



Republic of North Macedonia
MINISTRY OF ENVIRONMENT
AND PHYSICAL PLANNING

FIRST BIENNIAL TRANSPARENCY REPORT (BTR1)



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Foreword

The first Biennial Transparency Report (BTR1) of the Republic of North Macedonia represents a key step in fulfilling the commitments undertaken under the Paris Agreement and the established Enhanced Transparency Framework (ETF). This report provides a comprehensive and consistent overview of the national greenhouse gas emissions inventory, the progress in implementing the Nationally Determined Contribution (NDC), mitigation policies and measures, as well as relevant information on adaptation, financial support, technology transfer and capacity building.

The report was prepared in accordance with the UNFCCC modalities, procedures and guidelines (MPGs), by applying the latest IPCC methodological approaches and by ensuring a high level of data transparency, comparability and consistency. Its preparation integrated the results of national strategic documents, including the National Greenhouse Gas Inventory 2020-2022, the Climate Change Mitigation Analyses, the Enhanced Nationally Determined Contributions, the National Energy and Climate Plan and other documents developed within the framework of the BTR1 preparation project.

The preparation of the BTR1 took place in a period of dynamic energy and economic challenges, with special attention paid to aligning climate goals with the needs for energy security and sustainable economic development. This report confirms the commitment of the Republic of North Macedonia to transparent, accountable and continuous reporting, as well as to an active contribution to global efforts to address climate change.

Gratitude

Sincere gratitude is extended to all participants in the consultation process, workshops and technical meetings, including representatives from the public sector, academia, international organizations, the private sector and civil society. Their contributions have improved the quality, transparency and relevance of the report.

Overall, this report is the result of joint, coordinated and long-term cooperation, which forms the basis for further improvement of the national system for transparency and climate policies.

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List of abbreviations

GDP	Gross Domestic Product
SSO	State Statistical Office
AFOLU	Agriculture, Forestry and Other Land Use (AFOLU)
IPPU	Industrial Processes and Product Use
MAKSTAT	Database of the State Statistical Office
MANU	Macedonian Academy of Sciences and Arts
MAP	Report: Climate Change Mitigation, 2025
MoEPP	Ministry of Environment and Physical Planning
MAFWE	Ministry of Agriculture, Forestry and Water Economy
MRV	Monitoring, Reporting and Verification
MRVA	Monitoring, Reporting, Verification and Accreditation
MPGs	Modalities, Procedures and Guidelines
NDC	Nationally Determined Contributions
NAP	National Adaptation Plan
NID	National Inventory Document
UN	United Nations
ETF	Enhanced Transparency Framework
UKIM	University "St. Cyril and Methodius" - Skopje
CMC	Crisis Management Center
AR5	5th IPCC Assessment Report
BUR3	Third Biennial Update Report on Climate Change
CLC	CORINE Land Cover
CRF	Common Reporting Format
CTF	Common Tabular Format
FOD	First Order Decay
FAO	Food and Agriculture Organization
GCF	Green Climate Fund
GEF	Global Environment Facility
GSP	Global Support Programme
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
MCF	Methane Correction Factor
NECP	National Energy and Climate Plan of North Macedonia
NC4	Fourth National Communication on Climate Change
QA	Quality Assurance
QC	Quality Control
SWDS	Solid Waste Disposal Sites
T1	Tier 1
T2	Tier 2
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change

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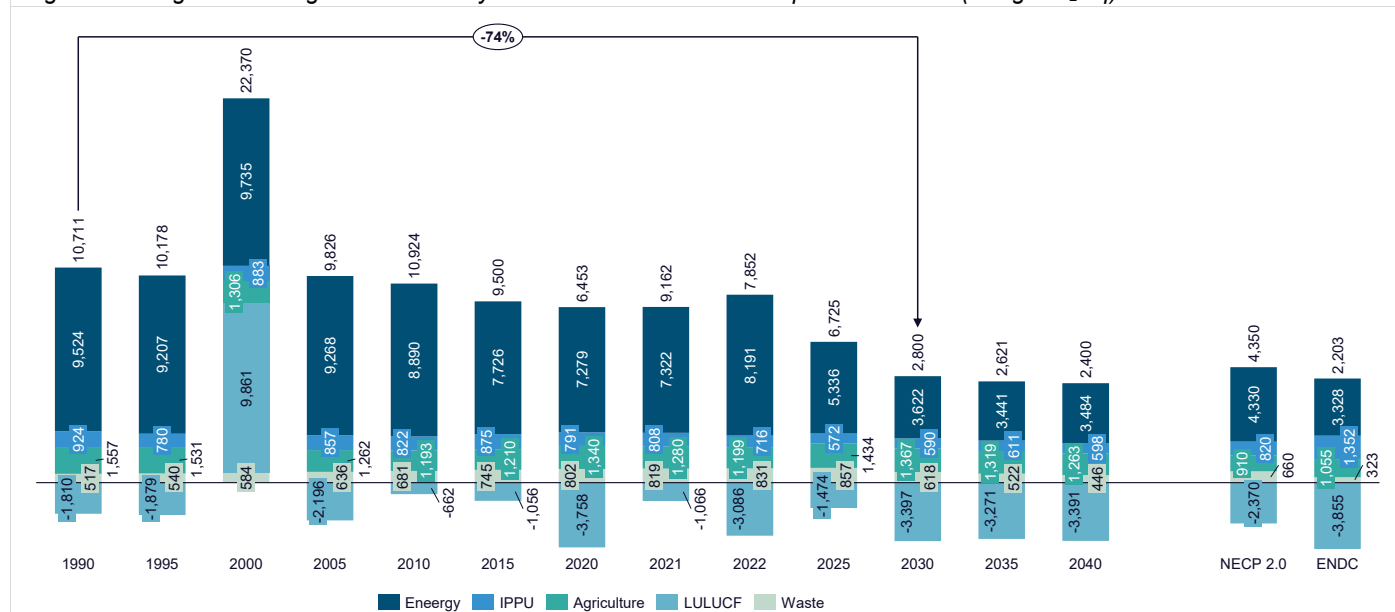
EXECUTIVE SUMMARY

The first Biennial Transparency Report (BTR1) for the period 2020–2022 of the Republic of North Macedonia was prepared in accordance with the requirements of the Paris Agreement through the Enhanced Transparency Framework (ETF). This document covers the national greenhouse gas emission inventory from 1990–2022, information on monitoring the progress of mitigation policies and measures from the Enhanced Nationally Determined Contribution (ENDC) of 2021, policies and measures for adaptation to climate change, as well as the needs for financial and technological support and capacity building.

The ENDC sets targets for reducing the total emissions by **51% by 2030** and the net emissions by 82% compared to the emissions levels in 1990. The ENDC includes 63 mitigation policies and measures, including 32 measures in the energy sector, 11 in the agriculture, forestry and other land use sector, 4 in the waste sector and 16 cross-sectoral and enabling policies and measures that serve to create institutional, technical and financial conditions for implementation of the remaining measures. BTR1 analyses 69 mitigation policies and measures, covering all relevant sectors, resulting from the analyses made in the Mitigation Action Plan (MAP). These policies and measures are harmonized with the policies and measures defined in the National Energy and Climate Plan (NECP), which was adopted by the Government in April 2026. The mutual harmonization of BTR1 and NECP was one of the reasons for submitting BTR1 later than the envisaged deadline.

The results show a high level of harmonization between the scenario With Additional Measures (WAM) and NECP, with net emissions in 2030 estimated at around 2,800 kt CO₂eq, which is relatively close to the ENDC (2,203 kt CO₂eq) (Figure 23). The main differences arise from the energy sector and the forestry and other land use sector, where BTR1 uses updated data from the national greenhouse gas inventory (including removals from perennial crops). However, despite these differences, the two documents are largely consistent, showing the same trends, strong growth of renewable sources, reduction of fossil fuels and a clear direction towards decarbonization. The differences are relatively small and mostly stem from the different treatment of certain technologies, the investment dynamics and the system optimisation in BTR1.

Figure 1 Total greenhouse gas emissions by sector - scenario WAM compared to NECP (in Gg CO₂eq)



Since the adoption of the ENDC, significant steps have been made in regard to climate change mitigation, such as a large number of implemented measures and adopted documents such as the Long-Term Climate Action Strategy (2022), the Fourth National Climate Change Plan (NC4), the first National Energy and Climate Plan (2023), the National Development Strategy (2024), etc. However, significant challenges still remain, such as the adoption of a Law on Climate Action, a National Adaptation Plan (NAP), as well as establishing a Monitoring, Reporting and Verification (MRV) system.

Based on the presented overall progress assessments, the implementation of mitigation measures within the ENDC of the Republic of North Macedonia shows moderate progress in key sectors:

- In the energy sector, which covers the largest number of actions and contributes the largest share of greenhouse gas emissions, the average implementation progress is estimated at around 65%. This indicates a steady trend, especially in measures related to the development of renewable energy sources, such as rooftop solar photovoltaics and solar thermal collectors, which received the highest implementation scores. Energy efficiency initiatives in public and residential buildings are also progressing moderately, although some critical infrastructure projects, such as biomass power plants or large hydropower projects, are facing delays due to financial, technical obstacles or obstacles in obtaining the adequate permits;
- In the waste sector, implementation progress is around 55%, reflecting a combination of solid early planning and slow implementation on the ground. Several measures, such as opening new regional waste management centres and closure of inadequate municipal landfills, are in the planning phase, but lack complete implementation. Legal and institutional obstacles have limited the capacity of municipalities, and the need for clearer financing strategies has contributed to a pace slower than expected in this sector. In addition, the resistance from local communities, particularly regarding the location of the regional landfills and the waste treatment plants, has emerged as a significant obstacle, delaying several planned investments and provoking public opposition in several municipalities.
- For additional and cross-sectoral measures, including those related to raising awareness, legislation and research and development, the average progress rate is just below 60%. This indicates an adequate level of engagement, but also highlights the need for systemic support mechanisms and stronger policy enforcement. A notable example of slow implementation is the 400 kV transmission line to Albania, which received the lowest implementation score (score 1 in the technical document referred to above). Although this project is strategically important for improving regional electricity connectivity and enabling integration of renewable energy sources, its implementation has been significantly delayed due to administrative, procurement and coordination issues. The agreement with the selected contractor was terminated and the process of identifying a new contractor is ongoing, thus further delaying the start of the construction and compromising the harmonization with the regional interconnection targets.

Overall, while the progress to date reflects a positive trajectory towards achieving the ENDC objectives, the current pace will need to be accelerated to ensure complete implementation by 2030. Likewise, a Financing Strategy accompanying the ENDC of the Republic of North Macedonia was developed in order to define the financial framework needed for implementation of the mitigation measures by 2030. The Strategy presents an ambitious investment agenda of over €21.3 billion (€25 billion at 2025 prices) if all measures are implemented, with a strong focus on the energy sector, which accounts for approximately 99% of the estimated investment needs.

Adaptation is a key pillar in the national response to climate change, with a focus on strengthening the resilience of the most vulnerable sectors such as agriculture, water resources, forestry and health. Within the framework of BTR1, based on previously conducted analyses, methodological foundations for monitoring the progress are presented, including the development of indicators, vulnerability assessments and defining priority measures. However, the need remains for adoption of a National Adaptation Plan and further integration of adaptation policies into all relevant national strategies, in order to systematically reduce the risks and damages of climate impacts.

Investments are a key driver for implementation of the climate policies, with the BTR1 providing a structured overview of the international support implemented in the period 2020–2022, as well as an assessment of future needs by sector. The analysis shows that the largest share of the funds was directed towards energy (renewable sources and energy efficiency), while a significantly smaller volume was allocated to adaptation in the waste and agriculture segments, indicating an uneven distribution of investments. At the same time, specific project interventions and programmes financed through international mechanisms such as GEF and UNDP were identified, as well as the need to significantly increase the total investment volume in order to support the objectives of the ENDC. The gap between the available and the necessary financial resources remains a key challenge, especially for infrastructure projects with high investment costs, which requires the mobilization of additional sources through the private sector, international funds and innovative financial instruments (public-private partnerships, green bonds, climate funds), as well as strengthening the institutional capacity for planning, absorption and monitoring of investments.

The national system is gradually being strengthened by involving the academia, research institutions, youth and non-governmental organizations in the processes of analysis, modelling and policy-making. Despite the current progress, the need remains for systematic funding of research, strengthening the link between science and industry and

establishing more efficient mechanisms for technology transfer, in order to accelerate the innovations and their practical application in the decarbonization process.

In order to build systemic resilience and raise public awareness, the climate change topic needs to be strengthened in other national strategies, ranging from education and innovation to aspects related to gender equality.

Relevant analyses and activities in the field of climate change in the country are published on the platform klimatekipromeni.mk. This well-established practice is expected to continue in the future.

The development of BTR1 is being implemented with support from the Global Environment Facility (GEF) and the United Nations Development Programme (UNDP) within the framework of the project "Development of the First Biennial Transparency Report of North Macedonia and the combined Second Biennial Transparency Report and the Fifth National Communication on Climate Change under the UNFCCC".

INTRODUCTION

Climate change represents one of the most serious global challenges of modern society, with significant economic, ecological and social implications. The Republic of North Macedonia, as a Party to the United Nations Framework Convention on Climate Change (UNFCCC) and a signatory to the Paris Agreement, has committed to continuously improving the national policies for climate change mitigation and adaptation and to transparent reporting on the progress. The preparation of the first Biennial Transparency Report (BTR1) represents a key step in fulfilling these international obligations, while simultaneously ensuring systematic, transparent and consistent monitoring of greenhouse gas emissions and the effects of the policies and the measures.

This report builds on previous national climate policy documents, while providing an improved methodological framework aligned with the latest IPCC guidelines and the requirements of the transparent framework mechanism established by the Paris Agreement. It is particularly significant that this document is being prepared in a period of strong energy and economic uncertainty at global and regional level, whereby climate goals must be balanced with the need for energy security and economic stability. However, the Republic of North Macedonia remains actively committed to the transition to a low-carbon and sustainable development model, through a gradual reduction of the dependence on fossil fuels, promotion of renewable energy sources, strengthening energy efficiency and improved management of the natural resources.

BTR1 is not only a technical document, but also a strategic tool for planning, policy-making and supporting the process of integration into the European Union. Through transparent presentation of data and results, the report enables informed decision-making, strengthening of public institutions, better coordination between stakeholders and active participation of the academia, the business sector and the civil society. Consequently, the national climate policy system is developed on the principles of scientific rigor, accountability and long-term sustainability.

At the same time, BTR1 also represents a basis for further improvement of the data collection and processing system, development of analytical capacities and improvement of the institutional cooperation. This creates a stable framework for subsequent reporting cycles, as well as for realistic assessment of the progress towards meeting the national and the international climate goals. This report, with its scope and methodological precision, highlights the continuous commitment of the Republic of North Macedonia to contribute to global efforts to combat climate change in a transparent, structured and accountable manner, promoting an inclusive and equitable approach that considers the different needs, vulnerabilities and roles of women, men and vulnerable groups in the climate policies.

1 NATIONAL GREENHOUSE GAS INVENTORY

1.1 INSTITUTIONAL SETTING, METHODOLOGY AND GREENHOUSE GAS EMISSIONS TREND

As a Party to the UN Framework Convention on Climate Change (UNFCCC), the Republic of North Macedonia is obliged to regularly prepare a national greenhouse gas inventory. This inventory presents a detailed record of how much greenhouse gases are emitted into the atmosphere from various sources (such as power plants, industrial facilities, cars, heavy goods vehicles, livestock) and how much is absorbed by sinks (such as forests and other natural ecosystems). This process is not just formal reporting, rather it is the basis for planning climate policies, monitoring national emission trends, assessing the effects of the mitigation measures and fulfilling the international obligations. That is the reason why the inventory is an integral part of the National Climate Change Plans (National Communications), the Biennial Update Reports (BUR) and, in accordance with the new requirements of the Paris Agreement, the Biennial Transparency Report (BTR).

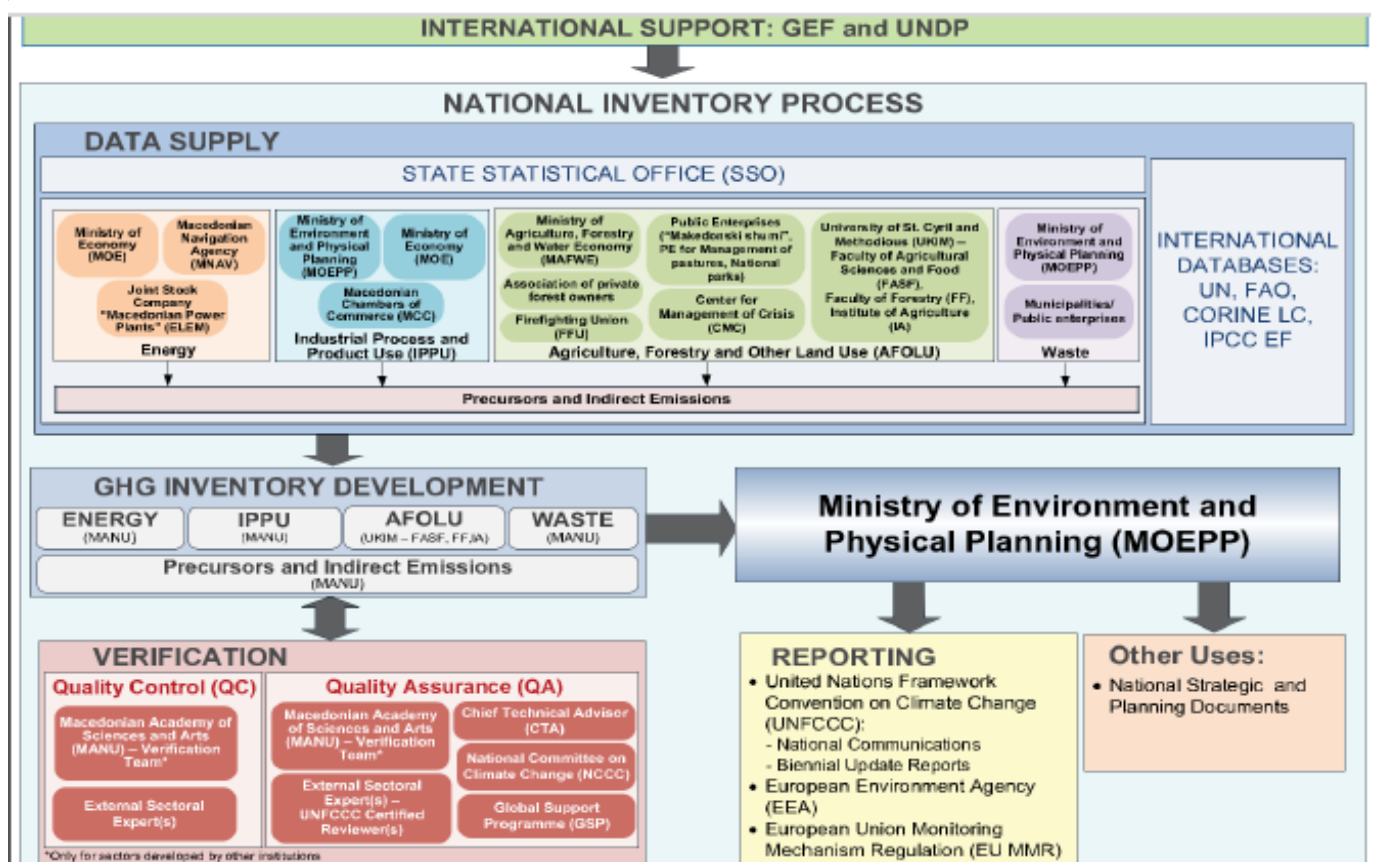
The process of preparing a National Greenhouse Gas Inventory (Figure 2) includes the following key entities:

- **Ministry of Environment and Physical Planning**, responsible for supervision of the inventory preparation process and for reporting greenhouse gas emissions to the UNFCCC, as well as for other international reporting on emissions;
- **Greenhouse Gas Inventory Development Team**, composed of a team from the Macedonian Academy of Sciences and Arts (MANU) and a team for the Agriculture, Forestry and Other Land Use sectors composed of experts from the University "Goce Delchev" in Shtip;
- **Verification Team**, which includes experts who perform quality control, as well as experts who guarantee quality assurance of the inventory, which is also provided through a multi-level structure, including the Chief Technical Advisor (CTA) engaged within the framework of the BTR1 development project.

The National Greenhouse Gas Inventory covers the time series for the period 2020–2022 and represents the first complete calculation carried out in the context of BTR1. At the same time, a comprehensive revision of the entire historical series from 1990 to 2019 was carried out. The need for revision arises from the fact that the IPCC Inventory Software version from 2020 was replaced by the latest version developed in 2025, which includes updated methodologies, additional improvements and corrected technical deficiencies. To ensure consistency and comparability of data across the entire time series, all years were recalculated and input data and emission factors were updated, as well as the application of AR5. This approach guarantees that the methodology is harmonized for all years and that the inventory fully meets the requirements of the enhanced transparency framework of the Paris Agreement.

The greenhouse gas inventory covers five main sectors: Energy, Industrial Processes and Product Use (IPPU), Agriculture, Forestry and Other Land Use (FOLU) and Waste. Each sector consists of categories and subcategories. The reported emissions cover the following greenhouse gases: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), perfluorocarbons (PFCs) and hydrofluorocarbons (HFCs). The inventory also covers precursors and indirect emissions of: carbon monoxide (CO), nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOCs), sulphur dioxide (SO₂) and ammonia (NH₃). Emissions of sulphur hexafluoride (SF₆) have not been estimated for Macedonia due to the unavailability of activity data.

Figure 2 Process of preparing a National Greenhouse Gas Inventory



Source: NID 2020-2022

Most of the activity data by sector (input data) used for the preparation of the national inventory are sourced from official national documents, such as: statistical yearbooks, energy balances, sector reports and the MAKSTAT database of the State Statistical Office (SSO), as well as from various strategies and reports from relevant institutions, such as the Ministry of Environment and Physical Planning (MoEPP), the Ministry of Agriculture, Forestry and Water Economy (MAFWE), the Geodetic Cadastral Information System (GCIS) of the Cadastre Agency, CLC+Backbone (Copernicus Land Monitoring Service) 2018/2021 and from international databases, such as population and gross domestic product (GDP) data from the United Nations (UN) and FAOstat.

In the preparation of the National Inventory, the Tier 2 Method was applied for CO₂ emission factors for lignite, residual fuel oil and natural gas in fuel combustion activities in the Energy sector. The Tier 2 Method was also used in the Industrial Processes and Product Use sector for emission factors for cement production in the mineral industry and for production of iron and steel and ferroalloys in the metal industry. The Tier 2 Method was also applied in the Agriculture sector, subcategory Livestock farming, to calculate emissions related to dairy cattle and pig activities. The Waste sector is another sector in which the Tier 2 Method was applied, but close to the Tier 3 Method, through the IPCC FOD method and taking into account country-specific data on waste disposal activity in solid waste landfills and historical data on GDP and population. For other sectors, the standard method, Method 1, was used.

In this inventory, greenhouse gas emissions from road traffic were calculated at a disaggregated level, by subcategories available in the IPCC software, which include: passenger cars (with and without 3-way catalysts), light duty trucks (with and without 3-way catalysts), heavy duty trucks and buses and motorcycles, evaporative emissions from vehicles and emissions related to the use of catalysts in road vehicles. A key element in this inventory is that COPERT is applied as the basic methodology for the entire period 1990–2022. From the COPERT model, based on data on the structure of the vehicle fleet, average kilometres, fuel consumption (l/100km) and distribution of fuel consumption by IPCC subcategories, a recalculation was performed for all years, beginning from 1990.

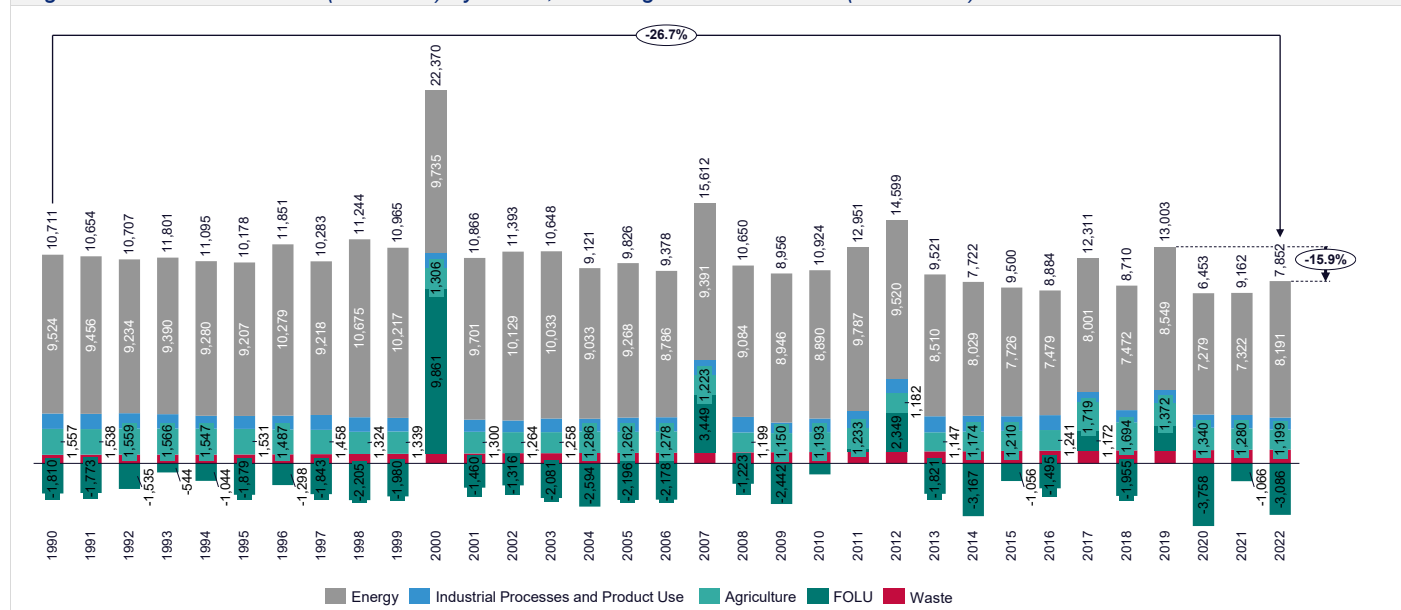
The estimates of precursors and indirect emissions (including indirect emissions of NH₃) are based on the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2023. The tables used for emission factors are referenced in the sub-chapters by sector in Chapter II. The estimates for all sectors are made using the Tier 1 methodology, i.e. Method 1 (Tier 1), except for the category Biological waste treatment – composting, in the Waste sector for which emission factors according to Method 2 (Tier 2) are applied. The methodologies for higher tiers require detailed characteristics of the fuels used in combination with on-site measurements or other detailed parameters, which were not available at the time of preparation of this inventory.

Total greenhouse gas emissions in Macedonia for the period 1990–2022 have decreased by about 33%, while in the period 2019–2022 they have decreased by about 16% (Table 1, Figure 3). The largest contribution is made by the Energy sector, which dominates with more than two-thirds of total emissions and remains the main source of emissions despite the gradual decline, especially after 2011. This decrease is a result of reduced electricity production from coal, improved energy efficiency and a greater share of natural gas and renewable sources, while on the other hand, there is an increase in consumption in the Transport sector. At the same time, the Forestry and Other Land Use sector shows the largest changes, in some years contributing as a significant carbon sink (up to -3,800 Gg CO₂-eq in 2022), while in others, turning into a source of greenhouse gas emissions, especially in years with larger forest fires. This is precisely what makes forestry a key, but also risky, element in the national balance sheet.

The results for total greenhouse gas emissions in Macedonia, excluding the Forestry and Other Land Use sector, provide a clearer picture of the sources of emissions in the economy. Total emissions in 2022 were around 10,900 Gg CO₂-eq, which presents a decrease of around 13% compared to 1990 (Figure 4), with the most pronounced decline after 2011. The main contributor is the Energy sector, which accounts for over 75% of total emissions; however, in absolute terms, a decline in emissions is observed. The Industrial Processes and Product Use sector accounts for around 7–9% and shows a slight increase in the last decade, mainly as a result of cement production and metallurgical activities. Agriculture has a relatively stable share (around 10–12%), with a very small decline primarily due to a decrease in livestock. On the other hand, the Waste sector shows continuous growth, with an increase in emissions by over 60% compared to 1990, which is related to urbanization, increased generation of municipal waste and limited application of waste selection and treatment systems. With the increase of emissions, the share of the Waste sector in total emissions increased from 4% in 1990 to around 8% in the period 2020–2022.

