). On the other hand, the implementation of the energy efficiency measures in the residential sector in the EU28 level contributes to decreasing the values of this indicator. Although, the projected useful energy is increasing, the level of this indicator during the overall planning period is predicted to maintain the same level as in 2018.

Figure 66. Final energy consumption in households per capita (kgoe/capita)



Macedonia compared to EU countries has lower GHG emissions intensity of energy consumption. The results show that this indicator will be decreased to 32 % in 2030 (Figure 67).

When the GHG emissions are expressed relative to the 1990 level, Macedonia is again in a better position than the considered EU countries (Figure 68). However, if none of the proposed policies and measures are implemented, the GHG emissions maybe 3% higher than in 1990. In WAM, the GHG emissions in 2040 will be reduced up to 51% compared to the 1990 level, which leads to 3 tCO_2-eq/capita (4.5 tCO_2-eq/capita in 2018) (Figure 69).

Figure 67. Greenhouse gas emissions intensity of energy consumption, 2000=100 (in %)

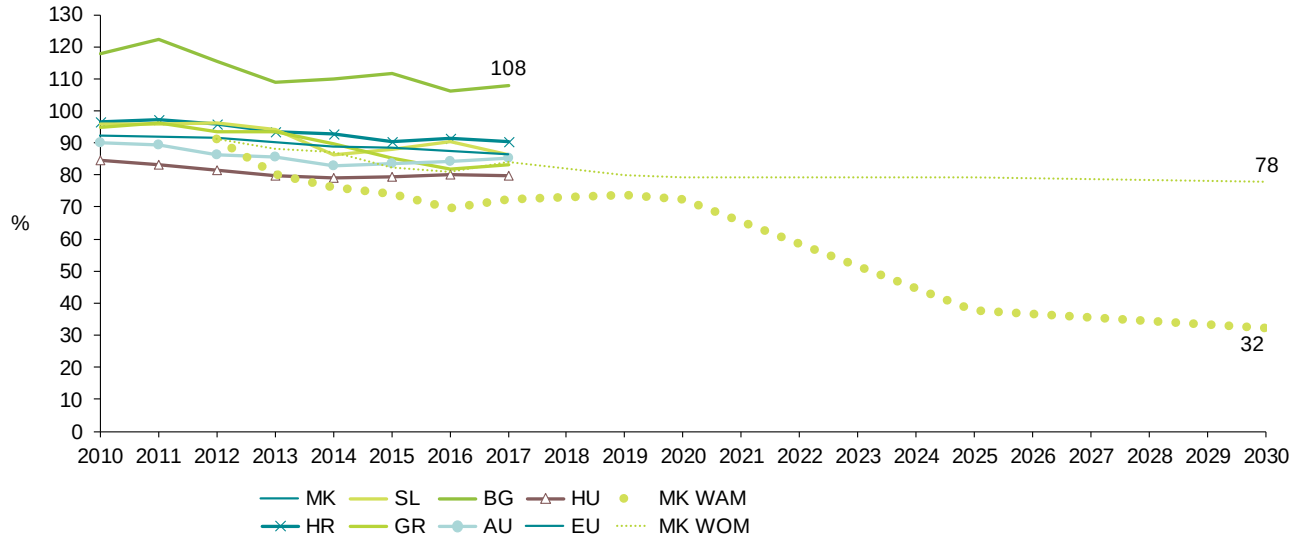
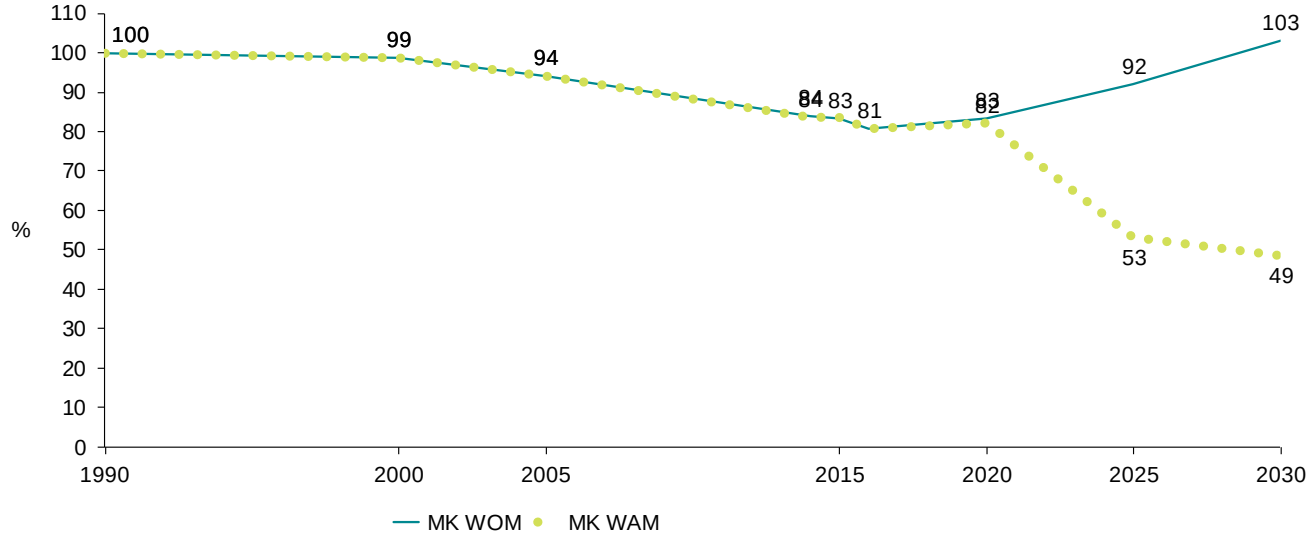
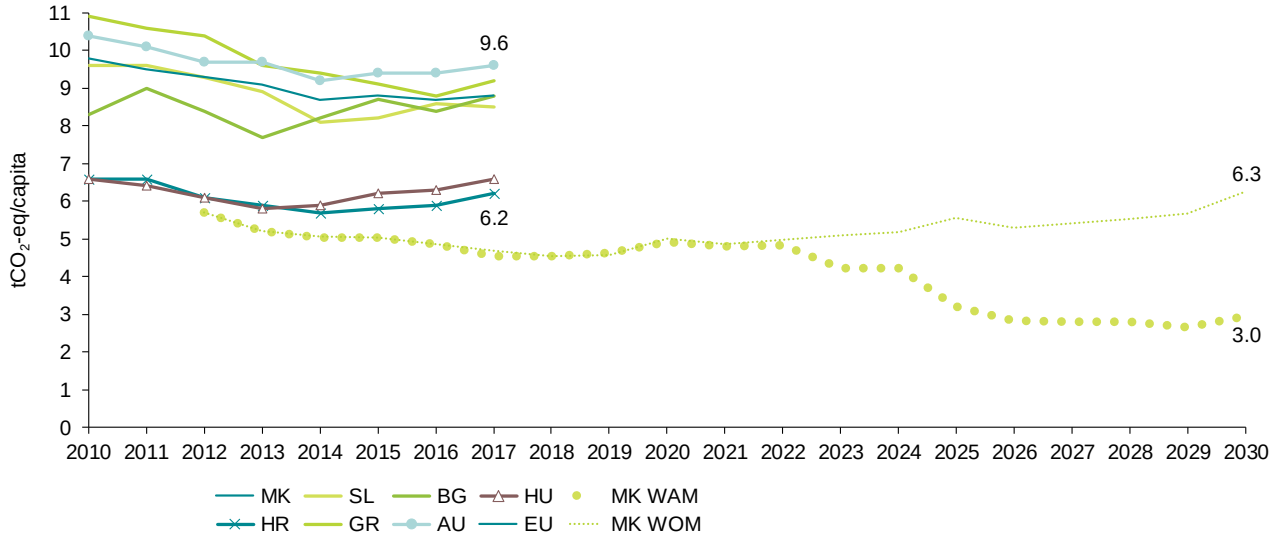