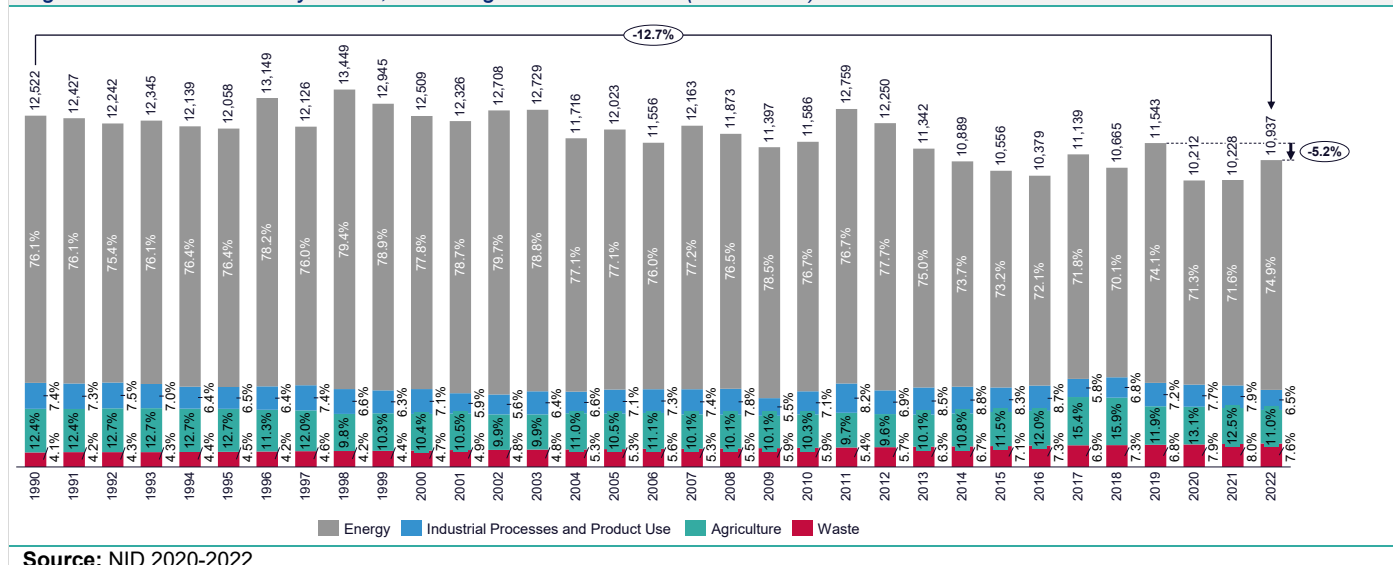
Table 1 Greenhouse gas emissions and sinks by sector (in CO₂-eq)									
Sector	1990	2000	2005	2010	2015	2019	2020	2021	2022
Energy	9523.8	9735.4	9267.6	8890.4	7725.6	8548.7	7279.0	7321.8	8191.3
IPPU	924.5	883.2	857.1	822.4	875.1	832.9	790.7	808.1	715.9
Agriculture	1556.7	1306.2	1261.5	1192.6	1210.3	1371.9	1339.6	1279.6	1199.3
Forestry	-1810.4	9861.0	-2196.2	-662.2	-1056.5	1460.0	-3758.4	-1066.1	-3085.8
Waste	516.6	584.3	636.3	681.0	745.2	789.2	802.3	819.0	831.0
Total	10711.2	22370.0	9826.4	11586.5	9499.7	13002.7	6453.2	9162.3	7851.6
Total excluding forestry	12521.6	12509.0	12022.6	10924.2	10556.2	11542.7	10211.6	10228.5	10937.5

Figure 3 Total net emissions (and sinks) by sector, including the FOLU sector (1990–2022)



Source: NID 2020–2022

Figure 4 Total emissions by sector, excluding the FOLU sector (1990-2022)



When emissions are analysed individually by gas, predominance of CO₂ is clearly evident, accounting for around 75–80% in each year of the series. Methane (CH₄) remains the second most significant gas; however, the sources of its emissions are changing – in 1990 the largest share came from agriculture, while in 2022 waste became the dominant source of methane. In such manner, CH₄ emissions become an indicator not only of agricultural practices, but also of the degree of urbanization and the efficiency of waste management systems. Fluorinated gases, although with a small share, are increasing at the fastest pace, reflecting the increased use of air conditioning (heating and cooling) systems in households, businesses and industry.

Energy is the predominant source of most precursors, with some changes in the distribution and the intensity of emissions. In 1990, almost all precursor emissions were generated from the energy sector, with a share of more than 95% for NO_x and CO and over 99% for SO₂. This reflects the situation in which the energy system was completely based on coal and residual fuel oil and transport with old vehicles. By 2022, the structure is somewhat more diverse and shows a decrease in the predominance of energy in some gases. Thus, in CO, the share of energy decreases from 96.5% to 68.3%, with an increase in the share of forestry (22.6%) and waste (6.6%), indicating increased combustion of biomass and waste, as well as emissions from organic processes. For NO_x and SO₂, energy still has a predominant influence (93.8% and 99.4%), with slightly lower values compared to 1990, showing the effect of some level of modernization and transition away from fuels containing sulphur.

For the period 1990–2022, it can be noted that there is a decrease of about 40% in total precursors and indirect emissions, which is a positive trend and also indicates an improvement in air quality. However, the trend is not linear: in some years peaks are observed, especially related to increased emissions of CO and NMVOC, which are the result of large fires. In the last 10 years, emissions have a general decreasing trend, especially of NO_x and SO₂, which indicates a decrease in coal use. There is also a decreasing trend in CO, which is related to the renewal of the vehicle fleet.

Methodological improvements and recalculations were necessary to ensure consistency and high reliability of the entire time series from 1990 to 2022. The new versions of the IPCC Inventory Software from 2025 (2.95, 2.96 and 2.98) contained certain inconsistencies, hence, the team used the old versions in parallel to prevent technical errors and to harmonize the calculations. The transition to AR5 GWP values required a complete recalculation of the series. In this process, previously identified omissions were also corrected, such as insufficiently entered sinks from perennial crops and additions to the parameters for direct and indirect N₂O. The updated data also include the revised demographic series according to the 2021 Population Census by the SSO, which significantly affects the Waste sector. The table with improvements in the national greenhouse gas inventory system compared to previous notifications is provided in Annex No. 1 of this BTR1.

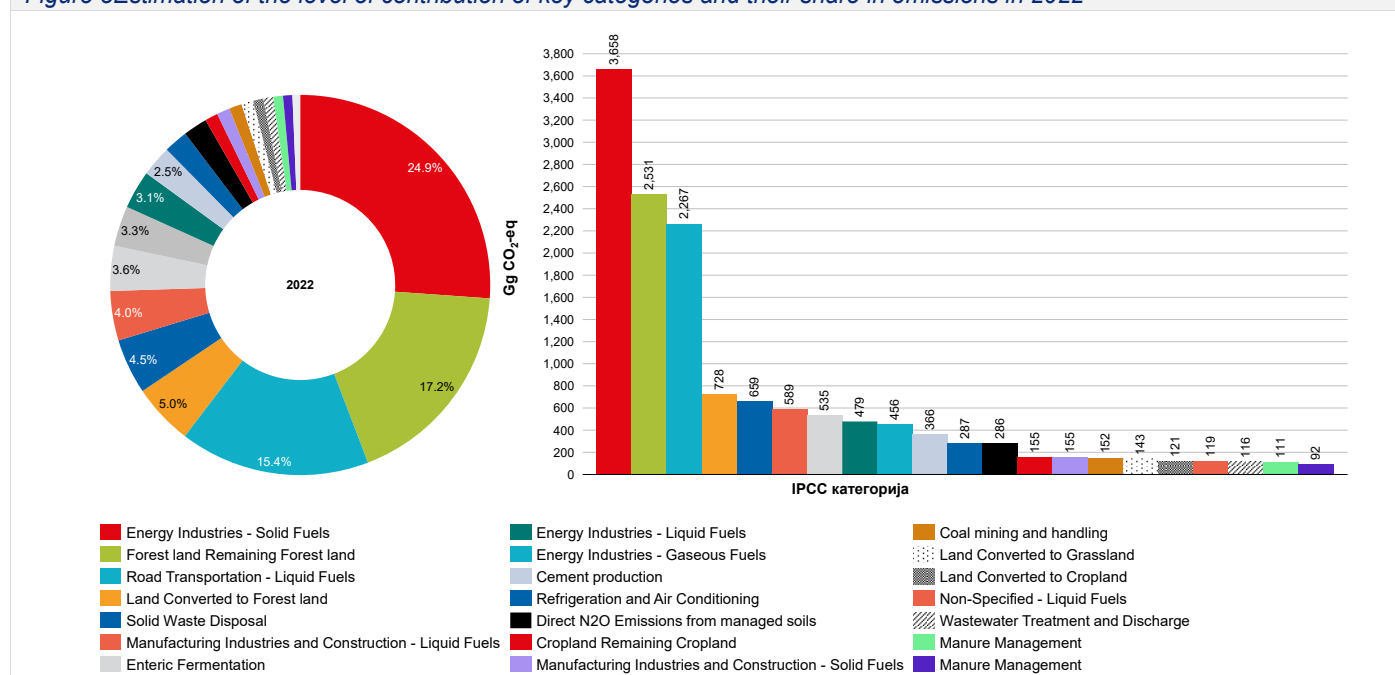
The revision process also included more extensive corrections in the Waste sector, especially by integrating new data on wastewater, landfills and treatment plants. The 2021 Census enabled more precise calculations because the previous years were based on approximate estimates of the SSO, which were now corrected by them for the entire time series from 2003 to 2021. New geospatial databases such as CLC+Backbone were applied in the FOLU sector, which enabled clearer categorization, correction of incorrectly classified areas and better assessment of emission sinks. The QA/QC process was significantly strengthened through parallel checks, comparative analyses, but also workshops with institutions, at which additional inconsistencies were identified, especially related to the IPCC software. This systematic verification contributed to greater precision, transparency and cross-sectoral harmonization in the new time series.

Methodological improvements are a strategic prerequisite for a sustainable national inventory. They ensure greater certainty in trends, more harmonized calculations, and greater confidence in the policy analyses resulting from them.

The analysis of key categories, according to the IPCC methodology (2006 Guidelines), was carried out in two manners – according to the level of emissions (level assessment), that shows which categories have the largest share in total emissions in a given year, and according to the trend of emissions (trend assessment), that shows which categories have the most influence on the change in emissions over time. In this procedure, all categories are sorted based on their contribution to total emissions, from the largest to the smallest, and then, what is known as the cumulative emissions threshold is determined. According to the standard approach (Approach 1), all categories that jointly account for up to 95% of total emissions or the change in emissions are considered key categories.

The results of the analysis of key categories according to the Level Assessment clearly show that the Energy sector is the predominant source of greenhouse gases in Macedonia. The category “Energy industries – solid fuels” has the largest share with 24.9% (Figure 5), which underscores the key role of coal-fired electricity production in total national emissions. This result unambiguously indicates that any strategy for reducing emissions must begin precisely from the Energy sector. Immediately following are “Forest land that remained forest land” (17.2%) and “Road transport – liquid fuels” (15.4%), which together with energy account for more than half of total net emissions. In this case, the Forestry sector acts as a sink, indicating that forests should be preserved, while Transport shows a constant increase in emissions due to the increase in the number of vehicles and the consumption of petroleum derivatives. In the middle of the ranking are “Land converted to forest land” (5.0%), “Solid waste disposal” (4.5%) and “Manufacturing industries and construction – liquid fuels” (4.0%), which also indicate a significant contribution that should be given priority. Agricultural activities, especially enteric fermentation (3.6%) and direct N₂O emissions from managed soils (2.0%), have a smaller share, but are nevertheless relevant within the agricultural sector. The assessment of the level of key categories in 1990 and 2022 is provided in Annex 2.

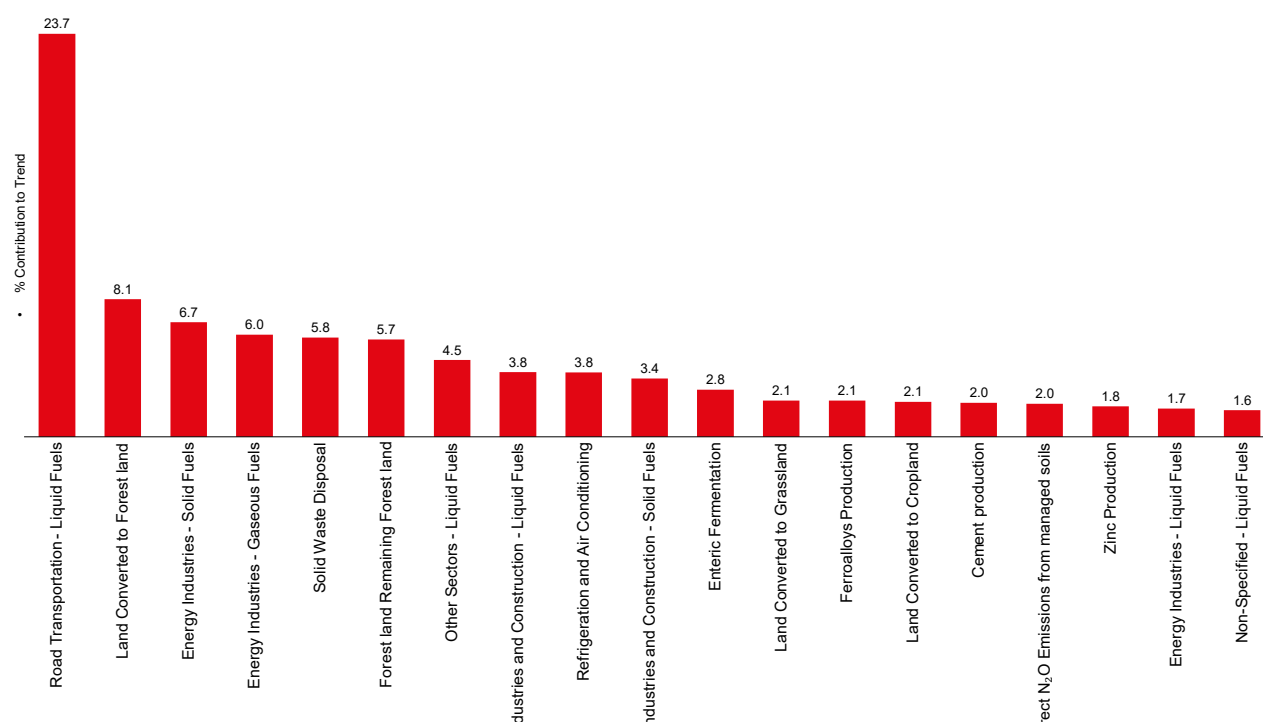
Figure 5 Estimation of the level of contribution of key categories and their share in emissions in 2022



Source: NID 2020-2022

The role of transport is also underscored by the trend analysis, with transport at the top with around 24% (Figure 6) due to having the largest change in emissions from 1990 to 2022. The growth of transport has paralleled economic expansion, higher levels of mobility and urban development. This trend is particularly important because it shows that unlike energy, where trends vary, transport is a sector with consistent emissions increase and therefore its significance in future policies will continue to increase.

Figure 6 Contribution of key categories to the emissions trend (1990, 2022) in percentage (%)



Source: NID 2020-2022

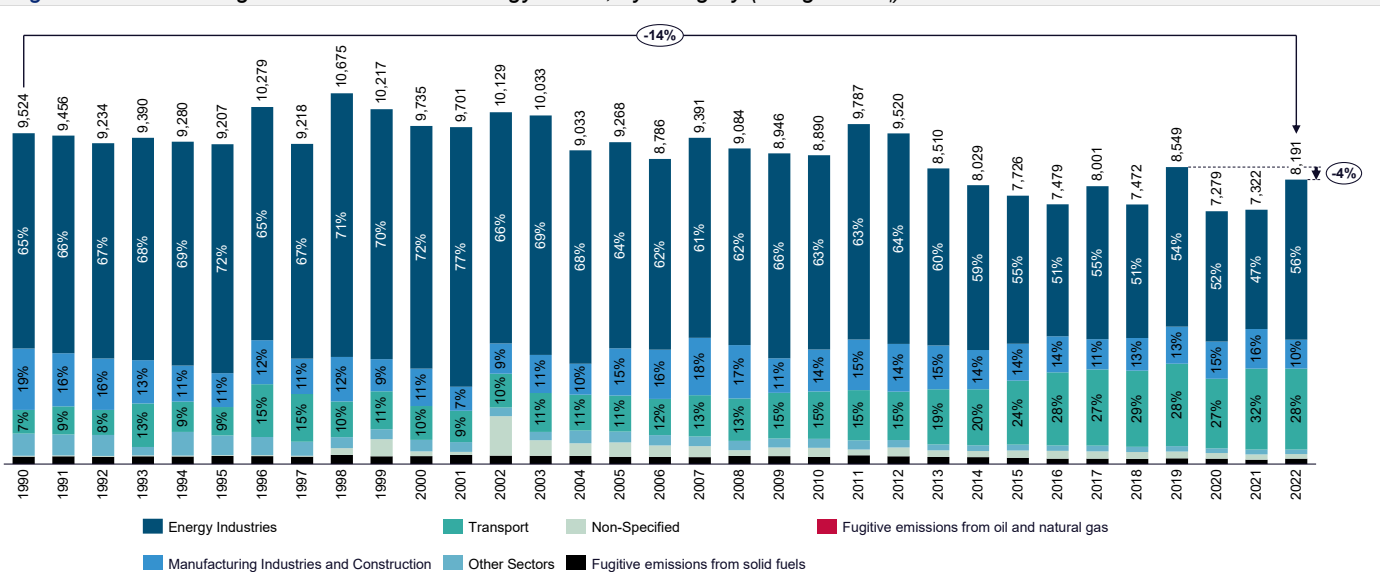
1.2 ANALYSIS OF GREENHOUSE GAS EMISSIONS BY SECTOR

1.2.1 ENERGY

Total emissions from the Energy sector in the period 1990–2022 change from year to year, with a constant predominance of the Energy Industries category, whose share usually ranges between 47% and 77% of total emissions. The initial years were characterized by high values, over 9,000 Gg CO₂-eq, with a peak in 1998, when emissions exceeded 10,600 Gg CO₂-eq (Figure 7). After 2011, as a result of reduced lignite production, increased electricity imports and structural changes in the energy system, a gradual decline in emissions began from around 9,800 Gg CO₂-eq, they were reduced in 2022 to around 8,200 Gg CO₂-eq. A comparison of 2022 with 1990 shows that emissions have decreased by 14%.

It should also be emphasized that one of the key reasons why total greenhouse gas emissions from the Energy sector are not decreasing significantly despite the reduction in coal-fired electricity production and its partial replacement with natural gas is precisely the continuous increase of emissions from the Transport sector. This sector has recorded a long-term and stable increase in the consumption of liquid fuels, which resulted in increased CO₂ emissions and in some way neutralizes the effect achieved by reducing coal consumption. Hence, transport represents a structural factor that limits the net effect of the transition in the electricity subsector. Expressed in numbers, Transport is the only sector with continuous growth, from 679 Gg CO₂-eq in 1990 to 2,328 Gg CO₂-eq in 2022, which reflects primarily increased motorization, but also increase in the transport of passengers and goods. In contrast, emissions from Manufacturing Industries and Construction are halved (from 1,771 Gg in 1990 to 832 Gg in 2022).

Figure 7 Greenhouse gas emissions in the energy sector, by category (in Gg CO₂-eq)



Source: NID 2020-2022

1.2.2 INDUSTRIAL PROCESSES AND PRODUCT USE

The Industrial Processes and Product Use (IPPU) sector covers several industrial branches: the mineral industry, the chemical industry, the metal industry, the use of solvents and other chemical products, the electronics industry, and the use of products that serve as substitutes for substances that deplete the ozone layer. It is important to distinguish between emissions generated from industrial processes, which are reported in the IPPU sector, and emissions from the combustion of fuels in the industry, which are reported in the Energy sector. In other words, the IPPU measures the impact of the production processes themselves, and not the energy consumption required to carry them out.

It should be emphasized that in the years following 2020, the industrial sector in the Republic of North Macedonia faced a dual challenge: the consequences of the Covid-19 pandemic and the subsequent energy crisis. These events temporarily reduced industrial activity, which contributed to total emissions from the IPPU sector in 2022 reaching a level of 716 Gg CO₂-eq, which represents a decrease of 22.6% compared to 1990.

During the analysed period, there has been a gradual decline in emissions from the metal industry, which, due to restructuring and reduced production, has reduced its share from 64% in 1990 to 9% in 2022. At the same time, the mineral industry has increased its share and became the predominant source of emissions, with around 50% of the sector's total emissions, while the category of use of products that serve as substitutes for ozone-depleting substances has grown and reached 40% in 2022.

SF₆ emissions have not been estimated due to lack of data.

1.2.3 AGRICULTURE

The sector covers greenhouse gas emissions from livestock farming, i.e. emissions from enteric fermentation (the biological activities of domestic animals), manure management, as well as soils and other agricultural activities, which include the emissions from fertilizer use and land cultivation.

Total greenhouse gas emissions from agriculture expressed in CO₂-eq have decreased from around 1557 Gg in 1990 to approximately 1200 Gg in 2022, representing a total reduction of around 23%. The maximum emissions from the Agriculture sector were reached in 2017 with around 1720 Gg CO₂-eq, which is primarily due to the use of a higher Tier 2 methodology for calculating emissions from enteric fermentation in dairy cows and manure management from farms. If only the period when the Tier 2 methodology was implemented is observed, it can be noted that emissions have decreased by around 30% (2022 compared to 2017).

Livestock farming has a dominant share in total emissions in the Agriculture sector throughout the entire period under consideration. The share of Livestock farming in the period 1990-2016 (when using the Tier 1 methodology) is around 77–83%, and in the period 2017-2022 it is within 67%–71% (when using the Tier 2 methodology). Although there is an increase in emissions in 2017, it should not be associated with an increase in the number of livestock, but exclusively with the application of the higher Tier 2 methodology. Basically, there is a decrease in emissions throughout the entire period, which is mainly due to the decline in the number of livestock in the country. It should be emphasized in this section that in the subsequent inventory, the team will make an effort to approximate the Tier 1 emission factors so that

they correspond to the emission factors obtained with the Tier 2 methodology in order to obtain a consistent series. Arable soils are the second subcategory with the largest share of emissions in the Agriculture sector, accounting for around 30% in the last six years (2017-2022).

1.2.4 FORESTRY AND OTHER LAND USES (FOLU)

The Forestry and Other Land Use (FOLU) sector is the only sector in the national greenhouse gas inventory that has a net absorption effect and acts as a carbon sink. Unlike other sectors that emit CO₂, CH₄ and N₂O, this sector, through biological growth processes, biomass accumulation and long-term carbon storage in soils and wood, manages to absorb a larger amount of CO₂ than it releases. This sector covers six land categories, forests, arable land, pastures, wetlands, urban areas and other land, as well as the conversions between them.

For most of the period under review, this sector has consistently generated negative net emissions (approximately – 1,500 to –3,000 Gg CO₂-eq), indicating sustainable biomass management. Extreme deviations, such as the positive peak in 2000, 2007, 2012, 2017, 2019, are a typical example of a disruption in sink capacity and are most often associated with forest fires, diseases, intensive logging, extreme climate conditions or revisions in methodology and land activities. In the case of the Republic of North Macedonia, these are fires.

1.2.5 WASTE

The categories covered within this sector are: solid waste disposal, biological treatment of solid waste, incineration and open burning of waste, as well as wastewater treatment and discharge, in accordance with the IPCC methodology.

According to the Greenhouse Gas Inventory of the Republic of North Macedonia for 2020–2022, emissions in the Waste sector increased by 60.8% in the period 1990–2022, increasing the share of this sector in total emissions from 4.2% in 1990 to 7.6% in 2022. Namely, the following categories contribute to greenhouse gas emissions: solid waste disposal, biological treatment of solid waste, incineration and open burning of waste, and urban wastewater treatment and discharge. Solid waste disposal is the category with the largest share in emissions from this sector.

Detailed analyses, methods and data on greenhouse gas emissions are provided in the National Inventory 2020 - 2022 (NID), submitted as a separate document with this BTR1, available at www.klimatskipromeni.mk -

<https://api.klimatskipromeni.mk/data/rest/file/download/2dad5238423bda958fb300251a8f93831fd8567d31ad8566b4d56489f6e70356.pdf>

2 MONITORING THE PROGRESS TOWARDS ACHIEVING THE NATIONALLY DETERMINED CONTRIBUTION

2.1 NATIONAL CIRCUMSTANCES

2.1.1 GOVERNMENT STRUCTURE

The Ministry of Environment and Physical Planning (MoEPP) has been designated as the National Focal Point for the United Nations Framework Convention on Climate Change (UNFCCC) and is the key government body responsible for policy-making in relation to the provisions of the UNFCCC ("Official Gazette of the Republic of Macedonia" No. 61/97). The Ministry is responsible for drafting of legislation, policy development and reporting on climate activities. The Ministry employs a State Advisor on Climate Change, whose main task is to initiate, coordinate and implement smart and scientifically justified policies in a transparent and inclusive manner in order to contribute to low-carbon development and building a society more resilient to climate change. The MoEPP has also established a Climate Change Unit within the Sector for Sustainable Development and Investments; however, during the reporting period, no civil servants were employed in the unit, which was established exclusively for matters related to climate change. The Macedonian Environmental Information Centre within the MoEPP has an important role in collecting, processing and reporting relevant environmental data, as well as in monitoring and reporting on air quality. However, there is no separate climate change department. This sector, in coordination with the State Advisor on Climate Change, does report on climate change as well.

The Ministry of Energy, Mining and Mineral Resources (MEMR) was established in 2024, with sectors that were previously part of the Ministry of Economy. MEMR is responsible for developing and implementing the energy policy of the Republic of North Macedonia, including preparing the NECP and reporting on its progress, in cooperation with the MoEPP.

The Ministry of Economy and Labor is also an important institution for implementing climate action in the country, supporting the growth of small and medium-sized enterprises, as well as women's entrepreneurship, improving the competitiveness of national industry, taking into account the industry's obligations arising from the EU harmonization process.

The Ministry of Agriculture, Forestry and Water Economy (MAFWE) is responsible for climate change mitigation and adaptation in the agricultural sector, land use, forestry and water.

The Ministry of Transport is responsible for the construction sector, in regard to land use planning, as well as freight transport, and issues related to commercial aviation. In regard to adaptation, its responsibilities may be relevant to aspects of climate-resilient infrastructure and land use planning.

The Civil Aviation Agency is responsible for the implementation of the National Aviation Legal System. In regard to climate change aspects, the Agency voluntarily participates in the UN Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), which is an international mechanism very similar to the EU ETS.

The Ministry of Health and, within the Ministry, the Institute of Public Health, is responsible for all aspects related to the impacts of climate change on human health. It has a major role in climate change adaptation measures, namely the implementation of the Strategy and the Action Plan for Health Adaptation to Climate Change.

The Ministry of Interior is responsible for establishing and managing a vehicle registry, as well as for supervising compliance with emission standards for road transport vehicles.

The Ministry of Finance manages budget allocations; however, climate budgeting is not yet clearly defined in national legislation.

The Ministry of Social Policy, Demography and Youth is the focal point for gender and climate perspective.

The Ministry of Culture and Tourism is responsible for protecting cultural heritage from the impacts of climate change, through defining and implementing adaptation measures. In addition, this Ministry is responsible for addressing the effects of climate change on tourism and developing adaptation strategies.

The Crisis Management Centre (CMC) has a fundamental role in the country's crisis management system and has responsibilities in prevention, early warning, crisis mitigation, recovery and coordination. The Centre includes 35 regional crisis management centres across the country. It is the national disaster management authority with responsibility for prevention, preparedness, response and early recovery.

The Hydrometeorological Service (HMS) is responsible for conducting measurements, monitoring and research related to climate-meteorological and hydrological parameters in the country. It also provides early warnings for meteorological and hydrological hazards. HMS is involved in the development of climate scenarios, extreme weather events, etc.

Local self-government units (municipalities and the City of Skopje) develop local climate action plans and implement climate change mitigation measures. Over the past decade, with support from UN Women, municipalities have implemented programmes addressing gender equality, including those in environmental protection and municipal services. From 2020 to 2023, UNDP worked with municipalities and public enterprises to integrate gender components into climate change programmes.

Although not part of the government structure, institutions such as **the Macedonian Academy of Sciences and Arts (MANU)**, **the University "Ss. Cyril and Methodius" of Skopje (UKIM)**, **the University "Goce Delchev" of Shtip (UGD)** and others, have been involved in the preparation of national strategies and plans related to climate change, continuously from the very beginnings of the process of national reporting on climate change, until today.

Representatives of non-governmental organizations working in the field of environment and climate change, as well as in gender-responsive budgeting, have a major role in awareness-raising activities, conducting research, and supporting municipalities in adaptation and mitigation efforts.

2.1.2 POPULATION

According to the latest Population Census of 2021,¹ the total population stands at 2,097,319 persons. The total permanent population stands at 1,836,713 persons. The total non-permanent population, which includes citizens of the Republic of North Macedonia absent abroad for more than 12 months and foreigners temporarily present in the Republic of North Macedonia for less than 12 months, stands at 260,606 persons. The number of persons for whom data was taken from administrative sources is 132,260 or 7.20% of the permanent population.

As in many other countries, the population moves to cities in search of employment. Approximately 25% of the population lives in the capital city of Skopje, located in the northern part of the country. Other major cities are Bitola, Kumanovo, Prilep, and Tetovo. The country is administratively divided into 80 municipalities, with the City of Skopje being a separate unit consisting of ten municipalities. The Republic of North Macedonia also experiences high rates of permanent and seasonal emigration.

The Republic of North Macedonia is divided into eight planning regions, which are non-administrative units established for statistical, economic and regional development, in accordance with the EU NUTS Nomenclature. These regions are: Skopje, Polog, Northeast, East, Southeast, Vardar, Southwest and Pelagonija.

2.1.3 GEOGRAPHICAL PROFILE

The Republic of North Macedonia is located in Southeast Europe, in the central part of the Balkan Peninsula and covers an area of 25,713 km². The capital city is Skopje.

There are at least 31 recorded wetlands on the territory of the country, including the large natural lakes of Ohrid, Prespa and Dojran, as well as several swamplands such as Monospitovsko Blato, Katlanovsko Blato and Badarsko Blato.

In regard to land use, the landscape is predominated by forests and semi-natural areas (about 60%), followed by agricultural land (approximately 36%), according to the CORINE Land Cover (CLC) methodology. Other land use categories include water bodies (about 2.2%) and artificial areas (such as urban areas). According to CORINE CLC Level-3 (2018), the total area of water bodies/wetlands is 54,899 hectares, urban areas (settlements) cover 44,764 hectares, while other lands account for 31,522 hectares.

In regard to land ownership, in 2021, 12.01% of women were land owners, while 87.99% of men were owners. Of these, 50% of female owners do not actively participate in decision-making processes related to land activities.

The geology of North Macedonia is defined by several tectonic units, including the Pelagonijan Massif, the Vardar Zone, and the Serbian-Macedonian Massif, which contain a variety of rocks – from Proterozoic crystalline rocks, through

¹ 2021 Population Census (https://www.stat.gov.mk/PrikaziSooopstenie_en.aspx?rbrtxt=146)

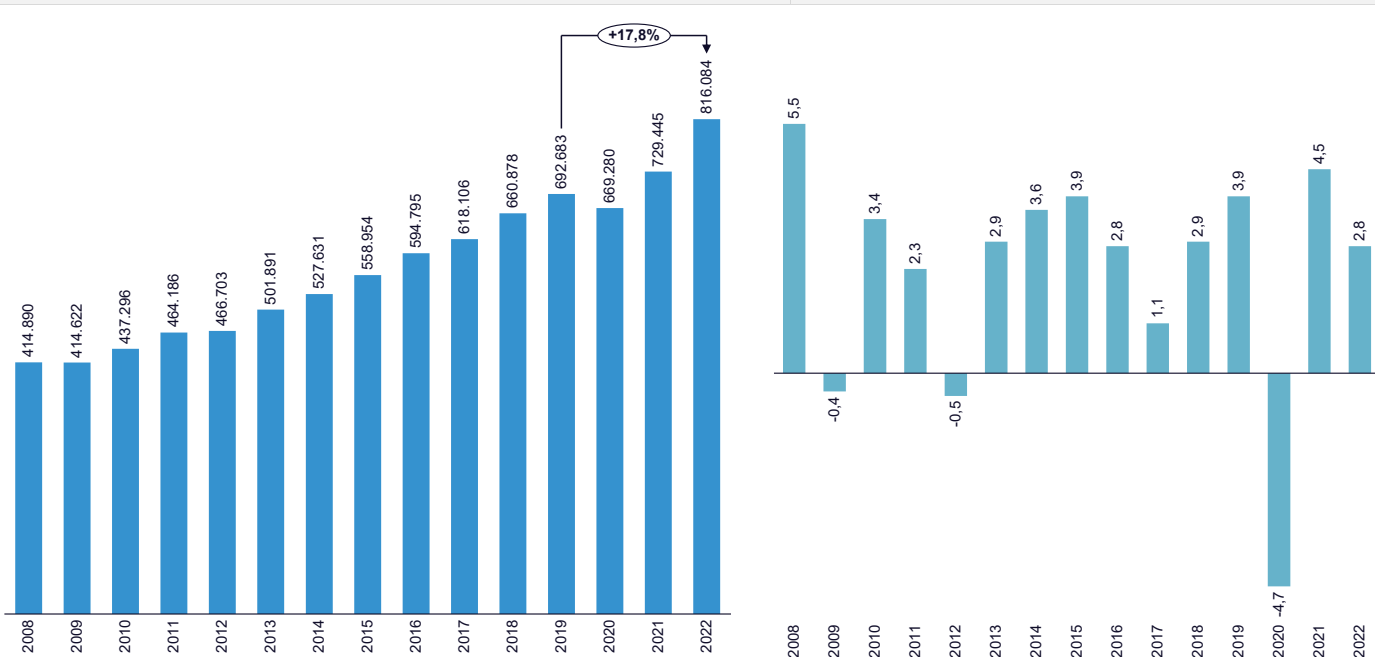
Paleozoic-Mesozoic metamorphic and igneous rocks, to Neogene-Quaternary sedimentary deposits. The country is rich in minerals such as antimony, copper, gold, and iron, which contribute to the developed mining industry.

2.1.4 ECONOMIC PROFILE

As a small country in terms of area and population, the Republic of North Macedonia has a relatively open economy, where foreign trade accounts for more than 90% of GDP. According to the data from the SSO, the gross domestic product in 2022 amounted to 816,084 million denars and compared to 2019 it has nominally increased by 17.8% (Figure 8). The real GDP growth rate in 2022 was 2.8% (Figure 9). Final consumption in 2022 in the GDP structure participated with 84.6%. The value of investments in fixed assets in 2022 amounted to 196,027 million denars.²

Figure 8Gross domestic product (GDP) of the Republic of North Macedonia

Figure 9Real GDP growth rate

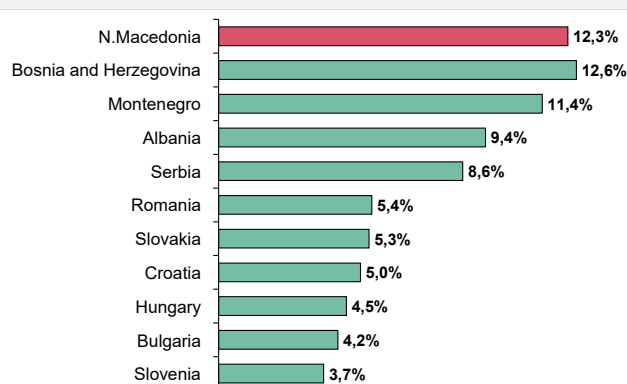
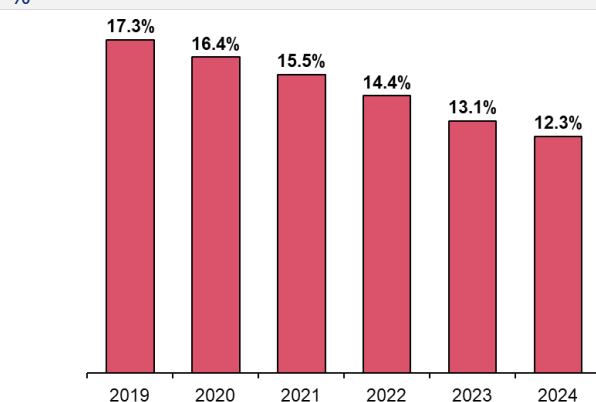


Source: SSO, team analysis

The Republic of North Macedonia has a relatively high unemployment rate, with the country positioned among the economies with higher unemployment levels in the region despite the downward trend in the past period (Figure 10 and Figure 11). Despite the positive developments, the employment structure remains unfavourable, especially in regard to gender representation. The gender gap has been present for a longer period of time and is related to the structural characteristics of the labour market, economic and social conditions, as well as the mismatch between labour supply and demand. In 2024, the employment rate for women was 49.6% (about 292 thousand persons), while the employment rate for men was 66% (about 392 thousand persons), of the active population aged 15 to 64.

Figure 10Unemployment rate in North Macedonia, 2019 – 2024, %

Figure 11Unemployment rate in CEE and SEE, 2024, %



Source: Eurostat; INSTAT; MONSTAT, team analysis.

²SSO: GDP in 2022, https://www.stat.gov.mk/pdf/2024/3.1.24.06_mk.pdf

Additionally, temporary employment among young people (15–29 years old) is twice as high as among adults (Table 2), as they are unable to find permanent jobs. The majority of temporary employed are men.

<i>Table 2 Temporary employment among young people (15–29 years old)</i>			
Sector	Men	Women	Total
Total employed	465,066	330,021	795,087

According to data from the State Statistical Office, in the first quarter of 2022, the labour force in the Republic of North Macedonia amounted to 811,197 persons, of whom 691,498 were employed, while 119,699 were unemployed.

Unemployment and inactivity among youth and women remain high despite a decrease in the overall unemployment rate. By the first half of 2020, more than 50% of women over the age of 15 did not participate in the labour market. The Republic of North Macedonia recognizes this problem as a long-term structural challenge and is taking numerous measures to address it, such as the EU Youth Programme³.

Despite the improvement in wage levels, there is still a significant gap in regard to gender equality. Female employees receive approximately 18–19% lower wages than male employees.

In 2022, the three sectors with the highest average monthly gross salary per employee were:

- Information and communication sector (1300 euros gross/month),
- Financial and insurance activities (1130 euros gross/month) and
- Mining and quarrying (1108 euros gross/month).

Two of these sectors employ a predominantly male population, while the financial and insurance sector employs predominantly women.

The lowest paid sectors with an average gross salary below 600 euros are:

- Water supply, sewage, waste management and remediation activities (586 euros gross/month),
- Administrative and support service activities (526 euros gross/month) and
- Accommodation and catering (463 euros gross/month).

The results of the Business Ready 2024 Index indicate that North Macedonia has a relatively favourable business environment, especially in terms of the availability of infrastructure services and the conditions for establishing businesses, which creates favourable preconditions for attracting private investments. However, the identified weaknesses in areas such as international trade, the labour market and financial services indicate the need for further institutional and regulatory improvements. Improving the business climate is key to mobilizing the private capital necessary to finance climate change mitigation and adaptation measures (Figure 12).

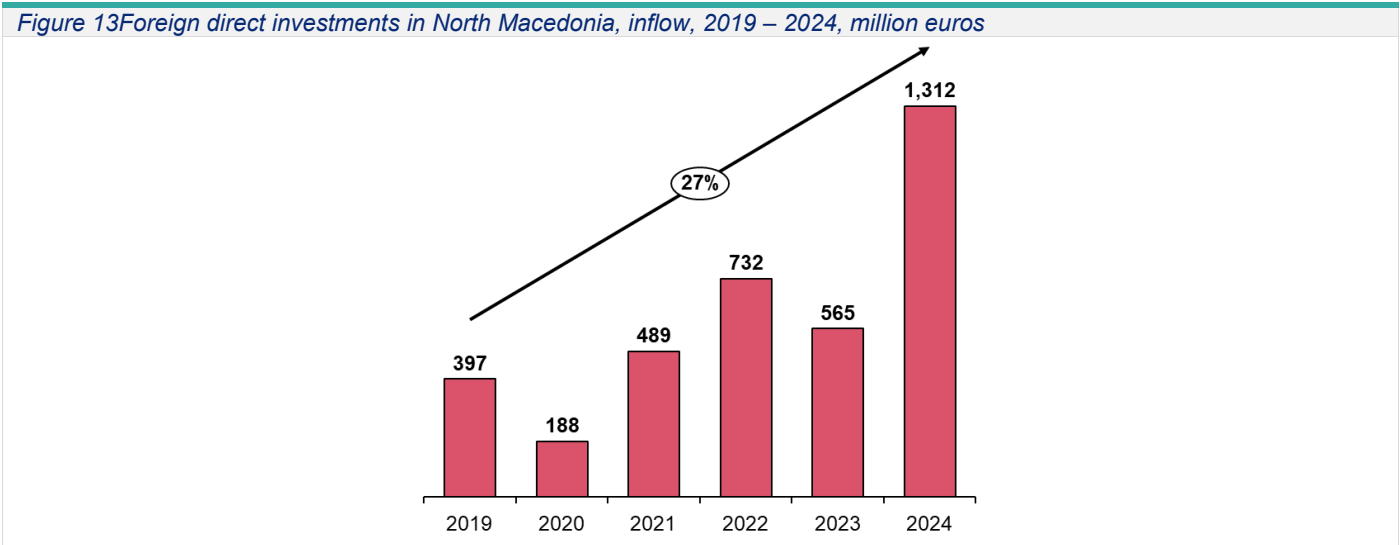
Figure 12. *Business environment by category, 2024*

Category	Description	Performance (0 – 100)
Establishment of business entities	Assesses regulations, digital services, and operational efficiency related to business entry	90.83
Location of business entities	Assesses regulations, governance, and the efficiency of procedures for selecting a business location	55.68
Infrastructure services	Key services supporting business operations: electricity, water, and internet	78.44
Labour force	Assesses good practices in employment regulations from the perspective of companies and employees	70.4
Financial services	Assesses regulations, availability of information, and efficiency	73.42
International trade	Assesses regulations, the quality of public services, and operational efficiency for import and export	65.34
Tax system	Fiscal system and private sector support	46.84
Dispute resolution mechanisms	Resolution of business disputes through court proceedings and alternative dispute resolution mechanisms, such as arbitration and mediation	61.1
Market competition	Assesses the quality of regulations, the quality of public services, and the implementation of key services for promoting market competition	62.26
Insolvency	Assesses the quality of regulations, the quality of institutional and operational infrastructure, and the operational efficiency of resolving insolvency proceedings through courts	60.09

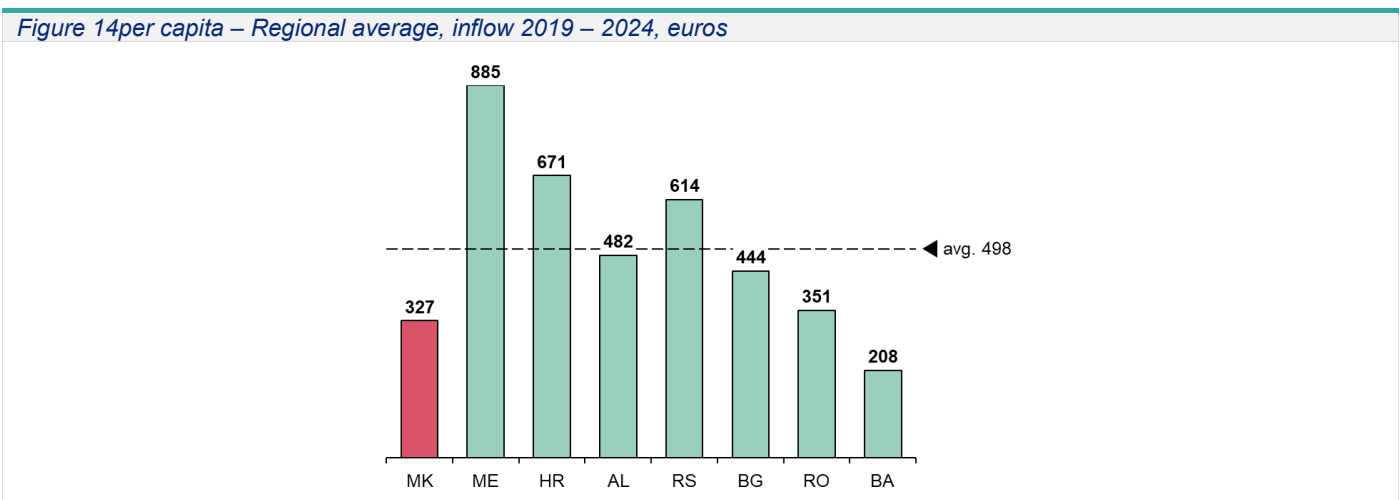
³ <https://av.gov.mk/youth-guarantee.nspx>

Source: World Bank - "Business Ready 2024" Report, team analysis

The energy sector has significant potential to attract foreign direct investments (FDI), which is a key factor for economic development and for financing climate change mitigation and adaptation measures. Globalization has increased the importance of foreign direct investments, especially for developing countries such as North Macedonia. Due to limited domestic financial and investment capacity, it is in the interest of all developing countries to achieve a more favourable investment climate and better working conditions. In addition, the entry of new foreign companies may stimulate the modernization of domestic companies, improve their performance and contribute to the promotion of economic development and competitiveness of the economy. In the long term, such economic trends create positive externalities. The inflow of foreign direct investments in North Macedonia in 2024 amounts to 1,312 million euros (Figure 13) and indicates increased confidence of foreign investors in the macroeconomic stability and the business environment of the country. The average amount per capita for the period 2019–2024 is 327 euros, which is significantly below the level of the countries in the region and below the regional average (Figure 14).



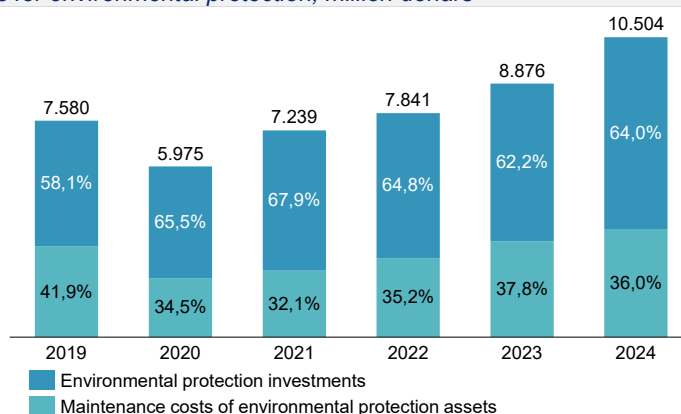
Source: United Nations – World Investment Report 2025, team analysis



Source: United Nations – World Investment Report 2025, Eurostat, team analysis

The attitude of the private sector towards environmental protection is perceived through investments and expenditures for prevention, reduction and elimination of the degradation of natural resources and pollution. Environmental protection expenditures represent a set of investments and current expenditures for undertaking activities related to environmental protection. Environmental expenditures include the following types of expenditures: ambient air protection; soil protection; water protection; wastewater and waste management; noise reduction; biodiversity protection; protection against radiation; R&D related to the environment and other investments and current expenditures related to environmental protection. The expenditures and the investments partially cover measures related to decarbonization and development of a circular economy, which are key pillars of the Green Agenda for the Western Balkans. The data indicate a growing trend of these investments in the Macedonian business sector, with around 10,504 million denars allocated for environmental protection in 2024 (Figure 15). These data indicate that the Macedonian business sector is already contributing to reducing negative impacts on the environment, creating a basis for further investments in green technologies and climate change adaptation and mitigation measures.

Figure 15 Investments and costs for environmental protection, million denars



Source: State Statistical Office (MAKStat database), team analysis

2.1.5 CLIMATE

The Republic of North Macedonia has diverse climatic characteristics. Direct climatic influences from the north, through the Kumanovo-Preshevo Valley, determine the emergence of a moderately continental climate, and the openness of the Vardar Valley to the south and the north is a factor through which the Mediterranean climatic influences from the Aegean Sea, on the one hand, and the cold air masses from the north, on the other hand, penetrate unhindered.

The coldest region is the Polog region, where the average air temperature is around 7°C in the mountainous western part, in the mountainous part of the Southwestern region, the Pelagonija region and the extreme part of the Eastern planning region (the Osogovo and the Maleshevo mountains) around 9°C. In the Pelagonija and Northeastern regions, the air temperature reaches 13°C, and average temperatures above 13°C are observed along the Vardar River in the Vardar region, the Southeastern region and parts of the Eastern and Skopje regions. The warmest region is surely the Southeastern region with an average temperature of around 15°C.

The annual cycle of temperature regime shows four distinct seasons, hot and dry summer and relatively cold winter, which are interconnected by relatively short transitional seasons of spring and autumn. The average summer temperature ranges from 16°C in the mountainous areas to 26°C in the Southern part of the country. The absolute maximum air temperature in the Vardar region was 45.7°C, which was measured in Demir Kapija in 2007. The average air temperature in winter varies from -1°C in the mountainous areas to 5°C in the Southeastern part of the country. In the Eastern region, the absolute minimum of air temperature was measured at -31.5°C, in Berovo in 1996. The average temperatures show that autumn is warmer than spring.

There is a large difference in the spatial and the temporal distribution of the types and amounts of precipitation. Annual precipitation amounts increase with altitude. The average annual precipitation for the multi-year period on the territory of the Republic of North Macedonia is lowest, below 500 mm, in the central part of the country, covering parts of the Vardar and Eastern regions. Parts of the Skopje, Northeastern, Pelagonija and Southeastern regions reach up to 700 mm. The mountainous parts of the Polog and Southwestern regions have the most precipitation, more than 1000 mm/year.

Based on historical meteorological measurements on the territory of the country and the latest models for regional climate scenarios, scenarios have been developed for the change in the main climate indicators, air temperature and precipitation by the end of this century. Based on them, it is highly likely that the Republic of North Macedonia will face a warmer and drier climate in the future, with increased frequency and intensity of extreme weather events. The amplitude of these changes is directly related to and depends on the intensity of global warming and the concentration of greenhouse gases. Thus, in the case of the most pessimistic scenario - RCP8.5, there is a high probability of an increase in the maximum air temperature of up to 5°C by the end of 2100.

For the needs of BTR1, indices were analysed through measured daily values of meteorological elements in the period from 1951 to 2022, in accordance with the guidelines and the recommendations of the World Meteorological Organization, the Guidelines for Defining and Monitoring Extreme Weather and Climate Events and the methodology from the Guidelines for Analysing Climate Change Extremes as Support for Adaptation Decisions. The full technical report from the HMS can be downloaded from the online portal www.klimatskipromeni.mk under the title: *Identification and Analysis of Extreme Climate Events in the Republic of North Macedonia (2025)* –

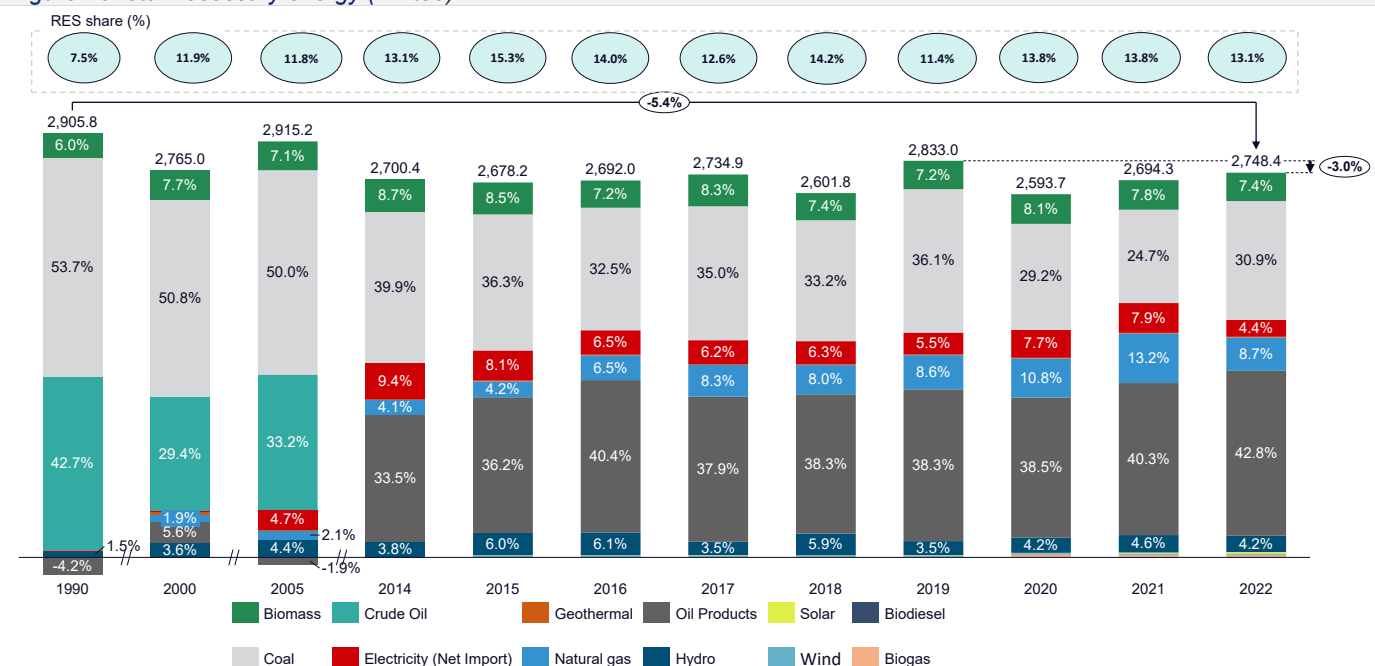
<https://api.klimatskipromeni.mk/data/rest/file/download/adf96df7b63113ae781469a28b606156c06b5bf8ce5e6aabdc9a61ee14ec4731.pdf>

2.1.6 DESCRIPTION BY SECTOR

Energy sector

The energy sector of the Republic of North Macedonia has traditionally been based on fossil fuels; however, in the past three decades there has been a gradual diversification of sources. In 1990, fossil fuels accounted for over 95% of total primary energy consumption, while in 2022 their share decreased to around 84% (Figure 16). Total primary energy in the period 1990-2022 decreased by 5.4%, while 2022 compared to 2019 showed a decrease of 3%. Although the decrease is relatively modest, it indicates a gradual transition to cleaner energy sources and the increasing role of renewable energy sources (RES), whose share increased from around 7.5% in 1990 to around 13% after 2022. At the same time, electricity imports, which in 1990 were almost negligible (0.2%), today represent a significant part of the energy balance, reaching around 5–6% of total consumption. This trend reflects Macedonia's dependence on external sources of electricity in years with lower domestic production, especially in seasons when hydropower potential is limited due to reduced rainfall and snowfall.