Figure 68. Comparison of GHG emissions in the WOM, WEM, WAM and WAM scenarios, 1990=100 (in %)



Note: The methodology used for calculating the GHG emissions is based on IPCC (excluding MEMO items), emissions and sinks from FOLU are excluded

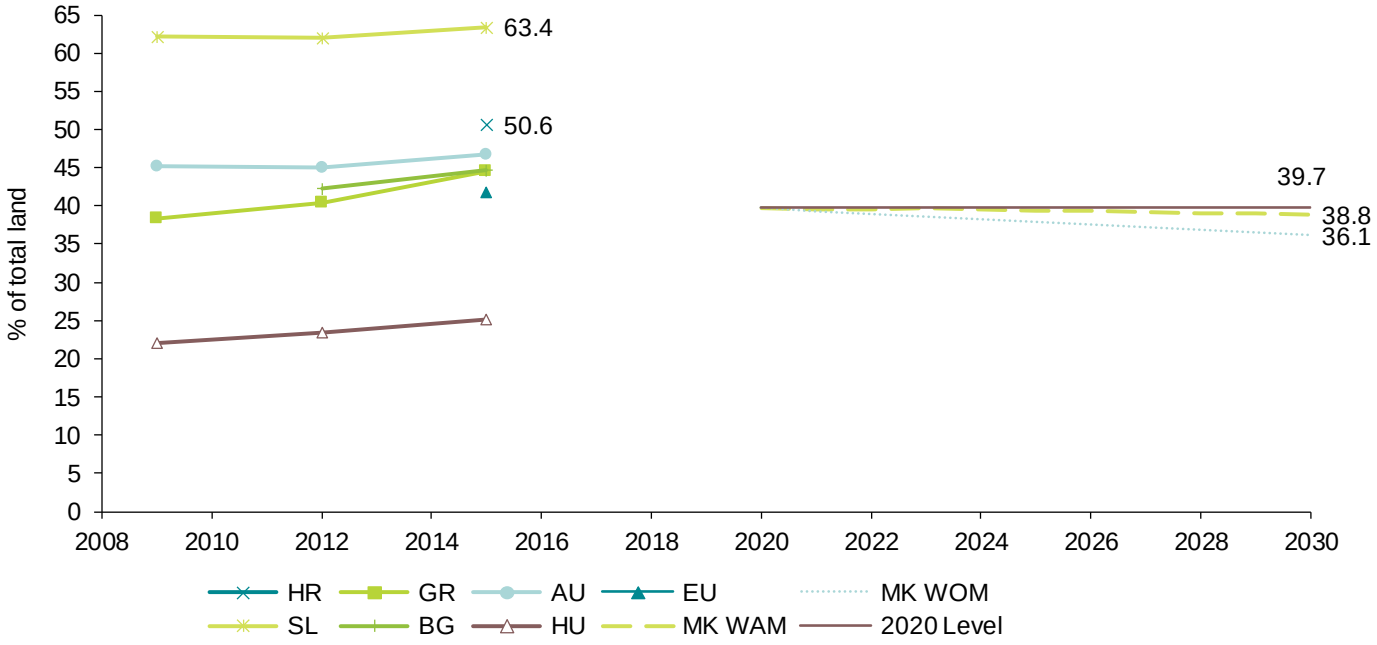
Figure 69. GHG emissions per capita (t CO2-eq/capita)



Note: The methodology used for calculating the GHG emissions is based on IPCC (excluding MEMO items), emissions and sinks from FOLU are excluded

Forest land indicator is calculated for the first time, but it is very important as the forest land influences to a high extend the overall GHG emissions mitigation potential. As a starting point for comparison, the percentage of forest land to total land in 2020 is used (around 40%). Compared to the selected EU countries, Macedonia is almost at the same level as EU 28. The country with the highest forest land share is Slovenia with 63.4% followed by Croatia with 50.6% (Figure 70). If the proposed measures in the Forest sector are not implemented the share of the forest land will decline for around 7 percentage points. On the other hand, the proposed measures will contribute to maintain almost the same level as in 2020.