Figure 16 Total necessary energy (in ktoe)

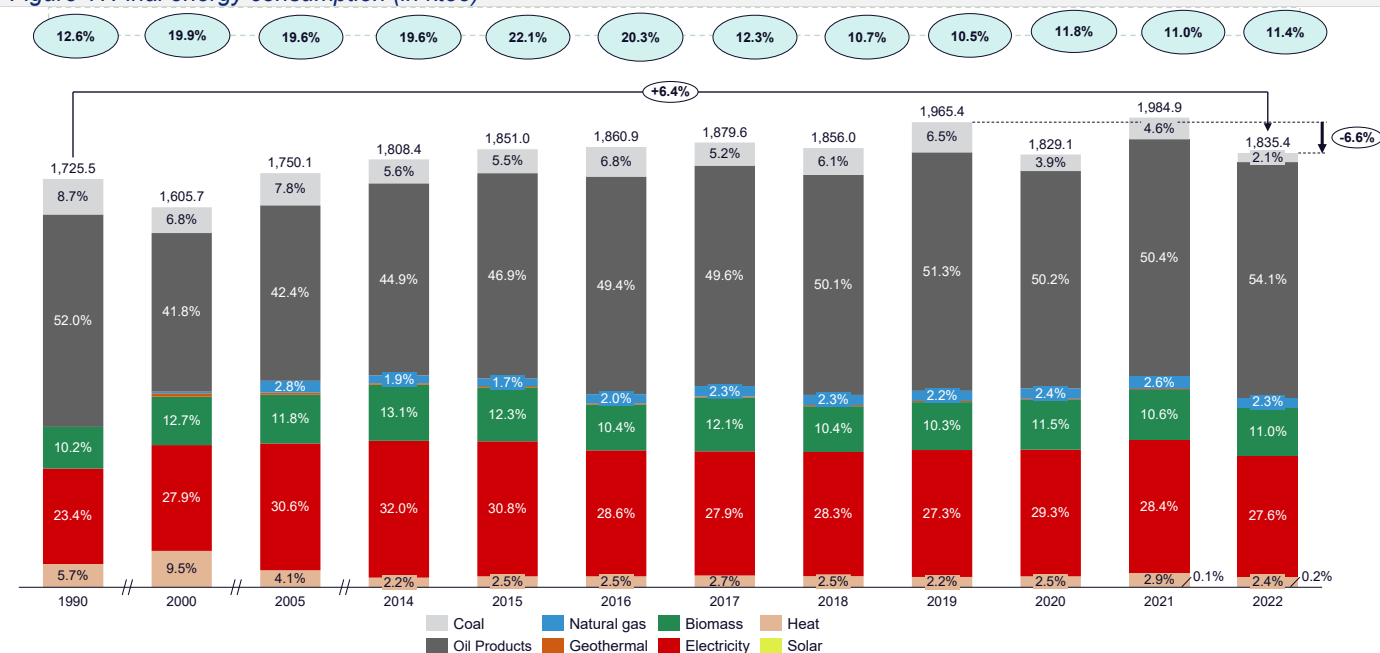


Source: IPCC software, team analysis

On the other hand, when analysing final energy consumption, i.e. the energy used by households, transport, industry and the commercial and the public sectors, a different dynamic is observed. In 2021, a maximum of almost 2,000 ktoe was reached, which is about 15% more than in 1990; however, in 2022 there was a decrease of over 7.5% compared to 2021 (Figure 17). Oil products are the most abundant energy source with about 50% share in the entire period, followed by electricity (28%), biomass (about 11%) and thermal energy and natural gas (about 2% each). These values indicate a stable, but slowly evolving structure of final consumption, where increased energy efficiency and new technologies gradually improve overall energy efficiency.

The fact that primary energy consumption is decreasing and final energy consumption is increasing indicates that the energy system is becoming more efficient, i.e. less energy is lost in the processes of production, transformation and transmission. This also means that the country today consumes less primary energy to provide the same or even greater volume of final energy, which means that technologies for production of electrical and thermal energy have improved, losses in the system have been reduced, and consumers are using more efficient devices. The increased share of renewable sources and natural gas is also contributing to this.

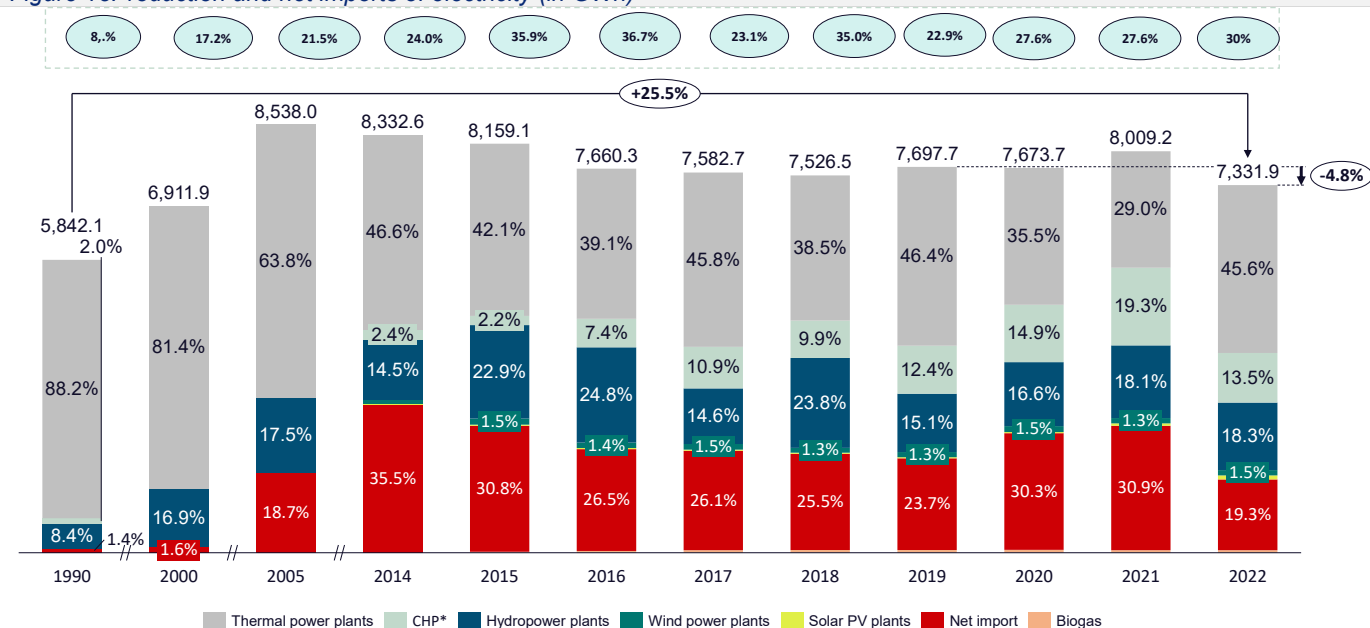
Figure 17 Final energy consumption (in ktoe)



Source: IPCC software, team analysis

Electricity together with biomass are very important energy sources for Macedonia, especially as domestic resources. Electricity production remains the most critical segment of the energy system. In 1990, thermal power plants accounted for 88% of the total electricity demand, and in 2021 their share decreased to 30% (Figure 18). At the same time, hydroelectric power plants and CHP increase their share to about 18% and 19%, respectively. New technologies such as solar and wind power plants have recorded significant, but still stagnant growth in the period under review.

Figure 18 Production and net imports of electricity (in GWh)



Source: IPCC software, team analysis

Note: In 1990 the value is for CHP (combined power plants) for own needs within industrial plants

Industrial processes and product use

The industry development in the Republic of North Macedonia in the past three decades is closely linked to the process of economic transition, from a centrally planned economy to a market-oriented system. In the 1990s, a significant decrease in industrial production was observed (Figure 19), as a result of the privatization, the restructuring, but also the closure of some of the existing industrial capacities, which also led to a decline in emissions in the IPPC sector.

The gradual increase in industrial activity in the Republic of North Macedonia is directly related to the increased inflow of foreign direct investments, especially after 2005. The entry of companies in the automotive industry and the production of electronic components has significantly changed the structure of the national industry. Thus, the share of traditional sectors such as metallurgy and the mining industry, which dominated industrial production and greenhouse gas emissions in the 1990s, has gradually declined, while the share of new, technology-oriented industries has increased.

However, despite these structural transformations, certain heavy industry capacities have remained active, and their production has in most cases remained at a stable or higher level compared to previous years (Figure 19), therefore they continue to represent a significant source of emissions in the IPPC sector. During the analysed period, a gradual decline in the emissions from the metal industry was noted, which due to restructuring and reduced production, reduced its share from 64% in 1990 to 9% in 2022 (Figure 19). At the same time, the mineral industry increased its share and became the predominant source of emissions, with about 50% of the total emissions in the sector, while the category of use of products that serve as substitutes for ozone-depleting substances is growing and reached 40% in 2022.

Figure 19 Production of cement, iron and steel and ferroalloys 1990-2022 (in kt)



Source: SSO, team analysis

It should be emphasized that in the years following 2020, the industrial sector in the Republic of North Macedonia faced a dual challenge: the consequences of the Covid-19 pandemic and the subsequent energy crisis. These events temporarily reduced the industrial activity.

Agriculture

Agriculture is the third largest economic sector in the Republic of North Macedonia. The share of agriculture in total GDP has remained relatively stable in recent years, with a share of approximately 10–12%, and if the processing industry related to agricultural production is included, the total share reaches 16–18%. According to the latest structural survey in agriculture, the total number of agricultural holdings is 178,125, of which 99.8% are family farms, while only 280 are registered business entities, i.e. agricultural activity enterprises. This structure shows that agriculture in the Republic of North Macedonia is predominantly small, fragmented and family-oriented, which has a direct impact on the productivity and the efficiency of production.

Livestock farming is a significant segment of the Macedonian agriculture and is closely linked to tradition, rural development and local markets, but faces structural challenges related to productivity and modernization. Although its share in the agriculture part of GDP has been declining in recent decades, this sector remains key in the context of greenhouse gas emissions, especially in the categories of enteric fermentation and manure management.

Macedonian livestock farming production is characterized by a dual structure, dominated by individual agricultural holdings, i.e. so-called family farms and large commercial livestock farms. Livestock farming production depends on the number of heads, average yields per head, but also on the quality of livestock nutrition, as well as investments in housing facilities and equipment used. The structure of Macedonian livestock farming production does not correspond to world trends due to the socio-economic and the natural conditions in the country, as well as the structure of agricultural holdings and tradition. Macedonian livestock farming production is gradually modernizing, with modest knowledge of modern livestock breeding technologies, which is certainly the reason for the low and weak productivity and uncompetitive products. There is a trend of decreasing the number of livestock heads; however, the productive characteristics and breed composition of livestock are improving. This trend indicates a gradual replacement of indigenous, low-productive livestock breeds with high-value heads that require strictly regulated nutrition and appropriate breeding conditions in order to achieve their genetic potential. Intensive climate change warns of the need to take adaptive measures in livestock farming, primarily raising awareness among stakeholders of selection and implementation of sustainable conservation of local populations and breeds. The main emphasis is placed on implementing breeding programmes in livestock farming that will lead to improved tolerance of farm animals to extreme climatic conditions, increased robustness and resistance of animals to diseases, as well as improved conversion for better utilization of available feed resources. By introducing these principles into the Programme for Protection of Biological Diversity in Livestock Farming ("Official Gazette of the Republic of Macedonia", 168/2018), preservation and use of genetic diversity is enabled among farm animal species and greater opportunities are provided in a shorter period of time to respond to the challenges brought on by climate change.

Greenhouse gas emissions from livestock farming production occur as a result of biological processes in domestic animals and the manner of manure management on farms. The amount of emissions depends on the type of animal, the breeding manner, the type and intensity of production, and on the practices used on farms to raise and manage livestock. The main greenhouse gases produced in livestock farming are methane (CH₄), nitrous oxide (N₂O) and ammonia (NH₃). They are emitted directly in the processes of respiration and feeding of animals, and indirectly through the decomposition of excreta (feces and urine) and their storage or use as manure. The number of heads in the last three years is presented in Table 3.

Table 3 Farm animal population data used for the Greenhouse Gases Inventory in Livestock Farming (number of heads)

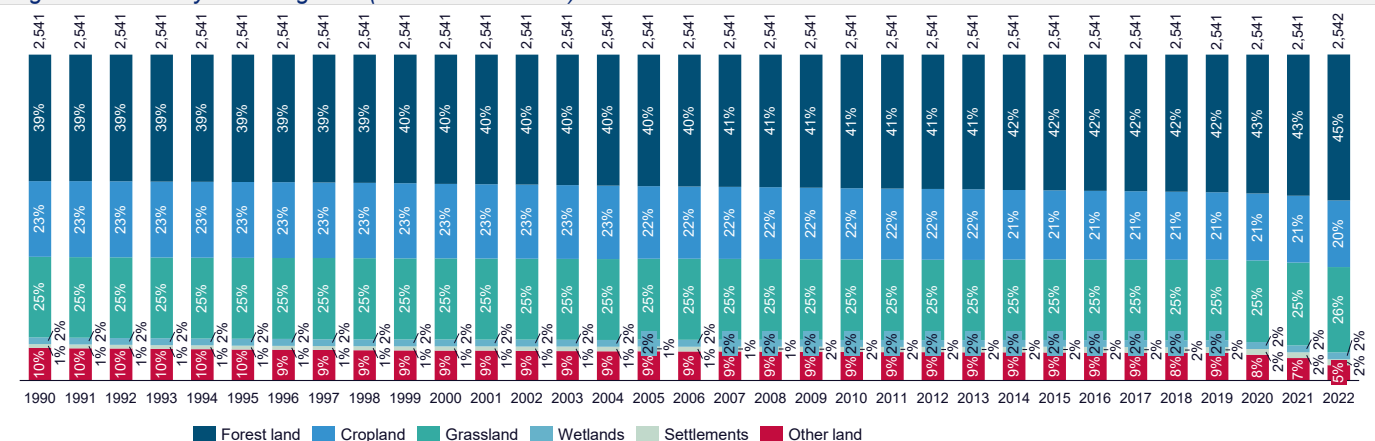
	Number of heads		
	2020	2021	2022
Total	2760191	2561115	2634456
Cattle	214991	177743	158824
Cattle - dairy cows	110206	105542	99606
Cattle - other	104785	72201	59218
Sheep	511116	524525	533175
Sheep up to one year	119518	108756	113313
Goats	77462	62450	63921
Goats up to one year	17546	13303	16265
Horses	12022	12165	12236
Adult pigs	18395	20331	21457
Finishers	145679	165815	161147
Laying poultry	1482348	1235894	1367092
Broilers	101268	97181	124332
Turkeys	13640	19143	13502
Other poultry	46206	123809	49192

Forestry and other land use

The Forestry and Other Land Use sector is the only sector in the national greenhouse gas inventory that has a net absorption effect and acts as a carbon sink. In the period 1990–2022, the land structure in Macedonia showed a clearly expressed long-term transformation, with forest areas gradually increasing their predominant role (Figure 20). The share of forests has been continuously increasing, from around 39% in the early nineties to almost 45% in 2022, which is in line with European trends of abandonment of agricultural areas. The abandonment of agricultural areas, i.e. arable land, leads to a gradual decrease, hence, from around 23% in 1990 its share dropped to around 20% towards the end of the analysed period. This trend indicates structural changes in the agricultural sector, reduced intensity of cultivation or transformation of part of agricultural areas into other categories. Pastures remain remarkably stable, at around 25% throughout the period, underscoring their role as a relatively constant component of livestock farming production. On the other hand, the consistency of pastures does not correspond to the livestock numbers, as shown in the previous chapter on livestock farming, where livestock numbers are significantly decreasing.

Urbanized areas, despite the growing pressure of population and infrastructure, range between 1% and 2%, which indicates moderate urbanization compared to regional trends. At the same time, the category of “other land” is decreasing, which generally reflects the conversion or natural transition of part of these areas to forest or agricultural categories. Overall, data for the period 1990–2022 indicate that Macedonia is characterized by strengthening forest ecosystems, moderate withdrawal of arable land and stability of pastures, which in turn fits into broader European patterns of land system transformation.

Figure 20 Areas by subcategories (in million hectares)



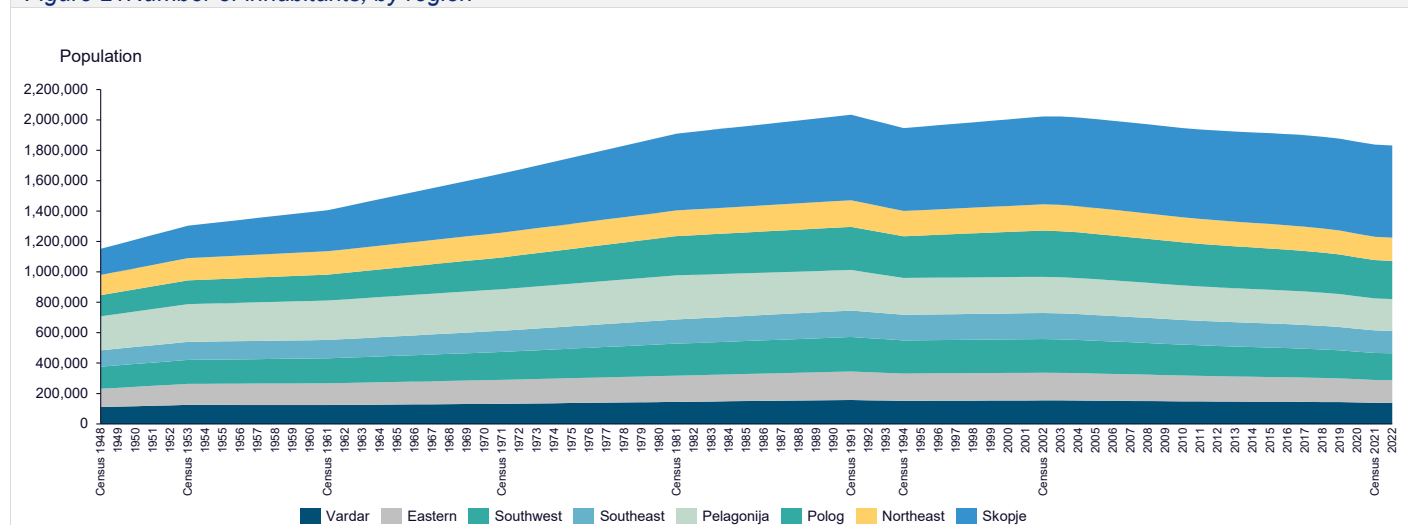
Source: IPCC software, team analysis

Waste

In the Republic of North Macedonia, there is only one landfill with an operating permit from the MoEPP (PE "Drisla"), and waste continues to be disposed of in substandard landfills that are not in compliance with the Landfill Directive and the national waste law. In order to address this challenge, according to the National Waste Management Plan 2020–2030, the priority is establishing an integrated system of regional centres for collection, selection, recycling and energy recovery of waste, in order to reduce the amount of waste ending up in landfills and gradually close illegal and substandard landfills.

Given the regional nature of addressing the waste problem, in the greenhouse gas inventory 2020-2022, for the first time, the Waste sector is analysed by region. One of the key input data is the number of inhabitants and it is entered for the period from 1950 to 2022 by region (Figure 21). The data are taken from the censuses conducted in the country in the years 1948, 1953, 1961, 1971, 1981, 1991, 1994, 2002. Interpolation has been done for the periods between the censuses. For the period from 2003 to 2023, updated data from the 2021 Census have been taken.

Figure 21 Number of inhabitants, by region



Source: State Statistical Office, Population Census and Revised data for the period 2003-2020, according to the 2021 Census

The amount of waste per inhabitant and the composition of waste are also key parameters in this sector. For that purpose, data for the entire period from 1950-2022 by region are used, according to the values provided in Table 4 and Table 5, respectively.

Table 4 Data on the amount of waste per inhabitant

Period	Value	Data source
1950-1990	260 kg/inhabitant	Estimated value (selected as a minimum value by all European countries in 1990)
1990-2003	Interpolation	/

2004	313 kg/inhabitant	According to the National Waste Management Plan 2006-2012 (https://www.moepp.gov.mk/wp-content/uploads/2014/12/Nacionalen-Plan-za-upravuvanje-so-otpad.pdf)
2005-2007	Interpolation	/
2008-2022	Data from the Statistical Office, by region	According to data on Municipal Waste Generated by Region and updated data on the number of inhabitants according to the 2021 Census

Table 5 Waste composition

Period	Data source
1950-1995	Data from IPCC Guidelines
1996-2015	Interpolation
2016-2022	Data on regions in Macedonia according to Regional Plans

In terms of landfill type, in 1950 it is assumed that all landfills belonged to the “Uncategorized” category, because there were no established landfills at that time. With the opening of the first organized landfill in a given region, part of the waste moved to the “Unmanaged Shallow” landfill type. As the amount of landfilled waste gradually increased, this type of landfill moved to the “Unmanaged Deep” landfill category. This classification process was carried out separately for each region and for each individual landfill, based on the available data on their development and capacity. The only landfill that falls into the “Managed” category is the “Drisla” landfill.

2.1.7 HOW NATIONAL CIRCUMSTANCES INFLUENCE GREENHOUSE GAS EMISSIONS AND SINKS OVER TIME

The national circumstances of the Republic of North Macedonia have a major impact on the trends of greenhouse gas emission and sinks, both historically and in terms of future development. These impacts arise from the structural characteristics of the economy, demographic trends, geographical conditions, energy system and institutional set-up.

The energy sector has a predominant role in the total emissions, which is directly related to the historical dependence on lignite and other fossil fuels for electricity production. This dependence results in a relatively high emission intensity of the economy, especially in periods of increased domestic electricity demand or reduced hydrological availability. At the same time, the gradual integration of renewable energy sources, as well as energy efficiency measures, have begun having a visible effect on reducing emissions in recent years.

Demographic and social factors, including urbanization and changes in the living standard, are affecting energy consumption, transport and waste. The increase in the number of vehicles and mobility leads to an increase in emissions in the Transport sector, which is one of the fastest growing sources of emissions in the country.

Geographical and climatic features, such as terrain, climatic conditions and distribution of natural resources, have a dual role. On the one hand, they affect the structure of the energy system (for example, the potential for hydropower and solar energy), and on the other hand, they affect the capacity of sinks, especially in the FOLU sector. Land use changes, forest fires and climate variations affect the ability of ecosystems to absorb carbon dioxide.

The impact of national circumstances on greenhouse gas emissions is presented in Chapter 1.2 “Analysis of greenhouse gas emissions by sector”. A detailed overview is provided in the Greenhouse Gas Inventory 2020-2022 and in the Climate Change Mitigation document developed in the process of preparing the BTR 1.

2.1.8 INSTITUTIONAL FRAMEWORK FOR MONITORING PROGRESS IN THE IMPLEMENTATION AND FULFILLMENT OF NATIONALLY DETERMINED CONTRIBUTIONS

The institutional set-up for monitoring progress in fulfilling the ENDC is presented in Chapter 1 “National Greenhouse Gas Inventory” and in Chapter 2.1.1 “Government Structure”.

2.1.9 SYSTEM FOR IMPLEMENTATION, MONITORING, REPORTING, DATA MANAGEMENT AND STAKEHOLDER INVOLVEMENT IN THE PROCESS OF IMPLEMENTATION AND FULFILLMENT OF NATIONALLY DETERMINED CONTRIBUTIONS

The system for implementation, monitoring, reporting and data management related to the implementation of the NDC in the Republic of North Macedonia is in a transition phase from a project-oriented to a systemic and institutionalized approach. Although there is a solid foundation built through many years of experience in preparing national reports, a fully integrated and legally regulated framework that would unite all elements of climate governance is still missing.

A key structural challenge is the absence of a comprehensive legal framework that systematically regulates implementation, monitoring, reporting and financing of climate actions. The draft Law on Climate Action, which is in the process of adoption, should ensure compliance with the relevant European Union legislation, in particular in the area of monitoring, reporting, verification and accreditation (MRV/MRV-A), as well as a clear allocation of institutional responsibilities. In the current situation, responsibilities are partially defined and fragmented between different institutions.

Despite the absence of a formally established and fully functional MRV system (more information on the status of MRV can be found in the document " Policy Paper - Status of Climate Policy Governance and MRV, 2025" prepared by the Institute for Good Governance and Policies in Environment and Climate Change - Skopje⁴), the Republic of North Macedonia has significant and continuous experience in monitoring, analysing and reporting on climate policies and measures, which is based on the long-standing practice of preparing the national greenhouse gas inventory and related reports. The national inventory is regularly prepared as a key component of the monitoring, reporting and verification system, providing consistent time series (1990–2022), trend analysis, identification of key categories and direct linkage to mitigation policies and decision-making.

In addition to the inventory, particularly developed practices exist in the energy sector, where national energy efficiency action plans and regular reports on renewable energy sources are systematically prepared, containing detailed information on the implemented measures, their scope and quantitatively assessed effects on the reduction of energy consumption and greenhouse gas emissions. In other sectors, although the approach is less formalized, there are relevant systems for collecting data in industry, waste management records and land use and forestry data primarily from the State Statistical Office and the Ministry of Environment and Physical Planning, which are used within the inventory and other national analyses.

These processes, although not integrated into a single formal MRV system, in practice function as its constituent elements and represent a solid technical and institutional basis for the further establishment of a fully integrated, consistent and sustainable system for monitoring the implementation of nationally determined contributions. However, the limited administrative capacity, especially in terms of specialized knowledge, data governance and intersectoral coordination, is a challenge. Although the Ministry of Environment and Physical Planning has a central role, significant strengthening of human resources and technical capacities is needed, as well as the establishment of clearer coordination mechanisms with other institutions. Intersectoral cooperation remains a key prerequisite, especially for monitoring integrated policies and measures (PaMs), which by their nature involve multiple sectors.

Stakeholder involvement is a positive aspect of the system, with the processes of preparing national reports and strategic documents regularly involving institutions, academia, the private sector, and civil society and youth organizations. However, this participation mostly takes place within the framework of projects and consultative processes, without a formalized and continuous participation mechanism.

2.1.10 CHANGES IN INSTITUTIONAL ARRANGEMENTS SINCE THE PREVIOUS BIENNIAL TRANSPARENCY REPORT

This is the first transparency report for the Republic of North Macedonia and there are no changes to report in this section.

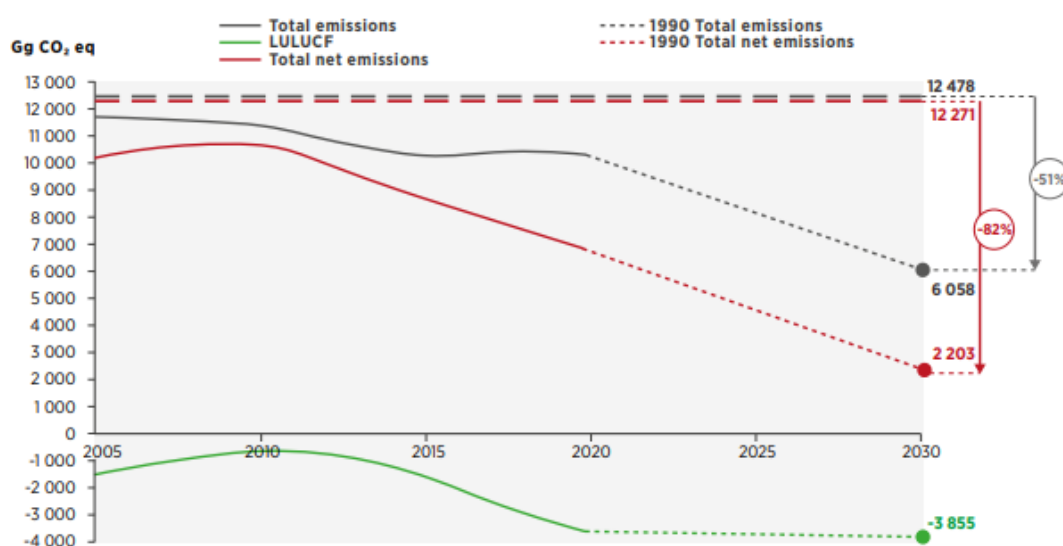
⁴ Available on

<https://api.klimatskipromeni.mk/data/rest/file/download/96cf4ecbc79287df8782bde8f7493d57c1770aa385ae7912b6ca01493c7d181f.pdf>

2.2 DESCRIPTION OF THE NATIONALLY DETERMINED CONTRIBUTION

The Enhanced Nationally Determined Contribution of the Republic of North Macedonia⁵ was adopted in 2021 and is a key strategic document for advancing the country's climate ambitions. With it, **the country committed to reducing total greenhouse gas emissions by 51%, or to reducing net emissions by 82%, by 2030, compared to 1990 levels** (Figure 22). The ENDC establishes a total of **63 mitigation measures, including 32 measures in the energy sector, 11 in agriculture, forestry and other types of land use, 4 in the waste sector, as well as 16 cross-sectoral and enabling policies and measures** that serve to create institutional, technical and financial conditions for implementation. These measures are assessed not only in terms of their potential for reducing emissions, but also through their socio-economic and gender dimensions. The ENDC introduces innovative approaches by quantifying the expected number of green jobs created, with projections of up to 9,895 new jobs by 2035, of which 77% are related to energy efficiency. Furthermore, gender equality and youth inclusion are integrated into the policy design process, with specific indicators and consultations held to ensure their meaningful involvement. Adaptation is not included in the ENDC.

Figure 22 Comparison of projected emissions (total excluding the FOLU sector) and net emissions (and sinks) of greenhouse gases (all sectors) in the ENDC, 2021.



Source: ENDC 2021

The ENDC is part of an interconnected system of policies and planning in the Republic of North Macedonia. It is based on a series of national documents developed in recent years, including the Second and the Third Biennial Climate Change Update Report, the Energy Development Strategy until 2040, the National Energy and Climate Plan 2021-2030 (NECP) from 2022, and the Long-Term Climate Action Strategy with an Action Plan. These documents provide the analytical basis and the scenario assumptions on which the ENDC is based. All documents are available on the website: <https://klimatskipromeni.mk/article/29>

These documents ensure consistency in the modelling of mitigation pathways and establish a unified framework for developing climate policies. The ENDC harmonizes the definitions of scenarios used in different documents, in particular with regard to the baseline scenario (WOM) and the mitigation scenario with additional measures (WAM). Table 6 presents a comparative overview of the key differences between the initial 2015 NDC (INDC/NDC 1.0) and the 2021 ENDC (NDC 2.0) in terms of sectoral coverage, included gases and methodological framework.

⁵

<https://api.klimatskipromeni.mk/data/rest/file/download/8fe945cf2fb09317ca6f8ca8d2612833153f698a7f0e43ad2b5da ce0c9f6f066.pdf>

Table 6 Main differences between aspects in the Initial Nationally Determined Contribution and the Enhanced Nationally Determined Contribution

Aspect	2015 I-NDC 1.0	2021 E-NDC 2.0
Sectors	energy sector	All sectors, cross-sectoral
Greenhouse gas emissions	CO ₂	CO ₂ , CH ₄ , N ₂ O, HFC
Scenarios	No measures / High ambition	WOM vs. WAM (aligned with NECP, BUR3)
Models	MARAKAL – Energy sector	Detailed models for all sectors
Social/gender aspects	There is none.	Covered (green jobs, gender indicators)
Integration with other strategies	It was being prepared in parallel with the Energy Strategy.	Integrated with NECP, BUR3

In the separate technical document developed within the BTR1, BTR2/NC5 project titled “*Rapid Assessment of the Implementation of the Macedonian Enhanced Nationally Determined Contributions to Climate Change*” (version May 2025)⁶, an effort (assessment) was made to assess the progress achieved in the implementation of the ENDC of the Republic of North Macedonia, as part of its obligations under the Paris Agreement. To ensure consistency and transparency in the assessment of each measure, a six-point assessment system was adopted. A traffic light assessment system was designed to visually simplify the six-point assessment scale in the bottom-up approach. This assessment system provides a transparent and practical manner of monitoring implementation, allowing policymakers to clearly identify which measures are progressing as planned and which require redesign, capacity support or resource mobilization. It also facilitates comparative analysis across sectors, enabling better prioritization of activities within the National Climate Action Strategy.

Based on the presented overall progress assessments, the implementation of mitigation measures within the ENDC of the Republic of North Macedonia shows moderate progress in key sectors:

- In the energy sector, which covers the largest number of actions and contributes the largest share of greenhouse gas emissions, the average implementation progress is estimated at around 65%. This indicates a steady trend, especially in measures related to the development of renewable energy sources, such as rooftop solar photovoltaics and solar thermal collectors, which received the highest implementation scores. Energy efficiency initiatives in public and residential buildings are also progressing moderately, although some critical infrastructure projects, such as biomass power plants or large hydropower projects, are facing delays due to financial, technical obstacles or obstacles in obtaining the adequate permits;
- In the waste sector, implementation progress is around 55%, reflecting a combination of solid early planning and slow implementation on the ground. Several measures, such as opening new regional waste management centres and closure of inadequate municipal landfills, are in the planning phase, but lack complete implementation. Legal and institutional obstacles have limited the capacity of municipalities, and the need for clearer financing strategies has contributed to a pace slower than expected in this sector. In addition, the resistance from local communities, particularly regarding the location of the regional landfills and the waste treatment plants, has emerged as a significant obstacle, delaying several planned investments and provoking public opposition in several municipalities.
- For additional and cross-sectoral measures, including those related to raising awareness, legislation and research and development, the average progress rate is just below 60%. This indicates an adequate level of engagement, but also highlights the need for systemic support mechanisms and stronger policy enforcement. A notable example of slow implementation is the 400 kV transmission line to Albania, which received the lowest implementation score (score 1 in the technical document referred to above). Although this project is strategically important for improving regional electricity connectivity and enabling integration of renewable energy sources, its implementation has been significantly delayed due to administrative, procurement and coordination issues. The agreement with the selected contractor was terminated and the process of identifying a new contractor is ongoing, thus further delaying the start of the construction and compromising the harmonization with the regional interconnection targets.

Overall, while the progress to date reflects a positive trajectory towards achieving the ENDC objectives, the current pace will need to be accelerated to ensure complete implementation by 2030. Likewise, a Financing Strategy accompanying the ENDC of the Republic of North Macedonia was developed in order to define the financial framework needed for implementation of the mitigation measures by 2030. The Strategy presents an ambitious investment agenda of over

⁶Available at:

<https://api.klimatskipromeni.mk/data/rest/file/download/eeeb446f446ff699e561fe89d6413c2352bd56bfc678936b53324c595a0e7f38.pdf>

€21.3 billion (€25 billion at 2025 prices) if all measures are implemented, with a strong focus on the energy sector, which accounts for approximately 99% of the estimated investment needs.

The Strategy emphasizes a multi-source financing model, combining domestic public funds, private sector investments, international donor support, and consumer contributions through regulated tariffs and incentive/subsidy schemes. While the Financing Strategy offers a broad and inclusive vision, its operationalization remains limited. One of the key shortcomings is the absence of a detailed financial plan linked to specific projects and timelines for their implementation. While high-level investment needs are outlined, including indicative costs by sector and measure, the Strategy lacks clear mechanisms for financial monitoring, disbursement schedules, and coordination across different financing sources. In addition, the institutional capacity to leverage international climate change financing and public-private partnerships remains underdeveloped, creating a bottleneck for scaling up investments. Access to financing at the local level is also limited. Municipalities, which have a key role in implementing building renovation, waste management and local transport measures, often lack solvency, co-financing capacity or technical expertise to raise funds on their own. While donor-supported programmes have helped initiating some local initiatives, the Strategy lacks a structured mechanism to facilitate access to climate change financing for local communities and municipalities, such as through guarantee schemes, dedicated municipal climate action funds or capacity building.

Private sector participation is key in the approach to financing, but targeted financial instruments such as risk-sharing funds, concessional loans or tax incentives are not clearly defined or implemented. This has contributed to low investor interest in certain segments, such as biomass power plants or passive buildings, where there are high upfront costs and regulatory uncertainties. Overall, while the ENDC Financing Strategy sets a strong conceptual foundation, it requires significant refinement to become a usable and results-oriented tool. A more detailed financing framework, with dedicated instruments for high-impact sectors, mechanisms to attract private capital and an inclusive approach for local self-governments, will be essential to enhance the implementation.

The process of developing the ENDC included:

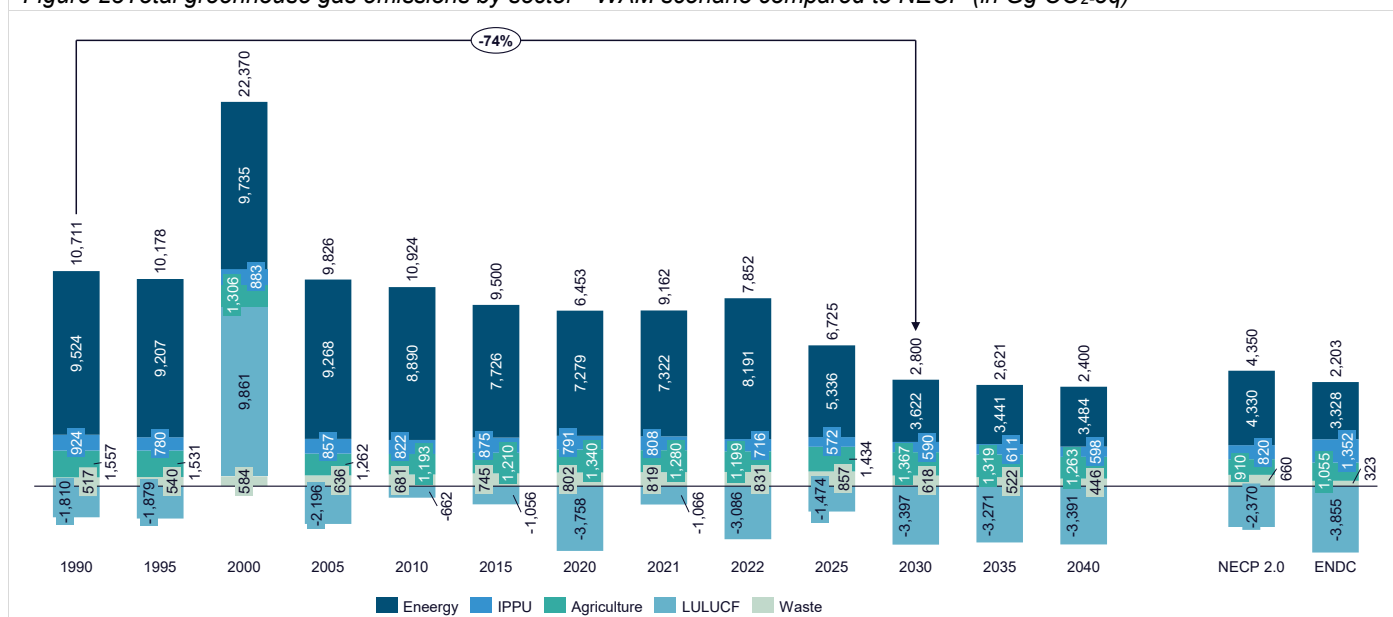
- 36 national experts and 13 international experts, of which a total of 25 are women in all relevant areas;
- 31 stakeholders (17 government bodies, 5 international organizations, 3 NGOs, 5 academic institutions and 1 private company);
- at the individual level, 667 people participated in 20 webinars (403 women), to provide data and to discuss and confirm the assumptions and results.

Within the BTR1 development project, a special document "Climate Change Mitigation" has been developed,⁷ in which three scenarios were analysed. One of the scenarios is the WAM (scenario with additional measures), in which **69 policies and mitigation measures were analysed**, covering all relevant sectors: 32 measures in the Energy sector, 1 measure in the IPPC sector, 7 in the Agriculture sector, 2 in Forestry, 5 in Land Use, 6 measures in the Waste sector, as well as 16 horizontal measures (cross-sectoral and enabling policies and measures). This portfolio represents a significant expansion and improvement compared to previous national documents, especially in the terms of technological solutions (use of battery systems and hydrogen), regulatory interventions and emission management in non-energy sectors. It should be emphasized that the document "Climate Change Mitigation" is harmonized with the new NECP adopted by the Government in April 2026.

The results show a high level of alignment between the scenario with additional measures (WAM) and NECP scenario, with net emissions in 2030 estimated at around 2,800 kt CO₂eq, which is relatively close to the ENDC (2,203 kt CO₂eq) (Figure 23). The main differences arise from the Energy sector and the Forestry and Other Land Use sector, where the BTR1 uses updated data from the national greenhouse gas inventory (including removals from perennial crops). However, despite these differences, the two documents are largely consistent, showing the same trends, strong growth of renewables, reduction of fossil fuels and a clear path towards decarbonization. The differences are relatively small and mostly stem from the different treatment of certain technologies, investment dynamics and system optimisation in the BTR1.

⁷ <https://api.klimatskipromeni.mk/data/rest/file/download/30c547cd97ff5b1884609e7b660a8a2001add145681907229d3dbaa88503a792.pdf>

Figure 23 Total greenhouse gas emissions by sector - WAM scenario compared to NECP (in Gg CO₂-eq)



According to the WAM scenario, the Energy sector, which has historically been the dominant source of emissions in the Republic of North Macedonia, is expected to achieve a 62% reduction in emissions by 2030. Agriculture is projected to contribute a 12% reduction, while the Waste sector is expected to reach a 19% increase in emissions. Meanwhile, the Forestry sector is projected to increase its greenhouse gas removal capacity by about 2 times compared to 1990. The ENDC adopted a regional and equitable approach to implementation, prioritizing measures according to the development needs of the different regions of the country.

For example, just transition programmes target the coal-dependent Pelagonija region, while the expansion of renewable energy sources and energy efficiency improvements are tailored to specific geographical and socio-economic contexts.

The analyses conducted within the BTR1 process will be supplemented during the preparation of the BTR2 and will also form the basis for NDC 3.0, which is in the process of preparation.

Despite significant progress in several priority areas, there are still significant implementation gaps that may hinder the full achievement of the country's ENDC objectives. These gaps are primarily the result of systemic challenges across institutional, financial, and regulatory aspects.

Institutional and human resource constraints

Implementation of measures is often delayed or fragmented due to limited administrative and technical capacity, especially at the local level. For example, the renovation of municipal and central government buildings is progressing moderately, but unified coordination and standardization across municipalities is lacking. Energy management in manufacturing industries similarly lacks dedicated energy managers for the implementation of the ISO 50001 standard and sector-specific guidelines, especially for small and medium enterprises. In addition, green procurement policies remain underutilized due to weak enforcement mechanisms and limited institutional knowledge of sustainable criteria among procurement officials. Measures such as building renovation and sustainable transport require cross-sectoral coordination that is currently underdeveloped.

Financial barriers and budget constraints

If all measures are implemented, the estimated **€21.3 billion** (2021 prices) needed to implement the ENDC measures by 2040 highlight the financial shortfalls. A prime example is the electrification of the Transport sector, which requires over €8.2 billion (2021 prices), but has made modest progress due to the absence of robust programmes for subsidies for electric vehicles (EVs), insufficient EV charging infrastructure and minimal public procurement of EVs in the state fleet. Similarly, the construction of passive buildings, while vital for energy savings, is hampered by high upfront costs, limited access to concessional financing and low consumer awareness. The biomass power plant programme is another example, where only one power plant has been built (for the reporting period) signalling weak investor interest, likely due to unclear market signals and insufficient risk mitigation instruments.

Policy and legislative shortcomings

It is important to note that the broader legal and institutional framework for climate action is still incomplete, in particular as the Law on Climate Action has not yet been adopted by the Parliament. The absence of this comprehensive legislation continues to limit cross-sectoral coordination and formal integration of climate objectives across all relevant policy domains, as well as one of the most important measures, carbon offsets. In addition, complete implementation of the Law on Energy Efficiency and other sectoral laws remains essential to provide the regulatory certainty needed to scale up investments and guide institutional efforts. However, more than three years after the adoption of the Law on Energy Efficiency, the necessary bylaws have not yet been adopted. This delay significantly undermines the implementation of the Law, leaving many of its provisions unenforceable in practice. Without clearly defined rules, procedures and institutional responsibilities set out in the bylaws, key mechanisms, such as energy performance standards, binding schemes and monitoring frameworks, cannot be effectively implemented. Therefore, accelerating the adoption of the bylaws is crucial for the complete implementation of the Law on Energy Efficiency. These legislative processes should be treated as a priority to enable a more coherent, enforceable and effective climate policy framework in the upcoming NDC 3.0 cycle. In addition, several key policy instruments have not yet been fully adopted or implemented. The development of the biofuels market remains stalled due to delays in the finalization of the Law on Biofuels, resulting in no practical use of biofuels in the Transport sector. Similarly, the measure to phase out incandescent light bulbs has not been officially enacted as a regulation, although market trends suggest that consumers are voluntarily switching to LEDs. In addition, the renewal of the national vehicle fleet shows limited effectiveness in the absence of binding fuel economy standards or fleet electrification.

Data and monitoring gaps

The lack of disaggregated data hinders the ability to effectively monitor progress. For example, the renovation of residential buildings is difficult to track due to the absence of a centralised renovation register, especially for privately financed and implemented upgrades. Similarly, rooftop solar photovoltaic systems are not systematically reported in national statistics, leading to an underestimation of the contribution of renewable electricity despite excellent progress in implementation. The Transport sector presents another data gap. Indicators such as breakdown by category, vehicle-kilometres or emissions by mode are either missing or outdated, making it difficult to quantify the impact of measures in this sector and monitor the real effect.

Additionally, gender-disaggregated data is lacking, which limits the ability to understand the different impacts of climate policies and measures on women and men, as well as on different vulnerable groups. Such data is important for creating more inclusive and equitable climate policies, better targeting of measures, and ensuring that no one is left behind in the transition process.

Challenges in multiple sectors

Public awareness and stakeholder engagement still remain unbalanced. Although public awareness campaigns and energy efficiency information centres have been launched, their reach and impact are not sufficient to change consumer behaviour to a large extent. This is evident in the limited use of solar thermal collectors (despite excellent implementation) and heat pumps, where technical knowledge among installers and end users remains an obstacle.

Systematic inclusion of various social groups, including women, youth, rural populations and vulnerable categories, is necessary in order to make climate policies and measures more accessible, more understandable and adapted to the diverse needs and capabilities of the population.

2.3 INFORMATION NEEDED TO MONITOR THE PROGRESS IN IMPLEMENTATION AND ACHIEVEMENT OF THE NATIONALLY DETERMINED CONTRIBUTION

This chapter presents the information needed to monitor the progress in implementation and achievement of the Nationally Determined Contribution of the Republic of North Macedonia, in accordance with the Enhanced Transparency Framework (ETF) established by the Paris Agreement and the relevant UNFCCC modalities, procedures and guidelines (MPGs). The purpose of this information is to provide a clear, transparent and consistent basis for assessing progress towards the set national targets, through the use of comparable indicators.

2.3.1 INDICATOR FOR DETERMINING THE PROGRESS TOWARDS NATIONALLY DETERMINED CONTRIBUTIONS

Nationally Determined Contributions (NDCs) set a specific target for reducing greenhouse gas emissions by 2030.

Total greenhouse gas emissions (excluding the Forestry and Other Land Use sector) in **CO₂ equivalent (CO₂-eq)** are the most direct and comprehensive indicator for monitoring a country's contribution to global warming. Greenhouse gas emissions include emissions from all key sectors (energy, industry and manufactured goods, agriculture and waste), which is considered the primary indicator for monitoring a country's ability to meet its overall emission reduction commitments under the Paris Agreement and its Nationally Determined Contribution. Therefore, the projection of this indicator is crucial for assessing progress in the medium term.

Total net greenhouse gas emissions (including the Forestry and Other Land Use sector) in CO₂ equivalent (CO₂-eq) is the second key country indicator (Table 7).

More detailed data are provided in the so-called Common Tabular Format for NDC or CTF-NDC tables, which are submitted additionally to the BTR1.

Table 7 Progress status and indicator

Indicator	Unit	Base year	Value after years				Final goal	Final year	Progress towards ENDC
		1990	2021	2022	2030				
Total greenhouse gas emissions excluding FOLU (net emissions with FOLU)	Gg CO ₂ eq	12521.6 (10711.2)	10228 (9162)	10937 (7852)	6058 (2203)	51% emissions (82% net emissions)		2030	In 2022, 12.66% decrease (26.69% net emissions) compared to the base year.

Since the energy sector is one of the largest contributors to greenhouse gas emissions in the country, it is logical to use the following key indicators that are interconnected and jointly contribute to achieving this goal:

- Share of renewable energy sources (RES) in electricity production, expressed in %,
- Share of RES in gross final energy consumption, expressed in %,
- Reducing dependence on energy imports.

It is essential to define well-balanced indicators to assess the effectiveness of climate change projects. This stems from the fact that establishing reasonable indicators for climate change projects is complicated by the long-term horizon of the impacts of mitigation and adaptation projects, as well as the uncertainty associated with the impacts of climate change.

The Law on Energy Efficiency and the bylaws that will be based on it, will set an institutional framework for the establishment of so-called SMART indicators that will realistically reflect the national context. They will be reviewed and discussed in future transparency reports.

2.3.2 INSTITUTIONAL ARRANGEMENTS FOR MONITORING INTERNATIONALLY TRANSMITTED MITIGATION OUTCOMES (ITMOs)

Internationally Transferred Mitigation Outcomes (ITMOs) represent the results of activities for reducing greenhouse gas emissions or sinks that can be transferred between countries under the cooperative approaches provided for in Article 6 of the Paris Agreement. In other words, if a country finances or supports an emission reduction activity in another country, part of the reduction achieved can, under certain rules, be transferred and used to meet the national climate goals of the country using that unit. Such approach requires clear rules for transparency, monitoring, reporting and avoiding double counting of the same emission reduction.

During the reporting period for the BTR1, the Republic of North Macedonia did not use Internationally Transferred Mitigation Outcomes (ITMOs) to achieve the targets set in its Nationally Determined Contributions (NDCs), in accordance with Article 4 of the Paris Agreement. This means that progress towards meeting national targets is monitored based on domestic emissions, the national greenhouse gas inventory, mitigation policies and measures, and emission projections, without using transferred outcomes from other countries.

2.4 POLICIES AND MEASURES FOR CLIMATE CHANGE

MITIGATION

Implementation of policies and measures (PaMs) aimed at reducing emissions and strengthening resilience is still at a low level, as it requires transformational (reform) change across all sectors — from energy and transport to agriculture and industry, forest management, waste and other key sectors. Achieving significant emission reductions will require comprehensive reforms, large investments in green technologies and strengthening institutional capacities to implement and manage climate action.

As the Republic of North Macedonia continues to develop its climate policies, the challenge of translating them into concrete and effective measures will be crucial for ensuring long-term success in mitigating climate change and adapting to its effects.

In the ENDC, a total of 63 policies and measures for climate change mitigation are analysed, of which 32 in the Energy sector, 11 in the AFOLU sector (4-agriculture, 2-forestry, 5-land use change), 4 in waste and additional 16 policies and measures that are enabling measures for sectoral mitigation measures. *In the new revised 2025 Mitigation Measures Report*, 69 policies and measures are analysed - 32 in the Energy sector, 1 in IPPU, 7 in the Agriculture sector, 7 in FOLU, 6 in the Waste sector, as well as the same additional enabling policies and measures.

For each policy and measure there is a:

- Title of the mitigation action;
- Main goal;
- Description;
- Information: type; sector; relevant planning documents, legal and regulatory acts; gases; methodology; assumptions;
- Implementation progress: steps taken or planned to achieve the action;
- Estimated emission reduction;
- Time frame; finances (budget);
- Institution(s) implementing the measure;
- Indicators for monitoring progress;
- Contribution to achieving the UN Sustainable Development Goals (SDGs).

Climate change mitigation policies and measures in the Republic of North Macedonia are a key foundation for the country's efforts to meet its nationally determined greenhouse gas emission reduction targets. The ENDC sets ambitious targets to reduce total emissions by 51% by 2030 and reduce net emissions by 82% compared to 1990 levels. In this regard, the defined policies and measures are designed and aligned with key national and international strategic documents, including the national communications, the Long-term Low Emission Development Strategy, as well as with the relevant European Union legislation within the framework of the accession process.

The Ministry of Energy, Mining and Mineral Resources (established in 2024) leads energy planning, supported by the MoEPP for the integration of environment and climate. The Energy Law (from 2020), the Law on Renewable Energy Sources and the Law on Energy Efficiency provide the legal framework. During the reporting period until 2022, the transposition of several important EU directives is ongoing (RED II, EED, EPBD, ETS Directive, etc.).

An important part of the national mitigation framework is the integration of gender equality principles. Guided by the Gender and Climate Change Action Plan (2021-2030), these policies increasingly aim to ensure equitable benefits and protection, especially for vulnerable households, households headed by women and in rural communities. These could be taken into account in future nationally determined contributions.

A summary overview of policies and measures (PaMs) is provided in Table 8 and Table 9, while a detailed overview by measures and sectors is presented in Annex 4 of the BTR1.

Table 8Summary of policies and measures by sector:			
Sector	Number of policies	Impact on emissions by 2030	Examples of measures/policies

		and measures		
Energy	32	–6.321 Gg CO ₂ -eq (–66% reduction)		Reduction of network losses, large hydropower plants, feed-in tariffs and premiums, biomass co-generation plants, solar systems, subsidy-free RES, biofuel market development, solar thermal collectors, heat pumps, building renovation, passive houses, elimination of incandescent light bulbs, improved street lighting, green procurement, renewal of the transport fleet, advanced mobility, electrification of transport, gas infrastructure, regional integration of the electricity market, smart communities, etc.
IPPU	1	225.6 Gg CO ₂ -eq		Implementation of the Kigali Amendment to phase out HFCs, through a phased reduction in the use of hydrofluorocarbon (HFC) greenhouse gases, starting in 2024.
Agriculture, Forestry and Other Land Use - AFOLU	11 (MAP is 14)	–435 Gg CO ₂ -eq (Agriculture, – 29% reduction) / 2,647 Gg CO ₂ -eq (FOLU sinks)		Reduction of CH ₄ from enteric fermentation in dairy cows, reduction of N ₂ O from manure management (pigs/cattle), integrated forest fire management, afforestation, land use change on steep slopes, contour tillage, permanent grasslands in orchards and vineyards, use of biochar, photovoltaic irrigation, etc.
Waste	4 (there are 6 in MAP)	–84 Gg CO ₂ -eq (–21% reduction)		Landfill gas combustion, mechanical-biological treatment (MBT) with composting in new landfills, waste selection (paper, packaging, plastic, glass, metals), recycling systems, etc.
Additional enabling measures (cross-sectoral)	16	/		Identification of RES locations, construction of regional interconnectors (electricity and gas), demand-responsive pricing, role of SMEs in energy transition, regional mobility of researchers, increased education on sustainable energy, protection of vulnerable consumers, new technologies, etc.