Figure 70. Forest land (% from total land)



Appendix 1 Methodology

In TBUR complete integration of the widely developed models for each of the sectors has been made, as well as their intersectoral connection through the main common drivers (Figure 71):

- The contribution of each measure for achieving the SDG goals is presented.
- With the help of the SDG indicators, the overall development of Macedonia in terms of GHG emission reductions in monitored, which can be compared to other countries. In this regard, for the first time in this report, an indicator from the Forestry sector was presented, with the help of which the forests area in Macedonia and its comparison with other countries was presented. Additionally, a new indicator in the Energy sector - Energy consumption in households per capita, was calculated and presented.
- For some measures in the energy sector are defined three different paths of implementation that correspond to a different scenario.
- Regarding the Energy sector, the ambitions of the proposed measures are much higher compared to those in SBUR. Several completely new measures have been introduced, the most important of which is the measure for the introduction of CO_2 tax, which significantly changes the penetration of other measures in the field of RES, energy efficiency, fuel switch, etc.
- Two completely new measures have been introduced in the AFOLU sector, Application of Biochar and Photovoltaic Irrigation.
- Regarding the waste sector, the changes that have been implemented in the waste sector within the GHG Inventory have been adequately incorporated into the mitigation model for the waste sector, such as the data for waste generation rate in industry and composition of waste. Additionally, for the first time in TBUR, a forecast of waste incineration emissions based on historical data has been made. Also, historical data for value added data has been linked to Total organic degradable material in the wastewater. Their connection, together with the value added projections from the MARKAL model, has been used to calculate the projections of emissions from Industrial wastewater treatment. Furthermore, for the first time, a measure (Improved waste and materials management at industrial facilities) has been introduced in the category Solid Waste Disposal from Industry.

Figure 71Additionally, a few changes have been made relative to the SBUR that can be summarized as follows:

- The contribution of each measure for achieving the SDG goals is presented.
- With the help of the SDG indicators, the overall development of Macedonia in terms of GHG emission reductions in monitored, which can be compared to other countries. In this regard, for the first time in this report, an indicator from the Forestry sector was presented, with the help of which the forests area in Macedonia and its comparison with other countries was presented. Additionally, a new indicator in the Energy sector - Energy consumption in households per capita, was calculated and presented.
- For some measures in the energy sector are defined three different paths of implementation that correspond to a different scenario.
- Regarding the Energy sector, the ambitions of the proposed measures are much higher compared to those in SBUR. Several completely new measures have been introduced, the most important of which is the measure for the introduction of CO_2 tax, which significantly changes the penetration of other measures in the field of RES, energy efficiency, fuel switch, etc.
- Two completely new measures have been introduced in the AFOLU sector, Application of Biochar and Photovoltaic Irrigation.
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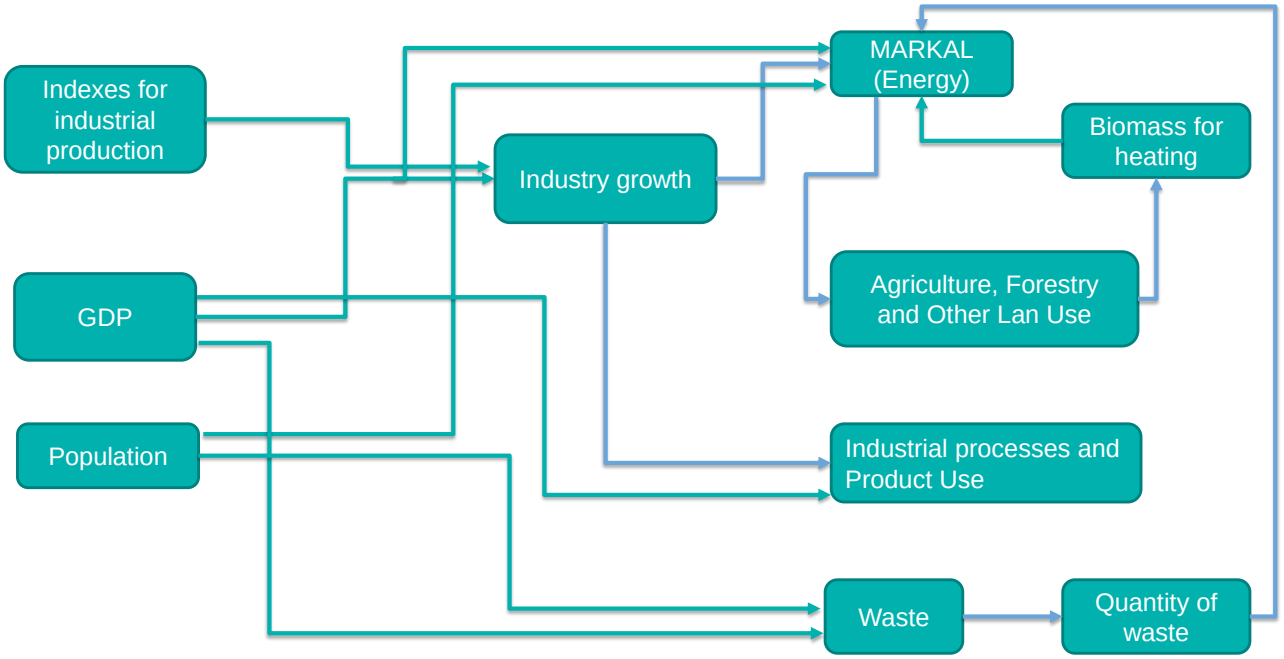
added data has been linked to Total organic degradable material in the wastewater. Their connection, together with the value added projections from the MARKAL model, has been used to calculate the projections of emissions from Industrial wastewater treatment. Furthermore, for the first time, a measure (Improved waste and materials management at industrial facilities) has been introduced in the category Solid Waste Disposal from Industry.

Figure 71. Intra- and Inter-sectoral Approach in TBUR Mitigation analyses



Appendix 2 Action Plan

Table 15. Action plan for realization of the WAM scenario

Policy/ measure	*Competent entity for realization*	*Type*	*Status*	*Source of finance*	*Indicative emissions reduction (Gg CO_2-eq)*	*Budget (mil. €)*	*Green jobs*
					2030		2030
Reduction of network losses	► Electricity distribution companies ► Heat distribution companies ► Ministry of Economy, Energy Agency	Technical	Ongoing	Distribution and transmission companies	323.4	170.0	
Large hydropower plants	► JSC ESM ► Ministry of Environment and Physical Planning ► Ministry of Economy, Energy Agency	Technical	Planned	JSC ESM, Public Private Partnership, Independent power producers	740.7	1716.2	
Incentives feed-in tariff	► Government of the Republic of North Macedonia ► Energy Regulatory Commission ► Ministry of Environment and Physical Planning ► Ministry of Economy, Energy Agency ► Private investors	Technical, Regulatory	Ongoing	Independent power producers, consumers of electricity through their bills	149.5	356.9	152
Incentives feed-in premium	► Government of the Republic of North Macedonia ► Energy Regulatory Commission ► Ministry of Economy ► Private investors	Technical, Regulatory	Ongoing	Independent power producers, incentives from the central government budget	162.6	240.6	220
Biomass power plants (CHP optional)	► Government of the Republic of North Macedonia ► Energy Regulatory Commission ► Ministry of Environment and Physical Planning ► Ministry of Economy, Energy Agency ► Private investors	Technical, Regulatory	Ongoing	Independent power producers, incentives through consumers bills	21.0	24.3	21

Policy/ measure	*Competent entity for realization*	*Type*	*Status*	*Source of finance*	*Indicative emissions reduction (Gg CO_2-eq)*	*Budget (mil. €)*	*Green jobs*
					2030		2030
Solar rooftop power plants	► Government of the Republic of North Macedonia ► Energy Regulatory Commission ► Ministry of Economy, Energy Agency ► Elektrodustribucija Skopje ► Suppliers of electricity ► Electricity end-users	Technical, Regulatory	Planned	Independent power producers, subsidies from national and local budget, EE fund	164.3	363.4	647
RES without incentives	► Government of the Republic of North Macedonia ► Energy Regulatory Commission ► Ministry of Economy, Energy Agency ► JSC ESM ► Private investors	Technical, Regulatory	Ongoing	JSC ESM, Independent power producers, Public Private Partnership	202.8	1325.4	1478
Development of the biofuels market	► Government of the Republic of North Macedonia ► Ministry of economy ► Companies that sell oil products	Regulatory, policy	Ongoing	Central government budget, consumers	211.0	n/a	
Introduction of CO_2 tax	► Government of the Republic of North Macedonia ► Energy Regulatory Commission ► Ministry of Environment and Physical Planning ► Ministry of Economy, Energy Agency ► Ministry of Finance	Regulatory	Planned	n/a	n/a	n/a	n/a
Energy efficiency obligation schemes	► Ministry of Economy ► Distribution system operators ► Suppliers and traders of electricity and gas	Technical, Regulatory	Planned	Consumers through their bills	162.8	182.0	
Solar thermal collectors	► Ministry of Economy, Energy Agency ► End-users	Technical	Ongoing	Private, EE fund, incentives from the central government budget, donors	21.5	70.0	543
Labeling of electric appliances and equipment	► Ministry of Economy, Energy Agency ► Producers and suppliers of electrical equipment and household appliances ► End-users	Regulatory	Ongoing	Private, EE fund	56.3	71.0	

Policy/ measure	Competent entity for realization	Type	Status	Source of finance	Indicative emissions reduction (Gg CO_2-eq)	Budget (mil. €)	Green jobs
					2030		2030
Increased use of heat pumps	► Ministry of Economy, Energy Agency ► End-users	Regulatory, Policy	Ongoing	Private, EE fund, incentives from the central and local government budget, donors	369.5	474.4	58
Public awareness campaigns and network of EE info centers	► Ministry of Economy, Energy Agency ► Energy suppliers ► End-users	Information	Ongoing	Private sector, donors, central and local governments	201.5	704.0	
Retrofitting of existing residential buildings	► Ministry of Economy, Energy Agency ► Donors and financial institutions ► Households	Technical, Regulatory	Ongoing	Private, donors through commercial EE loans, EE fund	73.0	1708.2	1832
Retrofitting of existing central government buildings	► Ministry of Economy, Energy Agency ► Ministry of Finance ► Local self-government ► Municipal public enterprises ► Donors and financial institutions	Technical, Regulatory	Ongoing	Central government budget, donors	19.2	170.0	133
Retrofitting of existing local self-government buildings	► Ministry of Economy, Energy Agency ► Ministry of Finance ► Local self-government ► Municipal public enterprises ► Donors and financial institutions	Technical, Regulatory	Ongoing	Local self-government budget, donors	19.8	150.0	121
Retrofitting of existing commercial buildings	► Ministry of Economy, Energy Agency ► Ministry of Finance ► Commercial buildings owners	Technical, Regulatory	Ongoing	Private, donors through commercial EE loans, EE fund	98.2	530.0	482
Construction of new buildings	► Ministry of Economy, Energy Agency ► Donors and financial institutions ► Investors (households)	Technical, Regulatory	Ongoing	Private, donors through commercial EE loans, EE fund	19.8	282.7	553
Construction of passive buildings	► Ministry of Economy, Energy Agency ► Donors and financial institutions ► Investors (households)	Technical, Regulatory	Ongoing	Private, donors through commercial EE loans, EE fund	17.0	1068.0	1324
Phasing out of incandescent lights	► Government of the Republic of North Macedonia ► Ministry of Economy, Energy Agency ► End-users	Technical	Ongoing	Central government budget, private	401.8	558.0	274