Table 9. Overview of policies and measures

Document number	Name	Description	Goals	Instrument type	Status	Sector(s)	Affected gases	Initial year of implementation	Implementing institution(s)	Emission reduction in 2030 (kt CO ₂ -eq)
1	Reducing network losses	Technical measures to reduce electricity losses in distribution include replacing overhead lines with underground ones (where possible), moving to a voltage level of 20 kV, installing new transformer stations to shorten 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 substation operation through automatic control.	Reducing losses in electricity and heat networks	Technical	In implementation	Energy	CO ₂	2025	Electricity transmission system operator; Electricity distribution system operators; Heat distribution companies	104.4
2	Large hydropower plants	Construction of new large hydropower plants taking into account environmental and social impacts	Increasing domestic production capacity from renewable energy sources	Technical	Feasibility/pre-feasibility studies have been developed; Chebren Feasibility Study	Energy	CO ₂	2030	Government of the Republic of North Macedonia; ESM AD (AD Elektrani na Makedonija); Ministry of Environment and Physical Planning; Energy Regulatory Commission; MEPSO; Ministry of Energy, Mining and Mineral Resources	n/a
3	Incentives feed-in tariff	Construction of new small hydropower, wind and biogas plants with feed-in tariffs that will stimulate construction	Preferential tariff for incentives	Technical and regulatory	In implementation	Energy	CO ₂	2030	Government of the Republic of North Macedonia; Energy Regulatory Commission; Ministry of Environment and Physical Planning; Ministry of Energy, Mining and Mineral Resources; Private investors	123.3
4	Incentives feed-in premium	Construction of solar and wind power plants with feed-in premium tariffs to stimulate construction	Increasing domestic production capacity from renewable energy sources	Technical and regulatory	In implementation	Energy	CO ₂	2030	Government of the Republic of North Macedonia; Ministry of Energy, Mining and Mineral Resources; Private investors	108.0
5	Biomass power plants (CHP optional)	This measure envisages construction of distributed small biomass power plants (CHP optional) with incentives feed-in tariffs. In addition to increasing the share of RES with these CHP plants, they should also contribute to increasing the flexibility of the electricity system and ensuring security of supply. It is envisaged to use biomass from industrial and municipal solid waste, taking into account the sustainability of biomass at the national level.	Increasing domestic production capacity from renewable energy sources	Technical and regulatory	In implementation	Energy	CO ₂	2030	Government of the Republic of North Macedonia; Energy Regulatory Commission; Ministry of Environment and Physical Planning; Ministry of Energy, Mining and Mineral Resources; Private investors	21.0

6	Rooftop solar power plants	Construction of rooftop solar power plants, on private as well as public buildings, regardless of whether they are consumers or systems from which the total electricity produced will be used for own purposes or stored. One of the possibilities for increasing the installed capacity of rooftop solar systems is through renewable energy communities.	Increasing domestic production capacity from renewable energy sources	Technical and regulatory	Adoption of the new Law on Renewable Energy Sources; Information campaigns	Energy	CO ₂	2030	Government of the Republic of North Macedonia; Energy Regulatory Commission; Ministry of Energy, Mining and Mineral Resources; Ministry of Finance; Elektro distribucija Skopje; Electricity suppliers Electricity end users	84.6
7	RES without incentives	Construction of wind, solar and biogas power plants at various locations in Macedonia, carefully selected to avoid environmental impacts compared to the benefits of the electricity produced.	Increasing domestic production capacity from renewable energy sources	Technical and regulatory	Development of a methodology for selecting the best location for the construction of solar and wind power plants; Planning battery storage capacity and establishing a regulatory framework	Energy	CO ₂	2030	Government of the Republic of North Macedonia; Ministry of Energy, Mining and Mineral Resources; Ministry of Transport; Electricity DSO; Electricity market operator; AD "Elektrani na Makedonija" (ESM AD); Private investors	219.8
8	Development of the biofuels market	Increasing the share of biofuels in line with the requirements of the revised Renewable Energy Directive (2018/2001).	The share of RES in the transport sector is almost zero and this is the main reason for not meeting the country's 2020 target. In order to meet the 2030 RES target in the transport sector, but also the overall RES target, it is necessary to have a functioning biofuels market.	Regulatory, policy	A draft version of the Biofuels Law has been developed; Development of a study on the target of RES in transport in 2030 in the EC countries; Development of a study on biofuels in Macedonia	Transportation	CO ₂	2030	Government of the Republic of North Macedonia; Ministry of Energy, Mining and Mineral Resources; Ministry of Finance; Ministry of Environment and Physical Planning; Energy Regulatory Commission; Oil traders	96.0
9	Binding energy efficiency scheme	The average annual final consumption for the period 2014-2016 is used to set the scheme. The measure implements the possibilities of Article 7 of the Energy Efficiency Directive, i.e. Article 14 of the Law on Energy Efficiency, for excluding consumption in the Transport sector (paragraph 1) from the sum of the average annual consumption and reducing consumption in the Industry sector (paragraph 2).	Fulfilling the obligation under Article 7 of the Energy Efficiency Directive	Technical, regulatory	The Law on Energy Efficiency has been adopted.	Energy	CO ₂	2026	Government of the Republic of North Macedonia; Ministry of Energy, Mining and Mineral Resources; Regulatory Commission for Energy, Water Services and Municipal Waste Management; Distribution system operators Electricity and gas suppliers	15.2
10	Solar thermal collectors	Electric hot water heaters are one of the largest consumers of energy with a major impact on electricity bills. On the other hand, the reduced investment	Reducing energy costs and improving efficiency	Technical	Previously implemented programmes to promote renewable	Energy	CO ₂	2025	Government of the Republic of North Macedonia; Ministry of Energy, Mining and Mineral Resources;	14.8

		costs for purchase and installation of solar thermal collectors are of great importance as they can reduce consumers' hot water bills. These systems also serve to save energy and can meet at least 50% of the annual hot water needs, depending on the hot water needs. In addition, solar thermal collectors can be used in combination with electricity and central heating systems.			energy sources and improve energy efficiency in households				End users; Municipalities and the City of Skopje	
11	Marking of electrical appliances and equipment	The placing on the market of energy-related products that are correctly designed and labelled is necessary to ensure that products sold in Macedonia comply with EU regulations, as well as to contribute to greater energy savings by their users (households, public and commercial entities). The correct labelling of energy-related products must be respected, so that buyers and end users are provided with relevant information on the energy consumption of these products.	Increased energy savings in households, public and commercial buildings	Regulatory	In implementation	Energy	CO ₂	2026	Ministry of Energy, Mining and Mineral Resources; State Market Inspectorate, State Environmental Inspectorate; Manufacturers and suppliers of electrical equipment and household appliances; End users	42.4
12	Increased use of heat pumps	Phasing out heating devices with electric (resistance) heaters, as well as inefficient biomass stoves and replacing them with heat pumps in line with EU climate and energy policy. Heating systems also play a major role in the cooling sector and significant savings can be achieved. What is particularly important and is one of the recommendations of the UNDP Green Cooling Study for Macedonia is to adopt regulations for labelling of devices. There are 12 more recommendations in the study that are of fundamental importance for these systems and all of them need to be implemented.	More efficient use of electricity	Regulatory, political, technical	In implementation	Energy	CO ₂	2025	Ministry of Energy, Mining and Mineral Resources; End users Civil society organizations	281.7
13	Information campaigns and network of information centres for energy efficiency (EE)	Although a number of campaigns are being carried out to promote energy efficiency by various stakeholders, there is still a lack of knowledge about the benefits of EE. Article 12 of the EE Directive stipulates that the country should take appropriate measures to promote and facilitate the efficient use of energy by small energy consumers, including domestic consumers. This can be done using various mechanisms. One of them is the establishment of EE information centres in local self-governments. Following the examples from the EU, in addition to this measure, several	Implementing information campaigns that will raise public awareness about the importance, effects and benefits of energy efficiency	Informative	Broadcasting TV commercials, announcements, campaigns and documentaries; Expansion of the Energy Efficiency Platform; Continuous work on existing and opening new information centres.	Energy	CO ₂	2026	Ministry of Energy, Mining and Mineral Resources; Energy suppliers; End users	117.9

		others should be implemented, such as: ► Education, starting from kindergartens, ► Training of employees in public institutions at central and local level, ► Creating an energy savings calculation tool that will show the financial and environmental effects of implementing a certain measure.								
14	Reconstruction of existing residential buildings	The measure covers renovations of residential buildings, including window replacement, initiated by the owners and/or supported by commercial banks and funds. This measure will ensure the issuance of energy performance certificates for buildings, as a prerequisite for the commissioning of the renovations.	To meet the requirements under the Energy Efficiency Law	Technical and regulatory	In implementation	Energy	CO ₂	2025	Ministry of Energy, Mining and Mineral Resources; Donors and financial institutions; Households	20.5
15	Reconstruction of existing central government buildings	Considering the state of energy performance of public buildings at the central level and the role they should have, it is essential to encourage their renovation. Article 10 of the Law on Energy Efficiency is of great importance as it can be a starting point for expanding the reconstruction. In the absence of more recent information on the public building stock, the calculations take into account the heated surface of the building stock from the National Programme for EE in Public Buildings (draft version) (including the healthcare sector, universities, student dormitories, scientific institutions, social care institutions, social work centres, as well as the state administrative sector - Ministry of Energy, Mining and Mineral Resources, Ministry of Education and Science, Ministry of Environment and Physical Planning and Ministry of Transport). In addition, the specific consumption given in the document is used (on average 214 kWh/m2). This measure provides for the reconstruction, including the replacement of windows, of existing public buildings under the jurisdiction of the central government. The measure will ensure the issuance of energy performance certificates for the buildings, as a prerequisite for the commissioning of the reconstructions.	Reconstruction of existing public buildings in order to meet the objectives of the Energy Efficiency Directive and the Energy Efficiency Law	Technical, regulatory	In implementation	Energy	CO ₂	2026	Ministry of Energy, Mining and Mineral Resources; Ministry of Finance; Local self-government; Municipal public enterprises Donors and financial institutions	20.9
16	Reconstruction of existing local self-	A strategy for reconstruction of existing buildings used by public sector entities at the state level should	Reconstruction of existing public buildings	Technical, regulatory	In implementation	Energy	CO ₂	2026	Ministry of Energy, Mining and Mineral Resources;	20.9

	government buildings	set an example and encourage local self-government units to pay special attention to buildings under their jurisdiction. The calculations take into account the heating area of the housing stock from the National Programme for EE in Public Buildings (draft version) (including primary and secondary schools, kindergartens, student dormitories, municipalities and buildings of the City of Skopje). Additionally, the specific consumption given in the same document is used (on average 214 kWh/m2). This measure provides for reconstruction, including the replacement of windows, of existing buildings used by public sector entities under the jurisdiction of local self-governments. The measure will ensure the issuance of energy performance certificates for buildings as a prerequisite for the commissioning of the reconstructions.	in order to meet the objectives of the Energy Efficiency Directive and the Energy Efficiency Law						Ministry of Finance; Local self-government Municipal public enterprises Donors and financial institutions	
17	Reconstruction of existing commercial buildings	Data on the commercial building stock is lacking, but according to the third NEEAP, the surface area of commercial buildings is estimated at almost 8 million m2. This measure covers the reconstruction of existing commercial buildings, including window replacement, initiated by the owners and/or supported by commercial banks and funds. The measure will ensure the issuance of energy performance certificates for buildings, as a prerequisite for the commissioning of the reconstructions.	Reconstruction of existing commercial buildings in order to meet the objectives of the Energy Efficiency Directive and the Energy Efficiency Law	Technical, regulatory	The Law on Energy Efficiency has been adopted.	Energy	CO ₂	2026	Ministry of Energy, Mining and Mineral Resources; Ministry of Finance; Commercial building owners	63.6
18	Construction of new buildings	An energy-efficient building reduces maintenance and utility costs, but in many cases improves durability, reduces noise, increases comfort and creates a healthy and safe indoor environment. A further objective of energy-efficient building is to limit damage to the ecosystem and reduce the use of natural resources such as energy, land, water and raw materials. This measure will ensure the issuance of energy performance certificates for buildings, as a prerequisite for the commissioning of the building.	Construction of new buildings that will meet the minimum criteria prescribed in the Rulebook on Energy Performance of Buildings	Technical, regulatory	Financial support for the construction of new buildings at the municipal level; The Law on Energy Efficiency has been adopted.	Energy	CO ₂	2020	Ministry of Energy, Mining and Mineral Resources; Donors and financial institutions; Investors (households)	21.3
19	Construction of passive buildings	The measure provides for construction of new passive residential buildings in accordance with EU Directive 2010/31/EU. This measure will ensure the issuance of energy performance certificates for buildings, as a	Every new building should be a nearly zero-energy building.	Technical, regulatory	The Law on Energy Efficiency has been adopted.	Energy	CO ₂	2026	Ministry of Energy, Mining and Mineral Resources; Ministry of Transport; Donors and financial institutions Investors (households)	16.6

		prerequisite for the commissioning of the building.								
20	Discontinuation of incandescent light bulbs	A number of governments around the world have taken steps to phase out incandescent light bulbs for general lighting in favour of other more energy-efficient lighting alternatives. The objective is not just to ban incandescent light bulbs but to improve energy efficiency. This includes replacing conventional incandescent light bulbs with compact fluorescent (CFL) and LEDs.	Improving lighting efficiency following EU policies	Regulatory, policy	The price of LED lights is decreasing.	Energy	CO ₂	2026	Government of the Republic of North Macedonia; Ministry of Energy, Mining and Mineral Resources; State Market Inspectorate; Lamp suppliers; End users	114
21	Improvement of street lighting in municipalities	The costs of street lighting, including electricity and maintenance, can have a huge impact on the budget of municipalities. In addition, new opportunities are opening up for municipalities, given the fact that a large number of manufacturers are working daily to improve lamps. It is necessary to replace inefficient lamps, purchasing new ones that will meet the highest energy efficiency criteria. (CFL and LED light bulbs).	Reducing the costs and increasing the quality of street lighting	Technical	Adoption of a Decree on Energy Performance Contracts; Continuation of promotional activities for the implementation of public-private partnership	Local	CO ₂	2020	Government of the Republic of North Macedonia; Energy Regulatory Commission; Ministry of Environment and Physical Planning; Ministry of Energy, Mining and Mineral Resources; Local self-government	37.9
22	"Green Procurement"	According to Article 6 of the Energy Efficiency Directive, central governments may only procure products, services and use buildings with high energy efficiency performance. Enhanced actions are needed to ensure legal and technical knowledge, as well as skills of public sector personnel at central level to include and evaluate energy efficiency requirements in public procurement procedures using the most economically advantageous tender criteria.	Application of energy efficiency criteria ("greening") in public procurement procedures	Regulatory	The Law on Energy Efficiency has been adopted; the Law on Public Procurement has been adopted.	Energy	CO ₂	2026	Ministry of Energy, Mining and Mineral Resources; Public Procurement Bureau; Local self-government	2.9
23	Increased use of central heating systems	Increased use of existing district heating systems by implementing information campaigns to connect new consumers, including those who were previously disconnected from the system.	Reducing local air pollution, considering that household heating is one of the main sources of local pollution	Technical information	In implementation	Energy	CO ₂	2030	Ministry of Energy, Mining and Mineral Resources; ESM Snabduvanje; AD "Skopje Sever"; "Energetika" – Skopje, a subsidiary of AD Elektrani na Makedonija (ESM AD); Private investors	4.1
24	Energy management in manufacturing industries	This measure envisages the implementation of mandatory energy audits of large companies and the implementation of the ISO 50001 standard, as well as advanced measurement and introduction of new IT technologies. This will enable the prevention of defects, better control of processes and faster action in production, using advanced data analysis and predictive technologies.	Efficient management of manufacturing processes in industry in order to increase production, while using the same energy consumption.	Regulatory, technical	In implementation	Energy	CO ₂	2025	Ministry of Energy, Mining and Mineral Resources, Energy Regulatory Commission, Water Services and Municipal Waste Management Services; Private companies	28.4

25	Introduction of efficient electric motors	A large part of the total electricity consumption in industries comes from electric motors. This measure envisages the replacement of outdated motors currently in use with new, more efficient motors.	Increasing the competitiveness of industrial products by improving efficiency in the production process and reducing resource use.	Technical	New efficient electric motors installed in a large number of companies	Energy	CO ₂	2025	Ministry of Energy, Mining and Mineral Resources, Energy Regulatory Commission, Water Services and Municipal Waste Management Services; Private companies	33.0
26	Introduction of more advanced technologies	Advanced industrial technologies offer great opportunities to further reduce energy consumption with potentially lower costs, as well as environmental benefits. In addition, they can help to accelerate progress in various industry branches.	Introducing more advanced technologies into industrial processes, which will also enable greater use of environmentally friendly fuels.	Technical	In implementation	Energy	CO ₂	2025	Government of the Republic of North Macedonia; Ministry of Environment and Physical Planning; Ministry of Energy, Mining and Mineral Resources, Regulatory Commission for Energy, Water Services and Municipal Waste Management Services; Private investors	237.2
27	Increased use of railways	The measure envisages the redirection of part of the passenger and freight traffic to rail transport, by improving the infrastructure and operational conditions. The measure includes: promotional and information campaigns to raise public awareness; investing in stations and improving "access to stations"; increasing network security and expanding network coverage	Increasing the share of rail transport of passengers and goods, with the aim of improving energy efficiency and reducing emissions in the Transport sector.	Technical, informative	Under implementation	National	CO ₂	2025	Government of the Republic of North Macedonia; Ministry of Transport; Ministry of Energy, Mining and Mineral Resources; AD Makedonski zheleznici - transport; Public institutions (end users); Private companies	91.7
28	Renewal of the national fleet of passenger cars	The measure envisages the application of more advanced technologies to improve energy efficiency in the Transport sector, through a reduction in VAT from 18% to 5% for hybrid and electric vehicles, financial incentives, gradual equalization of excise duties for diesel and gasoline and obligations for public institutions for procurement of vehicles with low CO ₂ emissions (up to 90 gCO ₂ /km by 2020 and 50 gCO ₂ /km Fiscal measures - Preparation and implementation of measures to reduce the VAT rate from 18% to 5% for hybrid and electric vehicles, as well as preparation of measures to gradually equalize excise duties on diesel and gasoline. Incentives - Design and implementation of a programme for financial incentives/subsidies for the purchase of vehicles with lower emissions	Gradual renewal of the state vehicle fleet with more efficient vehicles with low CO ₂ emissions, in order to reduce energy consumption and emissions in road transport.	Regulatory, political, informative	Adopted Vehicles Law (August 2019); Adopted Law on Vehicle Tax; Adopted bylaws arising from the Law on Vehicle Tax	National	CO ₂	2025	Government of the Republic of North Macedonia; Ministry of Transport; Ministry of Finance; Ministry of Energy, Mining and Mineral Resources; Ministry of Interior Public institutions (end users)	22.1

		Public procurement - Introduction and application of criteria for public procurement of low-emission vehicles in public institutions, with established limit values for CO ₂ emissions ≤90 gCO ₂ /km and ≤50 gCO ₂ /km.								
29	Renewal of the rest of the vehicle fleet (heavy goods vehicles, buses)	The measure includes tightening the regulations and criteria for import and renewal of the vehicle fleet (light and heavy goods vehicles and buses), with the aim of gradually introducing vehicles with higher Euro standards.	Reducing local air pollution from road traffic.	Regulatory, political, informative	Adopted Vehicles Law (August 2019); Adopted bylaws arising from the Law on Vehicle Tax	Transportation	CO ₂	2025	Government of the Republic of North Macedonia; Ministry of Transport; Ministry of Energy, Mining and Mineral Resources; Association of Road Transport Operators; Private companies	98.2
30	Advanced mobility	The measure provides for the introduction and support of bicycle and electric scooter rental systems, encouraging walking and optimizing parking, with the aim of redirecting short car trips towards active and micromobility modes of transport.	Reduction of local air pollution from road traffic,	Political, informative, financial	To continue implementing campaigns and subsidies for purchasing new bicycles and renting bicycles; To continue building new bicycle paths	National	CO ₂	2025	Ministry of Energy, Mining and Mineral Resources; Local self-government units; End users	3.0
31	Construction of the railway to the Republic of Bulgaria	Construction of the railway line to the Republic of Bulgaria (Corridor VIII).	Improving regional connectivity and increasing freight and passenger transport via rail through the construction of the railway to the Republic of Bulgaria.	Investment, technical, strategic	Completion of the construction of the Beljakovce–Kriva Palanka section; realization of the Kriva Palanka–Deve Bair section; and implementation of the agreed activities for the cross-border railway tunnel.	National	CO ₂	2020	Government of the Republic of North Macedonia; Ministry of Transport	24.6
32	Electrification of transport	The measure includes the introduction and promotion of financial incentives for the purchase of electric vehicles, as well as the planning, construction and expansion of public charging infrastructure in urban areas and on major road routes, in order to ensure a reliable and accessible charging network and encourage wider use of electric vehicles.	Accelerating the electrification of road transport and reducing greenhouse gas emissions and local pollutants through support for electric vehicles and the development of charging infrastructure.	Regulatory, strategic, informative	Under implementation	National	CO ₂	2025	Government of the Republic of North Macedonia; Ministry of Transport; Ministry of Energy, Mining and Mineral Resources	97.8
33	Implementation of the Kigali Amendment on the phase-out of HFCs	The Kigali Amendment is an amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer. The amendment adds the potent greenhouse gases hydrofluorocarbons (HFCs) to the list of substances controlled under the Protocol that are to be phased out.	Phase out the use of hydrofluorocarbon (HFC) greenhouse gases	Technical and regulatory	Implementation of the HFC phase-out schedule, with the help of projects supported by the Montreal Protocol Fund	IPPU	HFCs	2024	Ministry of Environment and Physical Planning	225.6

		The Republic of North Macedonia has become the 94th country to ratify the Kigali Amendment to phase out HFC refrigerants. North Macedonia follows the schedule of the Kigali Amendment to the Montreal Protocol for Annex 5 countries, starting with a phase-out of HFCs in 2024 and ending with a permanent 80% reduction in 2045.								
34	Reducing CH ₄ emissions from enteric fermentation in dairy cows by 20%	By modifying the nutritional practices and diet of dairy cows, CH ₄ emissions from enteric fermentation can be reduced by 20%. It is estimated that the number of dairy cows under intensive livestock farming systems will increase from the current 1% to 25-30% in 2040. As a result of the high-yielding cows, CH ₄ emissions will also increase. However, by modifying the diet (adding carbohydrates, high-quality forages and tannins) in the feed, CH ₄ emissions will be reduced by 20%. This mitigation measure can be implemented by changing the diet on dairy farms. There is no need for additional subsidies and financial incentives for this measure, since the advantage of using high-quality forage feeds in the diet of high-yielding heads is seen in higher productivity (the profitability of high-yielding heads is achieved only if high-quality forage feeds are used in the diet and nutritional management techniques are introduced). Practical training and demonstrations would be sufficient for farmers.	Reducing the level of CH ₄ emissions derived from enteric fermentation of high-yielding dairy cows.	Technical support, education	TMR with partially modified feed composition is already being applied on several intensive farms containing about 1% of the total dairy cow population.	National	CH ₄	2025	MAFWE	35.0
35	Reduction of N ₂ O emissions by up to 20% during manure management on dairy farms with more than 50 heads	This measure stimulates green investments in infrastructure and technology, such as biogas systems and composting plants. In addition, the measure encourages stakeholder cooperation between farms, municipalities and waste suppliers to optimize resource efficiency and integration of circular economy. As a result of modified manure management from dairy cows, N ₂ O emissions can be reduced by 20%. It is estimated that the number of dairy cows in intensive farming conditions on farms with more than 50 cows will increase from 1% to 25-30% by 2040. All farms will need to implement improved manure management in order to reduce nitrogen losses from feces and urine through increased N ₂ O, NO _x emissions. Therefore, it is necessary to change and modify the	Reducing the level of N ₂ O emissions resulting from manure management on farms with high-yielding dairy cows. This measure aims to improve environmental sustainability and reduce greenhouse gas emissions from the agricultural sector, especially from large livestock	Technical support, education	On existing larger dairy farms, the planning process for modified manure management has begun; No concrete steps have been taken	National	N ₂ O	2025	Agency for Financial Support of Agriculture and Rural Development	2.1

		manure management system on farms. This mitigation measure takes into account adaptations in existing farms and moderate investments in new farms (if adaptation or construction of new farms is carried out), in accordance with existing environmental protection legislation, improved farm management techniques will be mandatory. There is a need for adaptation subsidies and incentives in the design and construction of new dairy farms.	farms practicing intensive dairy farming systems. This measure also aims to reduce greenhouse gas emissions and environmental pollution from large dairy farms in North Macedonia by improving manure management, promoting the use of organic fertilizers and converting organic waste into renewable energy through biogas production.							
36	Reduction of N ₂ O emissions by 13% from manure management on pig farms	This measure stimulates green investments in infrastructure and technology, such as biogas systems and composting plants. In addition, the measure encourages stakeholder cooperation between farms, municipalities and waste suppliers to optimize resource efficiency and integration of circular economy. Poor manure management is a key source of N ₂ O emissions and nitrogen leaking into water resources, contributing to air and water pollution. The measure is expected to result in improved manure management systems by 5% of small farms with intensive pig farming systems. By modifying manure management in pig farms, N ₂ O emissions can be reduced by 50%. It is estimated that the number of finishers and finishers produced per sow will increase, while the total number of sows will remain stable. The number of pig farms with more than 1000 finishers and/or 350 sows will also increase. Therefore, there will be a need to implement improved manure management systems in order to reduce nitrogen losses through N ₂ O emissions. In 2040, it is expected that 90% of finishers will be produced on large intensive farms, which will	Reducing the level of N ₂ O emissions resulting from manure management on farms for intensive breeding of high-yielding pigs. This measure aims to improve environmental sustainability and reduce greenhouse gas emissions from the agricultural sector, especially from smaller livestock farms practicing intensive pig breeding systems. This measure also aims to reduce greenhouse gas emissions	Technical support, education	in the implementation phase	National	N ₂ O	2025	Agency for Financial Support of Agriculture and Rural Development	0.4

		account for 75% of the sows in the country. The mitigation measure takes into account adaptations in existing farms and moderate investments in new farms. There is a need for adaptation subsidies and incentives in the design and construction of new farms. Modification of techniques for direct application of liquid manure to arable land is envisaged.	and environmental pollution from large-scale pig farms in North Macedonia by improving manure management, promoting the use of organic fertilizers and converting organic waste into renewable energy through biogas production.							
37	Reduction of N ₂ O emissions by 20% from manure management in dairy cows on farms with a capacity of less than 50 heads	Poor manure management is a key source of N ₂ O emissions and nitrogen leaking into water resources, contributing to air and water pollution. The measure is expected to result in improved manure management systems on 5% of small dairy farms. With modified manure management on dairy farms, N ₂ O emissions could be reduced by 30%. According to the report of the study under the project "Fourth National Climate Change Plan and Third Biennial Update Report on Climate Change under the UNFCCC", the most common system is dry manure management, where feces and urine, together with bedding (mostly wheat or barley straw) are removed from the barn daily or weekly and the manure is composted in a pile near the farm. Farmers do not use manure covers or tanks to collect liquid waste (slurry) from the manure pile. In the process of manure fermentation, the pile is usually stirred to aerate the lower layers, which have anaerobic conditions, and the surface environment is aerobic. Fermented manure is most often used as fertilizer for arable land for a period of 2-3 months (depending on the storage space on the farm and the possibility of using the field). Depending on the fermentation of the manure, the loss of nitrogen can be up to 60%. The loss of nitrogen and the reduction of N ₂ O emissions can be achieved by extending the fermentation (maturation) period to 6 months and covering the manure pile. Therefore, the measure concerns the support of	Reducing the level of N ₂ O emissions resulting from manure management on farms with high-yielding dairy cows with a capacity of less than 50 heads. This measure aims to improve environmental sustainability and reduce greenhouse gas emissions from the agricultural sector, especially from smaller livestock farms.	Technical support, education	None	National	N ₂ O	2030	Agency for Financial Support of Agriculture and Rural Development	0.7

		farmers on farms with a capacity of less than 50 dairy cows in order to ensure adequate storage of manure for a longer period of time.									
38	Encouraging and intensifying the application of "green manure" (sideration)	Siderates enrich humus, improve soil structure, aeration and water retention. Mineral fertilizers do not affect the physical and structural properties of the soil. Organic matter from siderates increases the activity of soil microorganisms and earthworms. Mineral fertilizers can reduce activity at high doses. Legume siderates fix atmospheric nitrogen and, through symbiotic nitrogen fixation with certain strains of bacteria, they enrich the soil with forms of nitrogen available to plants. Mineral nitrogen fertilizers are a quick source of available nitrogen, but are easily leached downward. The dense cover of siderates overcomes weeds; some have an allelopathic effect. Mineral fertilizers do not prevent the development of weeds. The root system of siderates prevents erosion and leaching of nutrients. Mineral fertilizers do not provide such protection. Organic plant mass incorporated into the soil creates permanent reserves of nutrients. Mineral fertilizers have a short-term effect. Sideration reduces the need for mineral fertilizers. Sideration affects the reduction of pollution and greenhouse gas emissions. Siderates have a positive impact on increasing biodiversity.	Replacing or reducing the use of synthetic mineral fertilizers in plant production, which will largely contribute to reducing CO2 emissions and increasing sinks.	Research, Educational, Technical	Planning phase	National	N ₂ O	2030	MAFWE	93.6	
39	Encouraging and intensifying the application of reduced tillage and organic crop production	There are a number of advantages to reduced/conservation tillage, but in the context of these recommendations, the most significant are reduced greenhouse gas emissions – due to lower fuel consumption and greater retention of organic carbon in the soil. In terms of reducing greenhouse gas emissions, the advantage of the organic crop production method lies in the reduced dependence on industrial mineral fertilizers and synthetically produced pesticides (which require a lot of energy to produce). The greater number of hectares certified for organic crop production contributes to an increase in the amount of carbon stored in the soil, as well as to an increase in the level of biodiversity, both below and above ground.	Reducing greenhouse gas emissions – due to lower fuel consumption, synthetically produced fertilizers and pesticides, as well as greater retention of organic carbon in the soil	Research, Educational, Technical	In implementation	National	N ₂ O	2030	MAFWE	60.6	