Policy/ measure	*Competent entity for realization*	*Type*	*Status*	*Source of finance*	*Indicative emissions reduction (Gg CO_2-eq)*	*Budget (mil. €)*	*Green jobs*
					2030		2030
Improvement of the street lighting in the municipalities	► Government of the Republic of North Macedonia ► Ministry of Environment and Physical Planning ► Ministry of Economy, Energy Agency ► Local self-government	Technical	Ongoing	Central and local government budget, ESCO	37.9	25.3	12
Green procurements	► Ministry of Economy, Energy Agency ► Public Procurement Bureau ► Local self-government	Regulatory	Ongoing	Central and local government budget	9.4	24.0	
Increased use of central heating systems	► Ministry of Economy, Energy Agency ► Balkan energy Dooel Skopje ► JSC Skopje Sever ► "Energetika" - Skopje, subsidiary to JSC Macedonian Power Plants ► Private investors	Technical, Information	Ongoing	Private, EE fund, incentives from the central and local government budget	9.3	3.2	
Energy management in manufacturing industries	► Ministry of Economy, Energy Agency ► Private companies	Regulatory, Technical	Ongoing	Private, donors through commercial EE loans	67.8	/	
Introduction of efficient electric motors	► Ministry of Economy, Energy Agency ► Private companies	Technical	Ongoing	Private, donors through commercial EE funds	28.8	113.0	
Introduction of more advanced technologies	► Government of the Republic of North Macedonia ► Ministry of Environment and Physical Planning ► Ministry of Economy, Energy Agency ► Private investors	Technical	Ongoing	Private, donors through commercial EE loans, EE funds	206.0	438.6	
Increased use of the railway	► Government of the Republic of North Macedonia ► Ministry of Transport and Communication ► Ministry of Economy, Energy Agency ► JSC Makedonski zeleznici ► End-users ► Private companies	Technical, Information	Planned	Central government budget	37.2	180.6	

Policy/ measure	Competent entity for realization	Type	Status	Source of finance	Indicative emissions reduction (Gg CO_2-eq)	Budget (mil. €)	Green jobs
					2030		2030
Renewing of the national car fleet	► Government of the Republic of North Macedonia ► Ministry of Transport and Communication ► Ministry of Economy, Energy Agency ► End-users	Regulatory, Policy, Information	Ongoing	Private, EE fund, incentives from the central government budget	43.1	2167.7	
Renewing of other national road fleet	► Government of the Republic of North Macedonia ► Ministry of Transport and Communication ► Ministry of Interior Affairs ► Ministry of Economy, Energy Agency ► Private companies	Regulatory, Policy	Ongoing	Private sector	66.4	2300.0	
Advanced mobility	► Ministry of Economy, Energy Agency ► Local self-government ► End-users	Regulatory, Technical, Information	Ongoing	Private, EE fund, incentives from the central and local government budget, donors	3.6	/	
Construction of the railway to the Republic of Bulgaria	► Government of the Republic of North Macedonia ► Ministry of Transport and Communication ► Ministry of Economy, Energy Agency	Technical, Policy	Ongoing	Central government budget	24.6	720.0	
Electrification of the transport	► Government of the RM ► Ministry of Transport and Communication ► Ministry of Economy	Regulatory, Policy, Information	Ongoing	Private, EE fund, incentives from the central government budget	61.6	5058.5	
Reduction of CH4 emissions from enteric fermentation in dairy cows by 3%	► Ministry of Agriculture, Forestry and Water Economy	Livestock, enteric fermentation in dairy cow	Ongoing	Private sector	35.0	0.2	
Reduction of N2O emissions from manure management in dairy cows by 20%	► Ministry of Agriculture, Forestry and Water Economy	Livestock, manure management in dairy cow	Planned	Private sector	2.1	1.0	