40	Encouraging and intensifying the method of alternating wetting and drying of surfaces in rice cultivation.	Rice fields have been routinely and currently irrigated by flooding the entire surface area through so-called drainage/irrigation systems. Under these anaerobic (oxygen-free) conditions, organic matter in the soil and from plant residues decomposes through microbial methanogenesis, a process that releases methane (CH ₄). When rice fields are continuously flooded, high levels of methane emissions occur. The "Alternate Wetting and Drying (AWD)" method is a modern, efficient and sustainable technique for irrigating rice fields, developed by IRRI (International Rice Research Institute). It is applied in flooded rice cultivation systems. If implemented, it encourages and intensifies the method of rice cultivation through alternating wetting and drying of the surfaces, and can contribute to the reduction of methane emissions from rice fields. According to several scientific and expert literature sources, rice cultivation according to this method, due to the occasional creation of aerobic conditions in the rice fields, can contribute to the reduction of CH ₄ emissions by 30–70%.	Optimal water use, reduction of methane emissions (by 30–70%), improvement of root system aeration. Reduction of irrigation costs. This measure can contribute to maintaining or even increasing the average rice yield achieved in rice fields in the RNM.	Research, Educational, Technical	idea	National	CH ₄	2030	MAFWE	1.0
41	Establishing integrated forest fire management	Forest fires are a very serious problem with forest loss and a source of greenhouse gas emissions. In the period from 1999 to 2019, the average annual number of forest fires was 229, the average annual burned area was 10,985 ha and the average annual damage was 6.9 million euros. The total burned area under forest in the same period is about 219,163 ha with a total damage of about 138 million euros. This measure covers the protection of the forest area by extinguishing forest fires and the damage caused by forest fires.	Reducing the average annual burned area by 6000 ha	Reducing forest fires	The location for the construction and establishment of a forest fire training centre within the framework of the PE "Nacionalni Shumi" has already been selected, a plan has been prepared and 8 vehicles have been purchased.	National	CO ₂	2030	MAFWE through PE "Nacionalni Shumi"	n/a
42	Afforestation	Afforestation and restoration of degraded forests can change the land and can affect the provision of land-related goods and services. The provision of goods and services (to people and societies) and the establishment of traditional cultures, as well as the ecology of the land should also be taken into account. According to many strategic documents, there are about 1,500,000 ha of barren land for afforestation or restoration.	Afforestation of 5000 ha of barren land with oak (Quercus spp.)	Afforestation of barren land	There are nurseries producing more than 8,000,000 seedlings per year.	National	CO ₂	2025	MAFWE	n/a

43	Conversion of arable land with a slope greater than 15% into permanent meadows and pastures	Crop production on sloping land causes intensive processes of soil erosion and mineralization of soil organic matter. These processes lead to intensive decomposition of soil organic matter and emissions of carbon from the soil into the atmosphere. The conversion of these areas into permanent pastures (pastures, meadows) will significantly reduce the intensity of soil organic matter depletion and soil carbon emissions and will lead to carbon sinks. In areas with a slope greater than 15%, a document published by MANU in 2020 (Climate Change) recommends that those sloping areas where cereal crops are grown be converted into meadows and pastures. This land use conversion and change in the production system may affect the net annual income of primary producers. Therefore, implementation should be supported by incentives, especially in the first years of conversion in order to bridge the possible loss of income in agricultural holdings.	Conversion of arable land with a slope greater than 15% into permanent meadows and pastures	Educational, Technical	in the implementation phase	National	CO ₂	2025	MAFWE	3.7
44	Contour cultivation of arable agricultural land on sloping terrain (5-15% slope)	Regular tillage in agricultural crop production involves massive disturbance of the topsoil, which causes intensive mineralization of soil organic matter (SOM) and CO ₂ emissions. Continuous tillage of arable land on sloping terrain usually causes intensive soil erosion processes. Field experiments have shown that the amount of eroded soil sediment during tillage in the direction of the terrain slope is many times greater than in contour tillage (in the direction of the isohypses) and crop cultivation. This eroded sediment is rich in organic matter (SOM), which is rapidly mineralized under such circumstances, resulting in the release of a significant amount of soil carbon into the atmosphere. Contour cultivation means that all agrotechnical activities should be transverse to the slope of the terrain, i.e. in the direction of the isohypses. This measure is easy to implement, as it does not require special technical capacities and knowledge. In practice, farmers are usually not aware of its importance and impact on the overall fertility of the soil. With a systematic campaign to increase awareness	Reducing topsoil erosion and preserving organic matter in the soil	Educational, Technical	Contour cultivation tested in practice at two experimental locations; Contour cultivation promoted among farmers within the framework of several national and international projects	National	CO ₂	2025	MAFWE	28.0

		among farmers, this measure can be widely adopted.								
45	Cultivation of orchards and vineyards, on sloping terrain (slope of 5-15%), with sowing of perennial grass crops or mixtures of grass crops between the rows	In vineyards and orchards in locations where rows run along the slope, intensive classical cropping systems cause soil erosion and depletion of its organic matter, which in turn leads to increased carbon emissions from the soil. Changing the cropping system and planting perennial herbaceous species or mixtures of herbaceous crops between the rows can significantly mitigate soil organic matter losses and carbon emissions. This measure can be implemented without major efforts and with low initial costs.	Reducing soil erosion and increasing soil organic matter in vineyards and orchards on sloping terrain (5-15% slope)	Educational, Technical	in the implementation phase	National	CO ₂	2025	MAFWE	8.9
46	Using biochar to increase the carbon sink in agricultural land	Agricultural soils in the country are characterized as having relatively low carbon content and average to low fertility. The application of biochar can improve soil water retention capacity, soil nutrient storage and increase yield. Biochar can absorb up to 3 times more CO2 than its weight, due to its high carbon concentration. Biochar was included for the first time as a promising negative emission technology in a new IPCC special report: "IPCC Special Report on the Impact of Global Warming of 1.5 °C Above Pre-Industrial Levels and Associated Global Greenhouse Gas Emission Pathways, in Relation to Strengthening the Global Response to the Threat of Climate Change, Sustainable Development and Poverty Eradication Efforts" published in 2018. The process of applying biochar should go through several steps: i) research, ii) development of appropriate technology for different soil and crop combinations, iii) experimental/demonstration sites, iv) development of a support measure from national agricultural support programmes, v) promotion of the measure. This is a new measure and research is needed.	Reducing soil erosion and increasing carbon sinks (absorption and sequestration) and binding of organic matter in the soil.	Research, Educational, Technical	idea	National	CO ₂	2030	MAFWE	110.0
47	Installation of photovoltaic irrigation systems	Installation of a photovoltaic irrigation system with an installed capacity of 2.4 kW, capable of operating with a 3-phase 1.1 kW pump. Both cases are considered as mitigation practices, replacement of the petrol pump with a consumption of 0.3 liters of petrol per hour, with a 3-phase AC pump and the addition of a photovoltaic one and	Mitigation by replacing non-renewable energy sources for pumping water with renewable ones, thus	Research, Educational, Technical	There is a possibility of receiving support from IPARD 3 funds. The measure provides up to 65% co-financing and promotion of photovoltaic irrigation if the framework of this measure is feasible.	National	CO ₂	2025	MAFWE	93.3

		replacement of the 1.1 kW electric pump with a 3-phase AC pump and the addition of a photovoltaic one. The measure is suitable for already established irrigation systems on the farm, but also for the new establishment of irrigation systems with a water source on the farm. The measure is compatible with the IPARD 3 measure "Production of energy from renewable sources for own consumption, through the processing of plant and animal products from primary and secondary biomass (except biomass from fishery products) for the production of biogas and/or biofuels, use of solar energy, wind turbines, geothermal energy.	reducing CO2 emissions.							
48	Establishment of regional centres for integrated waste management	The measure covers the establishment and commissioning of five regional centres for integrated waste management that will include controlled collection and treatment of landfill gas by flaring, composting of biodegradable waste and modern systems for the treatment of separate waste streams. The implementation of the measure eliminates the practice of open burning of waste, reduces emissions of CH ₄ and other pollutants from landfills, and the treatment of medical waste will be carried out through sterilizers instead of incineration, thus ensuring a significant improvement in the protection of the environment and public health.	Reducing greenhouse gas emissions and pollutants through the establishment of regional centres for integrated waste management with controlled treatment technologies and safe waste handling.	Technical	Funding for other regions; Construction of regional waste management centres begins	Regional	CH ₄	2026	Ministry of Environment and Physical Planning; Municipalities; Public utility companies for waste management; Regional waste management companies; Inter-municipal waste management board	270.0
49	Closure and rehabilitation of existing substandard landfills	The measure covers the systematic closure, rehabilitation and reclamation of existing substandard landfills and illegal landfills, with the aim of stopping uncontrolled landfilling, open burning of waste and continuous emissions of pollutants and greenhouse gases. The implementation of this measure is inextricably linked to the establishment and commissioning of regional centres for integrated waste management, which provide alternative, safe and environmentally acceptable capacity for waste treatment and disposal. Only with the parallel implementation of both measures, the permanent closure of substandard landfills, reduction of CH ₄ emissions, protection of soil and water, as well as improvement of the health and quality of life of the population will be ensured.	Elimination of substandard landfills and reduction of greenhouse gas emissions and local pollution through their closure and rehabilitation	Technical	Implementation phase	Regional	CH ₄	2026	Ministry of Environment and Physical Planning; Municipalities; Public utility companies for waste management; Regional waste management companies; Inter-municipal waste management board	
50	Waste selection and recycling	The measure covers the establishment and improvement of waste selection	Reducing the quantities of	Technical, regulation	Implementation phase	Waste	CH ₄	2026	Ministry of Environment and Physical Planning;	53.2

		systems, including separate collection of paper, plastic, metal, glass and biodegradable waste, with the aim of increasing recycling rates and reducing the organic fraction sent to landfills, which directly contributes to reducing CH ₄ emissions from the Waste sector and improving overall waste management. This measure will help achieve the municipal solid waste recycling targets of 45% in 2035 and 65% in 2045, as defined in the National Waste Management Plan 2021-2031, while the measure also takes into account extended producer responsibility schemes, including the targets set in the Law on Packaging and Packaging Waste Management, thus enabling and supporting the achievement of the objectives of the circular economy.	waste going to landfill and greenhouse gas emissions through the introduction and expansion of waste selection systems						Municipalities; Public utility companies for waste management; Regional waste management companies; Inter-municipal waste management board	
51	Waste generation prevention	The measure includes a package of preventive interventions aimed at reducing waste generation "at source", through changes in consumer habits, replacement of single-use products with reusable alternatives, promotion of reuse and repair, reduction of food waste, eco-design and optimization of packaging, as well as economic and regulatory instruments at local and national level (campaigns, educational programmes). The measure directly contributes to reducing the quantities ending up in landfills and indirectly to reducing CH ₄ emissions from landfilling, through a long-term reduction in the total quantities of waste generated.	Long-term prevention and reduction of municipal waste generation per capita through changing consumption patterns and systematic introduction of waste prevention measures	Technical	Implementation phase	Waste	CH ₄	2026	Ministry of Environment and Physical Planning; Municipalities; Public utility companies for waste management; Regional waste management companies; Inter-municipal waste management board	n/a
52	Construction of new wastewater treatment plants	The measure covers the construction and commissioning of new wastewater treatment plants with the aim of replacing uncontrolled wastewater discharge with organized and efficient treatment, resulting in a reduction of CH ₄ and N ₂ O emissions from the Waste sector, improvement of water quality and compliance with national and European legislation. Within the framework of this measure, it is assumed that in the next five years a total of 10 new wastewater treatment plants will be built and commissioned, in the following municipalities: Veles, Kavadarci, Shtip, Delchevo, Debar, Vevchani, Bitola, Tetovo, Gostivar and Skopje.	Reducing greenhouse gas emissions from wastewater treatment through the construction and commissioning of new treatment plants.	Technical	Planning phase and implementation phase (Skopje, Bitola)	Waste	CH ₄ , N ₂ O	2026	Ministry of Environment and Physical Planning; Municipalities; City of Skopje; Public utility companies for water supply and sewerage; Ministry of Finance	25.0
53	Improved treatment of	This measure assumes industrial sludge treatment processes, which	Increasing the treatment rate	Regulation, Technical	/	Waste	CH ₄ , N ₂ O	2026	Ministry of Environment and Physical Planning;	62.4

	industrial wastewater	include mechanisms and processes used to treat waters that are in some way contaminated by anthropogenic industrial or commercial activities before their discharge into the environment or their reuse. This measure, i.e. the treatment of industrial wastewater, is also part of the integrated environmental permits of industrial facilities.	of industrial wastewater, through sludge reduction						Public municipal waste management enterprises; State Environmental Inspectorate; Inter-municipal waste management board; Authorized environmental inspectors (municipalities)	
54	Introduction of MRVA system and national carbon pricing mechanism	The measure envisages the development and phased implementation of a carbon pricing mechanism in the period 2025–2029, in preparation for integration into the EU ETS. It includes the establishment of a MRVA system, a digital registry, an institutional framework and training of all relevant stakeholders.	To establish a functional national carbon pricing mechanism supported by a MRVA system and alignment with the EU ETS by 2030.	Regulatory, institutional, capacity building	Draft version of the law on climate change prepared; Preparation of the legal framework; Initial MRVA activities	Energy	CO ₂	2025	Government of the Republic of North Macedonia; Ministry of Environment and Physical Planning; Ministry of Energy, Mining and Mineral Resources; Ministry of Finance	n/a
55	Just Transition Programme	The measure covers the establishment of institutional structures, the development of regional strategies, the retraining of workers and the development of energy storage capacities. It supports the gradual abandonment of coal and economic transformation.	Development of a programme for a socially responsible and just transition	Regulatory	Planned steps	Energy	CO ₂	2025	Government of the Republic of North Macedonia; Ministry of Energy, Mining and Mineral Resources; Public Enterprise Elektrani na Severna Makedonija (ESM); Ministry of Labor and Social Policy	n/a
56	Identification of suitable locations for the construction of photovoltaic and wind power plants	In accordance with Recommendation 2024/1-MC-EnC on accelerating the implementation of renewable energy sources and the application of the "energy efficiency first" principle, this measure provides for the establishment of a legal and institutional framework for the identification and mapping of suitable locations for the development of RES, as well as the provision of the necessary grid and storage infrastructure. In this regard, in 2023, MANU and Eko Svest, with the support of the Natural Conservancy, prepared a study on the utilization of mines and other degraded (brownfield) locations for the construction of solar and wind power plants. The study is the basis for development of a national methodology that will enable the identification of suitable areas without significant impact on the environment and local communities. The methodology will take into account spatial, ecological, technical and economic criteria, as well as the availability of infrastructure and anthropogenic activities.	Increasing the share of renewable energy sources in the electricity sector and in the heating and cooling sectors; reducing energy dependence; improving the security and resilience of the energy system; increasing the grid's ability to integrate RES.	Technical	Adoption of methodology; Legal implementation; Definition of acceleration areas; Public campaigns; Integration into national plans	Energy	CO ₂	2025	Government of the Republic of North Macedonia; Ministry of Energy, Mining and Mineral Resources; Public Enterprise Elektrani na Republika Severna Makedonija (ESM); Ministry of Labor and Social Policy; Donors	n/a

		Additionally, renewables acceleration areas will be defined, in accordance with Directive (EU) 2023/2413, applying the "do no harm" principle. In parallel, the measure includes the implementation of pilot projects (photovoltaic, wind, hydro and storage systems), public campaigns and the integration of lessons learned into national plans. Projects such as photovoltaic power plants in Oslomej and Bitola, the Bogdanci wind farm, rehabilitation of hydropower plants and solar central heating in Bitola are already being implemented. Around 26 million euros in investments have been provided for these activities, as well as technical support for the preparation of project documentation.								
57	Smart communities	Macedonia has significant potential for development of small-scale photovoltaic systems, especially on rooftops and degraded areas. One of the key mechanisms for increasing these capacities is the development of energy communities (civic and renewable energy communities), which enable joint investment, production and use of energy. In 2023, the Law on Cooperatives was adopted, which allows for the establishment of cooperatives in the Energy sector, while energy legislation applies to aspects that are not regulated. The measure aims to create favourable conditions for the development of energy communities by removing administrative and regulatory barriers, as well as by raising public awareness. Additionally, the measure is complementary to the simplification of permit procedures (one-stop-shop), the introduction of long-term renewable energy contracts (PPAs), as well as energy efficiency measures (especially in residential buildings). It also contributes to reducing import dependence, increasing domestic production and developing the internal energy market.	Increasing the share of renewables in the electricity sector; transitioning to less carbon-intensive fuels; increasing consumer participation in energy markets; improving security of supply.	Educational and technical	Law on Cooperatives adopted; Legal basis for energy communities established	Energy	CO ₂	2025	Universities (or secondary schools); Non-governmental organizations, etc.	n/a
58	Construction of a 400 kV cross-border transmission line between the Republic of North Macedonia and	The measure covers the construction and modernization of the transmission network in North Macedonia, including new interconnections (in particular with Albania and Greece), reconstruction of the 110 kV network and introduction of new system management	Strengthening the electricity transmission network for the integration of renewable sources and	Technical	Construction contract signed; Interconnection projects with Albania launched; Modernization of 110 kV network	Energy	CO ₂	2020	MEPSO; Ministry of Energy, Mining and Mineral Resources	n/a

	the Republic of Albania	technologies. The objective is to enable secure integration of renewable energy sources, improve system stability and increase regional connectivity. Activities include the construction of new transmission lines and substations, digitalization of the network, introduction of dynamic load management (DLR) systems, as well as improvement of reactive power through shunt reactors.	increasing cross-border connectivity.							
59	Development of cross-border natural gas transmission infrastructure	On 10.07.2015, the Republic of Macedonia became a signatory to the Memorandum of Understanding on a Common Approach to Addressing Natural Gas Diversification and Security of Supply Challenges, within the framework of the Central and South-Eastern Europe Gas Connectivity Initiative (CESEC). ESM AD Skopje has started implementing the obligations arising from this initiative, which are aimed at promoting the diversification of natural gas supply and ensuring security of supply in the region. This should happen through the improvement of regional infrastructure and integration of natural gas markets through the joint engagement of all EU Member States and Energy Community Contracting Parties. This initiative should ensure the supply of the necessary quantities of natural gas to all consumers in the Central and South-Eastern Europe region, including the Republic of North Macedonia. In addition, there is an initiative to build a gas pipeline with the Republic of Serbia. The gas pipeline to Serbia could provide an additional - alternative source and transit opportunity. Both initiatives can increase the system utilization rate, which has the potential to reduce tariffs and aid gasification efforts in the Republic of North Macedonia.	Diversification of natural gas supply, increasing market competitiveness and reducing energy prices.	Technical and regulatory	Construction of an interconnector with Greece has begun; Preparation of studies for other interconnectors.	Energy	CO ₂	2020	NOMAGAS AD Skopje	n/a
60	Development of a gas pipeline network	North Macedonia has an ambitious gasification plan, a detailed list of planned infrastructure projects, with their implementation timeframes. The increased level of access to the natural gas transmission network is particularly targeted at industrial consumers (who are, in fact, the most affected by the measures in the green scenario). This is particularly important because natural gas as a fuel is	Improving the natural gas transmission infrastructure in the Republic of North Macedonia	Technical	In implementation	Energy	CO ₂	2020	NOMAGAS AD Skopje	n/a

		particularly significant for the implementation of measures aimed at decarbonizing the Industry sector. In addition, with the implementation of this measure, air quality will significantly improve.								
61	Development and construction of a natural gas distribution network	North Macedonia has an ambitious gasification plan, and natural gas is one of the resources that can significantly contribute to the realization of the goals of achieving the energy transition by 2040. At the same time, with the implementation of this measure, the air quality on the territory of the country will significantly improve.	Diversification of energy resources in Macedonia	Technical	Planned steps	Energy	CO ₂	2020	Ministry of Energy, Mining and Mineral Resources; NOMAGAS AD Skopje; Local self-governments	n/a
62	Regional integration of electricity markets	The interconnection and integration of the wholesale (day-ahead) electricity market within the Energy Community, and the development of a free electricity market, have an important role for the Macedonian Energy sector. The development of domestic energy capacities is planned in the context of an integrated regional and European electricity market. The integration will enable all market participants to access the single European market through implicit allocation of transmission capacities, thereby increasing competition, liquidity and market efficiency. This will lead to better allocation of resources, cost reduction and increased security of supply. Within the framework of the measure, a day-ahead market has already been established (from 2023), and the next step is joining the European SDAC and SIDC mechanism through market coupling with neighbouring countries (Greece, Albania and Kosovo). This process requires the definition of a Capacity Calculation Region (CCR), coordination with TSOs and NEMOs, as well as approval by ACER.	Increasing competitiveness in electricity markets	Regulatory	Harmonization with EU regulations; Coordination with regional operators; Market participant readiness; Development of IT systems	Energy	CO ₂	2025	National Electricity Market Operator (NEMO)	n/a
63	Variable electricity demand depending on the price of electricity	The measure envisages the introduction of price signals in the Electricity sector in order to enable an active role for consumers in demand management (demand response – DR). This approach allows consumers to adjust their consumption depending on electricity prices, i.e. to reduce consumption during periods of high prices and increase it when prices are lower. The introduction of DR will contribute to better balancing of the system.	Introducing price signals for users that will stimulate electricity consumption during periods when the price of electricity is lower.	Regulatory	DR analyses prepared; Regulatory activities underway	Energy	CO ₂	2025	Participants in the electricity market; Ministry of Energy, Mining and Mineral Resources	n/a

		increasing energy efficiency and reducing the need for additional production capacities. The measure includes the development of dynamic tariff models (time-of-use, real-time pricing), the implementation of smart meters, the creation of financial incentives for consumers and the development of digital platforms for automated consumption management. The Energy Regulatory Commission will play a key role in the implementation, providing an appropriate regulatory framework, while operators and suppliers will be responsible for technical implementation. This measure is expected to improve system stability, reduce costs and facilitate the integration of renewable energy sources.								
64	Reducing energy poverty and protecting vulnerable consumers	The measure aims to ensure fair energy access for all citizens, especially vulnerable categories, in conditions of gradual liberalization of the energy market and expected price increases. In accordance with the Energy Law, a methodology for measuring energy poverty has been developed, according to which a significant proportion of households are exposed to risk. The measure envisages a combination of financial and structural measures, including subsidies, social tariffs and energy efficiency programmes, to reduce energy costs for vulnerable households. In addition, programmes for home renovation, replacement of inefficient appliances and introduction of renewable energy sources at the household level will be developed. The measure envisages the establishment of a national registry for energy poverty, the definition of targets for its reduction and the introduction of mechanisms for protection against price shocks. At the same time, coordination between institutions and integration with existing social programmes will be ensured. The measure also envisages the development of one-stop-shop centres and engagement of local energy advisors to support citizens.	Protection of vulnerable consumers and reduction of energy poverty in conditions of market liberalization.	Regulatory	Developed methodology for energy poverty; Energy Law adopted	Energy	CO ₂	2025	Ministry of Energy, Mining and Mineral Resources; Suppliers of electricity, natural gas and heat	n/a
65	Development of technologies and research	The measure aims to systematically strengthen the national research and innovation ecosystem in order to support the energy transition, through	Accelerating research, development and application	Research	Establishment of INOVA – Agency for Innovation Activity, Scientific and	Energy	CO ₂	2025	Ministry of Education and Science; Fund for Innovation and Technological	n/a

	capacities for energy transition	the development and application of innovative technologies in energy. In this context, it is envisaged to deepen cooperation between the academia, research institutions, industry and policymakers, in order to create an integrated approach to the development of new technological solutions. Special focus is placed on identifying and supporting priority areas such as renewable energy sources, energy storage, hydrogen technologies, digitalization of energy systems and energy efficiency. The measure envisages the development of funding programmes for research and innovation projects, as well as support for technology transfer and their commercialization. Additionally, mechanisms will be established to better connect the education system with the needs of the labour market, through the development of new curricula, training and specialized skills in the field of clean energy. This will enable the creation of a qualified workforce that can actively participate in the energy transition process. The measure also envisages active involvement in European and international research and innovation programmes (such as Horizon Europe), with the aim of attracting additional funding and integration into European innovation networks.	of advanced technologies to support the energy transition and decarbonization of the economy.		Technological Development and Entrepreneurship					Development; Chamber of Commerce of the Republic of North Macedonia	
66	“Green” education and training on energy efficiency and transition	The measure aims to transform the education system by integrating content related to the energy transition into all levels of education, from primary to higher education. This includes revising and modernizing curricula to include topics such as renewable energy sources, energy efficiency, climate change and sustainable development. Special emphasis is placed on developing practical skills and competencies through vocational training, laboratory work and cooperation with industry. The measure also envisages strengthening the link between education, research and the labour market, in order to provide a workforce that meets the needs of the energy transition. Additionally, participation in European research and education programmes	Integration of energy efficiency, renewable energy and energy transition topics into the education system and development of a skilled workforce for a green economy.	Research	Partially included sustainable development topics in curricula; Participation in European educational programmes	Energy	CO ₂	2025	Universities, secondary and primary schools	n/a	

		(e.g. Horizon Europe, Erasmus+) will be encouraged, which will enable access to knowledge, finance and international partnerships. An important segment of the measure is also the support of scientific research work in the field of energy and sustainable development.								
67	Cross -sectoral and geographical mobility of researchers	The transfer of knowledge and experience between researchers from industry and academia is extremely important for building sustainable domestic human resources capacities. Cross-border mobility and exchange of personnel between countries are also of particular importance for this. An example of a concrete measure could be – doctoral students at universities could be supported and stimulated to do their doctoral research within private companies that will cooperate with their home universities.	To encourage cross-sectoral and geographical mobility of researchers	Research, regulation	Steps taken	Transportation	CO ₂	2025	Universities and industry	n/a
68	Alignment of S3 and SME strategy with the priorities of the Energy Union	The measure aims to ensure the systematic inclusion of the Energy Union priorities in the national strategies for smart specialization (S3) and the development of small and medium-sized enterprises. Although priority areas and objectives are defined in the existing strategies, clean energy technologies are not explicitly covered, which makes it difficult to monitor and support them within the existing monitoring system. In this regard, national targets for financing and developing clean energy technologies will be defined, as well as indicators for monitoring research, innovation and competitiveness. This will enable better targeting of research and development funds, monitoring of scientific production and industrial participation, as well as improving the country's position in terms of technological development. To implement the measure, a working group with representatives from relevant institutions will be established, which will coordinate the harmonization of strategies. An analysis of the current state of clean energy technologies, their market potential and export opportunities will be conducted. Based on this, specific sub-goals will be defined, such as investments in research and development, number of scientific publications, patents and mobility of researchers.	Integrating the Energy Union priorities into the Smart Specialization Strategy (S3) and the Small and Medium Enterprises (SME) Strategy.	Research, technical and volunteer	Defined priorities in the S3 strategy	Energy	CO ₂	2025	Small and medium-sized enterprises; Ministry of Education and Science	n/a

		The results of this measure will be used to update national strategies and to better integrate energy priorities into economic and innovation development.								
69	Development of capacities for the production, transport, storage and use of hydrogen	The measure aims to establish prerequisites for the development of the hydrogen economy in Macedonia through the development of an appropriate legal framework, institutional capacities and technical standards. The introduction of hydrogen as an energy carrier will contribute to the decarbonization of the industry and the energy sector, as well as to increasing the flexibility of the system. The measure envisages activities to strengthen institutional capacities (Ministry of Energy, Regulatory Commission, NOMAGAS), as well as the implementation of pilot projects for the production, storage and use of hydrogen. These pilot activities will provide practical experiences for the definition of technical standards and licensing procedures. In addition, technical guidelines and specifications for hydrogen infrastructure will be developed, and the gas network will be prepared for the gradual integration of hydrogen. The measure is linked to the development of green hydrogen for industrial applications and to research and innovation strategies. It also builds on regional initiatives and studies financed by international funds.	Enabling the use of hydrogen as an energy carrier in the energy system.	Research and regulatory	Initial analyses and studies prepared	Transportation	CO ₂	2025	Ministry of Energy, Mining and Mineral Resources; NOMAGAS	n/a

2.5 BRIEF SUMMARY OF GREENHOUSE GAS EMISSIONS, SINKS AND TRENDS

This section presents Table 10 with summary greenhouse gas emissions and sinks for the period 1990–2022, presented by gas and sector. The table covers total emissions and net emissions, with the results presented as values with and without the inclusion of the FOLU sector, in order to ensure clearer comparability of trends and the role of sinks in the overall emissions balance.