Policy/ measure	*Competent entity for realization*	*Type*	*Status*	*Source of finance*	*Indicative emissions reduction (Gg CO_2-eq)*	*Budget (mil. €)*	*Green jobs*
					2030		2030
Reduction of NO2 emissions from manure management in swine farms by 13%	► Ministry of Agriculture, Forestry and Water Economy	Livestock, manure management in swine cow	Ongoing	Private sector	0.4	1.0	
Reduction of N2O emissions from manure in dairy cows by 20% for farms below 50 Livestock Units	► Ministry of Agriculture, Forestry and Water Economy	Livestock, manure management in dairy cow	Planned	Private sector	0.7	1.0	
Establishing integrated management of forest fires	► PE "National forests" ► Ministry of Agriculture, Forestry and Water Economy	Forest fires reduction	Ongoing	PE "National forests", other forest enterprises	345.0	1.5	
Afforestation	► PE "National forests" ► Ministry of Agriculture, Forestry and Water Economy	Afforestation of Barren Land	Ongoing	PE "National forests", other forest enterprises	312.5	7.8	
Conversion of land use of field crops above 15% inclination	► Ministry of Agriculture, Forestry and Water Economy	Land management and land use change in the category of cropland	Ongoing	Private sector	3.7	1.5	
Contour cultivation on areas under field crops on inclined terrains (5-15%)	► Ministry of Agriculture, Forestry and Water Economy	Land management and land use change in the category of cropland	Ongoing	Private sector	28.0	1.0	
Perennial grass in orchard and vineyards on inclined terrains (>5%)	► Ministry of Agriculture, Forestry and Water Economy	Land management and land use change in the category of cropland	Ongoing	Private sector	8.9	1.0	

Policy/ measure	Competent entity for realization	Type	Status	Source of finance	Indicative emissions reduction (Gg CO_2-eq)	Budget (mil. €)	Green jobs
					2030		2030
Use of biochar for carbon sink on agricultural land	► Ministry of Agriculture, Forestry and Water Economy	Land management of the category of cropland	Planned	Private sector	110.0	30.0	
Photovoltaic irrigation	► Ministry of Agriculture, Forestry and Water Economy	Agriculture – irrigation replacing fossil energy with renewables	Ongoing	Private sector	93.3	47.0	
Landfill gas flaring	► 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)	Technical	Ongoing	Local self-government through Public Utilities, Public Private Partnership, Grants from the EU	489.7	20.5	
Mechanical and biological treatment (MBT) in new landfills with composting	► Ministry of environment and physical planning ► Public utilities for waste management ► State Environmental Inspectorate ► Inter-municipal board for waste management ►Authorized Inspectors of Environment (Municipalities)	Technical	Ongoing	Local self-government through Public Utilities, Public Private Partnership, Grants from the EU	108.0	36.1	
Selection of waste - paper	► Ministry of environment and physical planning ► Public utilities for waste management ► State Environmental Inspectorate ► Inter-municipal board for waste management ►Authorized Inspectors of Environment (Municipalities)	Technical	Ongoing	Local self-government through Public Utilities, Public Private Partnership, Grants from the EU	62.5	2.0	

Policy/ measure	*Competent entity for realization*	*Type*	*Status*	*Source of finance*	*Indicative emissions reduction (Gg CO_2-eq)*	*Budget (mil. €)*	*Green jobs*
					2030		2030
Improved waste and materials management at industrial facilities	► Ministry of Environment and Physical Planning ► Public utilities for waste management ► State Environmental Inspectorate ► Inter-Municipal Waste Management Board ► Authorized Inspectors of Environment (Municipalities)	Regulation, Technical	Planned	Ministry of Environment and Physical Planning Municipalities and city of Skopje Industrial facilities	3.3	0	