Table 10 Summary of emissions and sinks by gas and sector for the entire period 1990-2022 (in accordance with paragraph 91 of the MPGs)

Greenhouse gases (Emissions/sinks)	Base year 1990	2000	2005	2010	2015	2020	2022	difference between 1990 and the last reporting year
	(Gg CO ₂ eq)							(%)
CO ₂ without FOLU	10,038.71	10,200.67	9,682.90	9,147.15	7,972.69	7,491.54	8,323.42	-20.6%
CO ₂ with all sectors	8,228.32	20,061.72	7,486.74	8,484.92	6,916.22	3,733.129	5,239.43	-57.0%
CH ₄ without FOLU	1,985.06	1,882.24	1,841.84	1,807.12	1,879.02	1,763.97	1,676.05	-18.4%
CH ₄ with all sectors	1,985.06	1,882.24	1,841.84	1,807.12	1,879.02	1,763.97	1,676.05	-18.4%
N ₂ O without FOLU	415.52	364.91	398.03	396.18	397.77	659.85	648.99	36.0%
N ₂ O with all sectors	415.52	364.91	398.03	396.18	397.77	659.85	648.99	36.0%
HFCs	0.00	4.51	99.54	231.64	306.69	295.95	286.87	
PFCs	82.57	56.63	0.30	4.65	0.00	0.00	0.00	-20.6%
Unspecified mix of HFCs/PFCs	NE	NE	NE	NE	NE	NE	NE	
SF ₆	NE	NE	NE	NE	NE	NE	NE	
NF ₃	NE	NE	NE	NE	NE	NE	NE	
Total (excluding FOLU)	12,521.86	12,508.96	12,022.61	11,586.74	10,556.17	10,211.31	10,935.33	-14.5%
Total net (all sectors)	10,711.47	22,370.01	9,826.45	10,924.51	9,499.70	6,452.90	7,851.34	-36.4%
Total (without FOLU, with indirect)	NE	NE	NE	NE	NE	NE	NE	
Total net (all sectors, including indirect)	NE	NE	NE	NE	NE	NE	NE	
Greenhouse gases (Emissions/sinks) by sector	Base year 1990	2000	2005	2010	2015	2020	2022	difference between 1990 and the last reporting year
								(%)
1. Energy	9,523.76	9,735.37	9,267.62	8,890.36	7,725.65	7,279.00	8,191.32	-16.3%
2. IPPU	924.47	883.15	857.10	822.42	875.07	790.68	715.89	-29.1%
3. Agriculture	1,556.72	1,306.18	1,261.54	1,192.64	1,210.29	1,339.57	1,199.32	-29.8%
4. FOLU	-1,810.40	9,861.05	-2,196.16	-662.22	-1,056.47	-3758.4	-3,085.90	41.3%
5. Waste	516.65	584.28	636.33	681.05	745.16	802.33	830.97	37.8%
6. Other	NO	NO	NO	NO	NO	NO	NO	
Total net (all sectors)	10,711.20	22,370.03	9,826.42	10,924.24	9,499.70	6,452.2	7,851.60	-36.4%

NE – not estimated

NO – no emissions

2.6 PROJECTIONS FROM SCENARIOS FOR REDUCING GREENHOUSE GAS EMISSIONS

The Revised (Enhanced) Nationally Determined Contribution (ENDC) (2021) considers the following emission scenarios to estimate future greenhouse gas emissions (these are updated with the latest data from the 2025 Climate Change Mitigation Measures document):

- **Scenario Without Measures (WOM)** - Business-As-Usual, assuming there are no new mitigation policies, projecting a 78% increase in total emissions by 2030 compared to 1990.
- **Scenario With Existing Measures (WEM)** - Includes policies that are currently implemented with existing measures.
- **Scenario With Additional Measures (WAM)** - Includes an additional planned set of mitigation measures in addition to existing policies.*

**An enhanced scenario (e-WAM) is also analysed here, which includes further enhanced measures that would achieve significant reductions, but such measures are financially unsustainable. Therefore, it was not taken into account in the latest revised projections from 2025.*

The Scenario With Existing Measures shows the development of emissions under conditions where only the policies and measures already adopted and launched are implemented. Under such conditions, emission reduction occurs gradually and to a limited extent, as a result of ongoing regulatory activities, existing investments and the natural replacement of technologies. In contrast, the Scenario With Additional Measures shows the dynamics of emissions under conditions of enhanced and coordinated implementation of measures in all relevant sectors. This scenario allows a view of the potential for a deeper transformation of the energy system, industry and other sectors, as well as the effects of a more intensive application of modern technologies and policies aimed at reducing emissions.

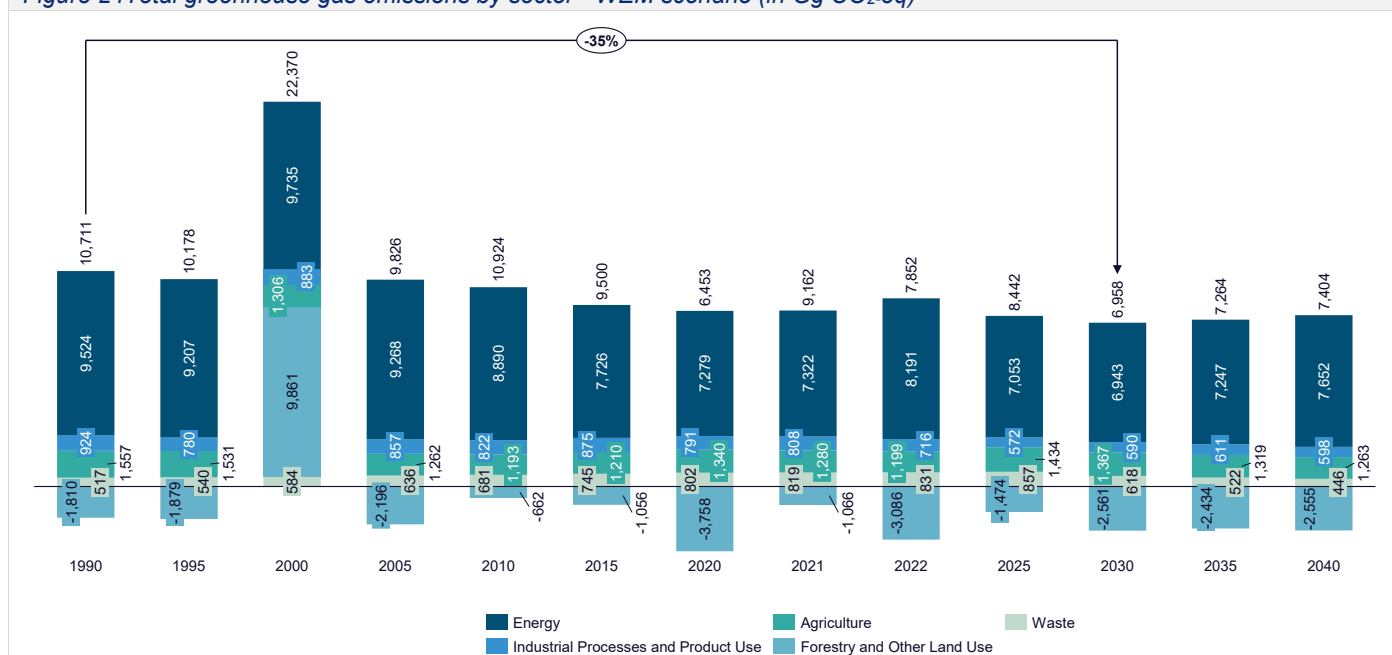
It is important to note that the difference between the two scenarios stems primarily from the energy and forestry sectors, while the same assumptions and values are used in the industrial processes and product use (IPPU) and agriculture sectors. In the Energy sector, the WAM scenario includes all the measures listed in the previous chapter, resulting in a more pronounced decarbonization compared to the WEM scenario. In the Forestry sector, the differences are related to fire management and afforestation dynamics: the WEM scenario considers measures related to livestock farming and a reduction in the areas affected by fires from an average of 9,000 ha to 6,000 ha by 2030, while the WAM scenario envisages a more ambitious reduction of fires to 3,000 ha by 2030, as well as additional afforestation. In doing so, the area of transitional forest is decreasing from 95,000ha to 80,000ha by 2030, with a further decrease of 5,000ha every five years until 2030, while deciduous forests are increasing, especially through oak afforestation.

In the WOM scenario, total greenhouse gas emissions show a relatively stable trend in the period up to 2030, with a slight decrease of about 3% compared to 1990. Despite variations between sectors, it is clear that energy dominates with the largest share in total emissions in both the historical and the planning period up to 2030. The agriculture, industrial processes and waste sectors participate with a significantly smaller share, but remain stable in structure. After 2030, the emission trend changes and the WOM scenario shows a gradual, but significant increase in total emissions by 2030. By the end of the period, a growth of about 82% compared to 1990 is projected, which indicates increased pressure on the Energy sector and the need for decarbonization. Energy increases its share in this period to about 87% of total emissions, which confirms that this is where the greatest potential, but also risk, for future climate policies lies. The remaining sectors are growing moderately or remaining at a stable level, without drastic changes in their structure.

Under the **WOM scenario**, emissions increase steadily from 12,521 Gg CO₂-eq in 1990 and 10,211 Gg CO₂-eq in 2020 to almost 11,783 Gg CO₂ eq in 2030 (excluding the FOLU sector), reflecting a continuation of current activity trends without further mitigation. If net greenhouse gas emissions are taken into account, they increase from 10,711 Gg CO₂-eq in 1990 to 10,418 Gg CO₂-eq in 2030 (15,078 Gg CO₂-eq in 2040). This path is incompatible with the country's climate goals.

With the **WEM scenario**, net emissions decrease from 10,711 Gg CO₂-eq in 1990 to 6,453 Gg CO₂-eq in 2020, to 6,958 Gg CO₂-eq in 2030 (7,404 Gg CO₂-eq in 2040) (Figure 24).

Figure 24 Total greenhouse gas emissions by sector - WEM scenario (in Gg CO₂-eq)



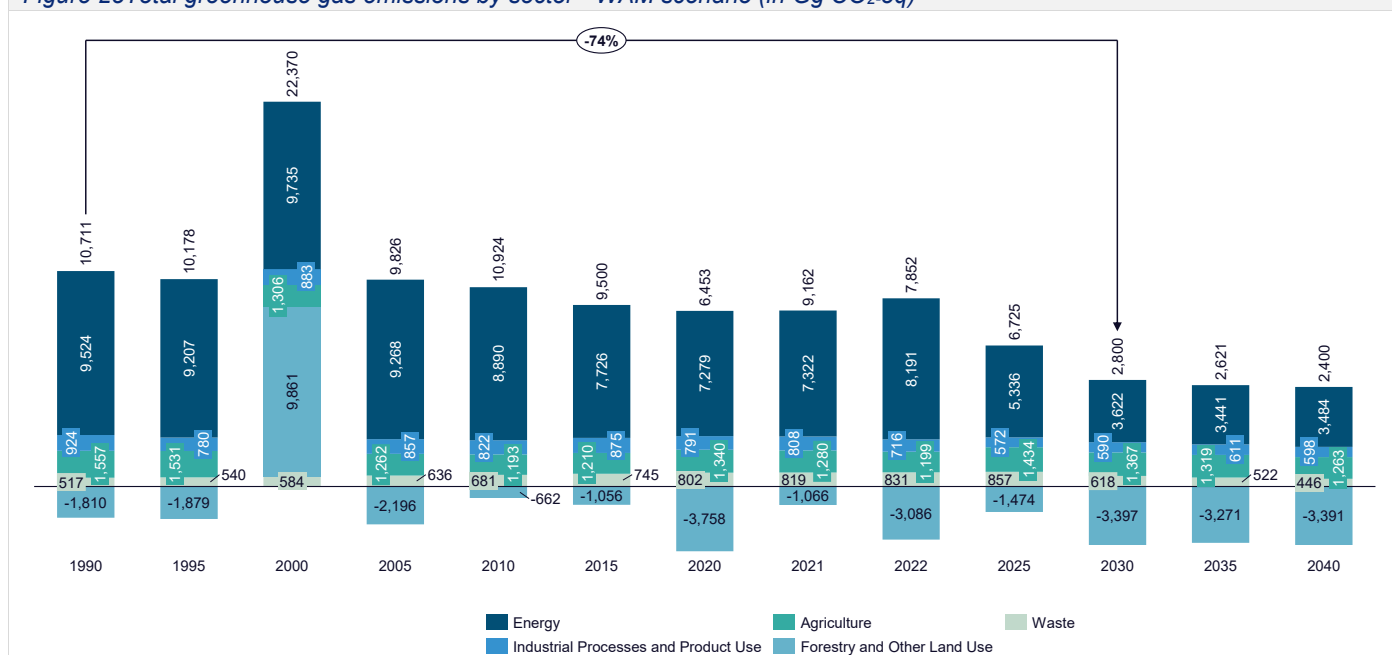
The scenario with complete implementation of climate change mitigation measures shows a clearly expressed and continuous trajectory of reduction of total national greenhouse gas emissions in the period 2025–2040. Already in the first phase of the projections, by 2030, emissions are reduced by more than 74% compared to 1990 (Figure 25), which indicates significant and early effectiveness of the policies and technologies introduced in the sectors. Most of this reduction comes from the Energy sector through the replacement of fossil fuels with renewable sources, improving energy efficiency and electrification of the transport and energy sectors. At the same time, the stable role of forestry and land use as a sink is maintained, which further reduces the net balance of national emissions.

In the period after 2030, the dynamics of the reduction continue with an even more pronounced trend. By 2040, net emissions are reduced by 77% compared to 1990 levels. Projections show that the contribution of the Energy sector to total emissions gradually decreases as a result of a high level of decarbonization of energy production and supply.

This scenario of integrated implementation of measures represents a state-of-the-art trajectory for national decarbonization, aligned with long-term climate goals and European policies. The results clearly demonstrate that the systemic approach, combining energy transition, land management, industrial innovation and circular models, creates a cumulative effect that exceeds the individual contribution of each sector on its own. At the same time, the role of sinks from the Forestry sector remains crucial for achieving a low-carbon balance. This scenario represents a realistic perspective of the transformation towards a low-emission economy, if measures are implemented consistently, in coordination and with a long-term vision.

In the WAM, net emissions in 2030 are around 2,800 kt CO₂eq, with a further reduction to 2,621 kt CO₂eq in 2035 and 2,400 kt CO₂eq in 2040 (Figure 25). This represents a reduction of around –74% compared to 1990, indicating a strong ambition that is very close to the ENDC. If the sinks from the FOLU sector are excluded, then emissions are reduced by around 51%, which is the same as the target defined in the ENDC.

Figure 25 Total greenhouse gas emissions by sector - WAM scenario (in Gg CO₂-eq)



Within the WAM scenario, **69 policies and measures have been analysed**, covering all relevant sectors: 32 measures in the Energy sector, 1 measure in the Industrial Processes and Product Use (IPPU) sector, 4 in the Agriculture sector, 2 in Forestry and 5 in Land Use and 9 measures in the Waste sector. In addition, 16 horizontal measures are included that have the role of enablers, by strengthening institutional, regulatory and financial capacities. This portfolio represents a significant expansion and improvement compared to previous national documents, especially in the area of technological solutions (battery systems, hydrogen), regulatory interventions and emission management in non-energy sectors. The difference in the measures between the ENDC and the updated 2025 Mitigation Report is that the latter defines 5 additional measures in the Waste sector and one in the IPPU sector.

The new NECP 2.0 (adopted by the Government in April 2026) sets a target of 6,720 Gg CO₂-eq by 2030 (excluding the FOLU sector). This essentially means a reduction in emissions of around 46.1% compared to 1990. If net emissions (including sinks, all sectors) are taken into account, the updated 2030 target in NECP 2.0 is 4,350 Gg CO₂-eq, which would be around a 60% reduction compared to the 1990 baseline.

The Climate Change Mitigation Document compares the differences between the NECP 2.0 and the mitigation analyses included in the BTR1. Although both documents were developed in parallel and significant efforts were made to align them, some differences are inevitable due to the different methodological approaches, with the BTR1 using an integrated optimization model of the entire energy system (MARKAL), while the Energy and Climate Plan uses a model (LEAP) and the optimization is performed only on the electricity system. This means that the results in the BTR1 are obtained as the most economically optimal solution. However, by aligning key assumptions, such as the operation of TPP Bitola until 2040, the differences are significantly reduced and better comparability is enabled. Hence, the comparison is not intended to assess which document is “correct”, but rather to understand the range of possible results and their robustness.

The main differences arise from the Energy sector and the Forestry and Other Land Use sector, where the BTR1 uses updated data from the national greenhouse gas inventory (including absorptions from perennial crops) and an optimization approach, while the NECP assumes higher electricity production and export (over 13,000 GWh in 2040, compared to around 10,000 GWh in the BTR1). This leads to higher emissions in the NECP, as increased production also implies greater use of energy capacities, including fossil fuels. However, despite these differences, the two documents are largely consistent, showing the same trends, strong growth of renewables, reduction of fossil fuels and a clear direction towards decarbonization. The differences are relatively small and mostly stem from the different treatment of certain technologies, investment dynamics and system optimization in BTR1.

WAM analysis shows significant socio-economic benefits, primarily through the creation of new jobs and the structural transformation of the economy. The total number of jobs increases from 3,899 in 2025 to 6,405 in 2030 and reaches 10,484 in 2040 (Figure 26), which represents an almost threefold increase and a clear indicator of the intensity of investments and policies. In the initial period, jobs related to energy efficiency predominate (2,351 in 2025), but over time renewable energy sources take the lead, reaching 5,410 jobs in 2040, compared to 5,074 in energy efficiency. Additionally, the structure of jobs in renewables shows that long-term activities, such as maintenance and indirect services are gaining increasing importance (1,519 and 1,296 jobs in 2030) (Figure 27), indicating a stable and

sustainable development of the sector. In parallel, the air quality analysis shows a significant decrease in PM2.5 emissions in the WAM scenario, from around 8.1 kt in 2020 to 3.2 kt in 2040, while in the WEM they reach around 6.0 kt, and in the WOM they even increase to 7.7 kt, which clearly highlights the importance of additional measures for the health of the population (Figure 28).

Figure 26 Total new jobs in the WAM scenario

Figure 27 Distribution of RES jobs in the WAM scenario

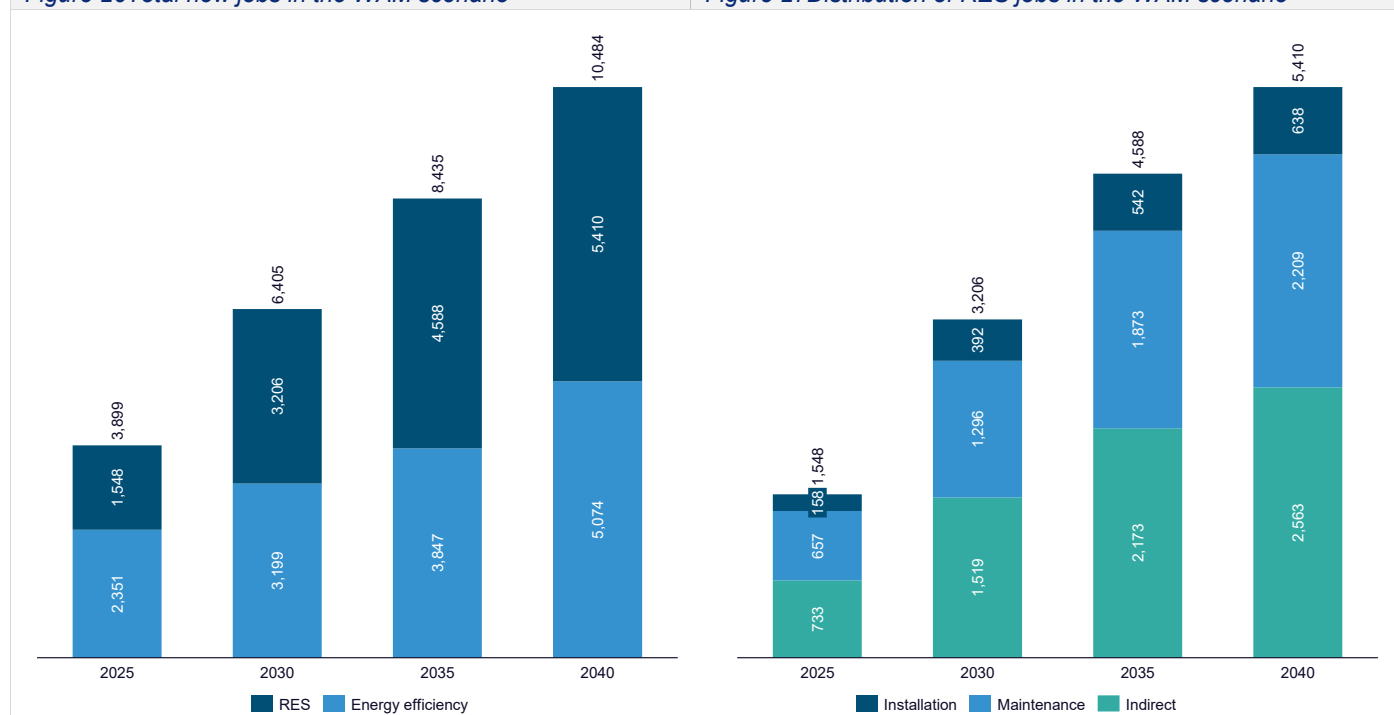
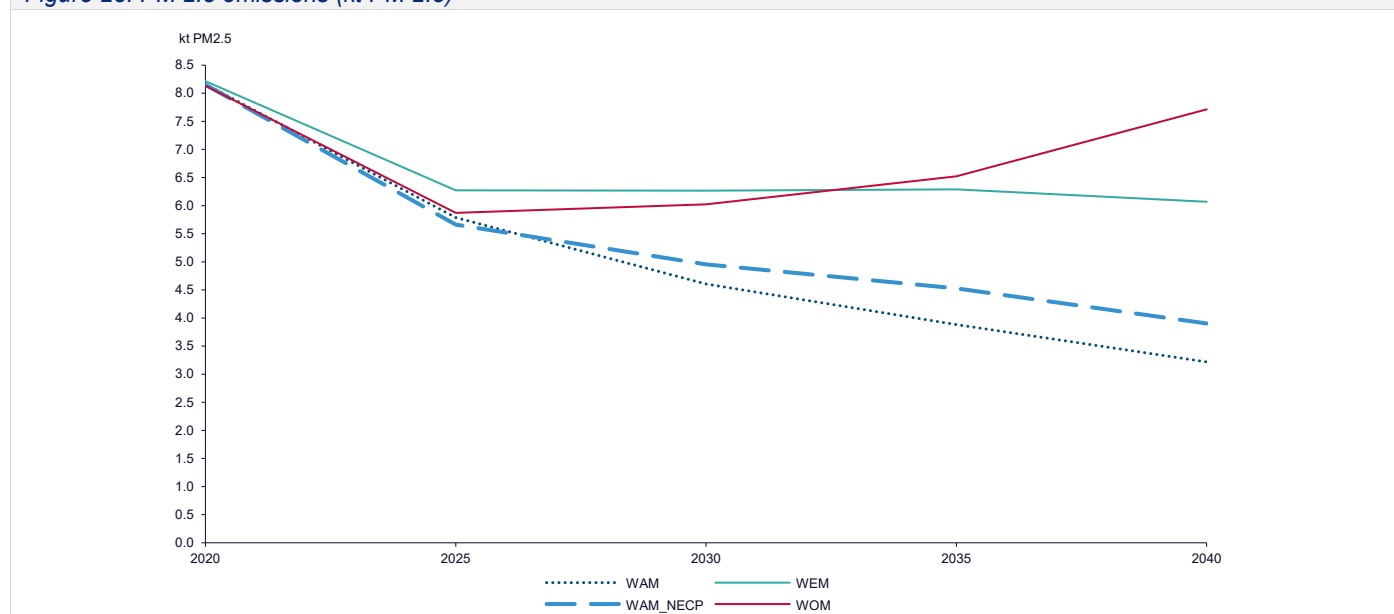


Figure 28. PM 2.5 emissions (kt PM 2.5)



From an economic perspective, the WAM scenario requires significant investments of around €22 billion, of which 88% are directed to the Energy sector, while the rest are allocated to waste (3%) and forestry (1%), additional measures of around 3%, confirming the central role of the energy transition. Annually, these investments amount to around €792 million, or approximately 9% of GDP, which is a level that can be mobilized through a combination of public and private sources (Figure 29). However, despite the higher initial costs, the analysis shows that the WAM scenario leads to lower total system costs, which are around 9% lower in 2040 compared to the measures scenario without measures, mainly due to reduced dependence on fossil fuel import and higher energy efficiency (Figure 30). This suggests that the transition to a low-carbon economy is not only a cost, but also a significant economic opportunity that provides long-term benefits, including greater energy security, price stability and sustainable economic growth.

Figure 29 Investments for the implementation of WAM

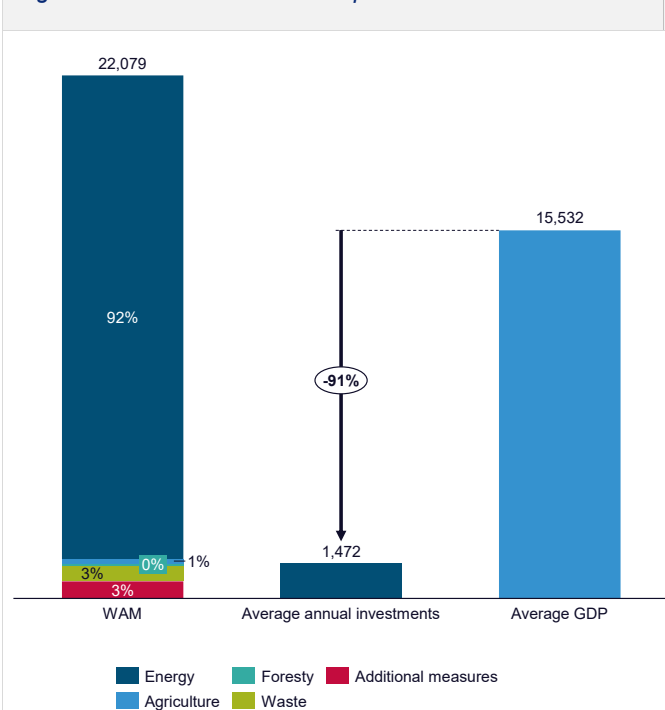
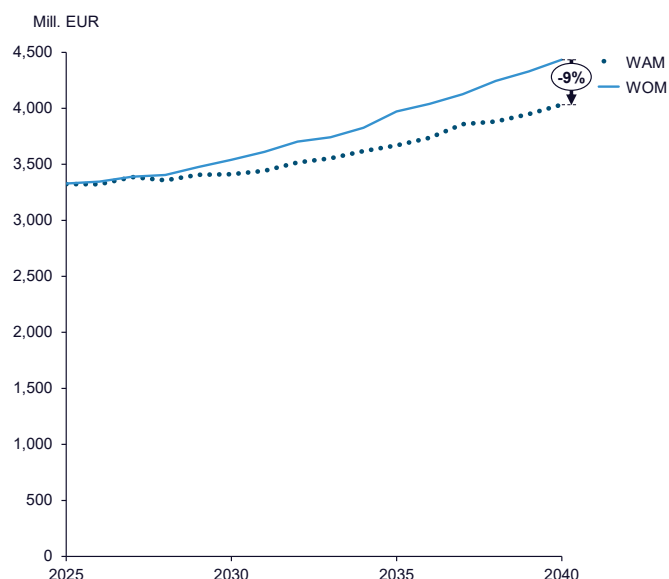


Figure 30 Comparison of total costs in WOM and WAM in the Energy sector



The additional analyses presented in the annexes provide an innovative perspective on the role of public perception in policy design and implementation, especially in the Waste sector. By applying advanced methods such as sentiment analysis and thematic modelling to over 13,000 social media posts and around 9,500 media contents, the results show that negative sentiment related to waste management predominates in Macedonia, especially regarding landfills, institutional efficiency and lack of recycling infrastructure. At the same time, the media analysis indicates a gradual increase in the positive tone of topics related to renewable energy sources, which highlights the role of the media as a potential driver of public support. A comparison with European Union states, such as Spain, shows that a higher level of trust in institutions is associated with significantly more positive public sentiment (76% positive reactions, compared to around 83% negative in Macedonia). **These results indicate that the successful implementation of policies depends not only on technical solutions, but also on their social acceptability, which emphasizes the need to integrate public perception as an integral part of the process of creating and implementing climate policies.**

The methodologies used to assess the simultaneous benefits of mitigation of adaptation actions and economic diversification plans (as required in paragraph 75 of the MPGs) are consistent with those applied to mitigation policies and measures (source: Climate Change Mitigation Measures, 2025). Key points are:

- Modelling tools:
 - Bottom-up modelling and least-cost optimization using the MARKAL (MARKet ALlocation) model.
 - 2006 IPCC methodology for assessing greenhouse gas emissions.
- Analytical approaches:
 - Regression models for some AFOLU measures and waste measures (e.g., photovoltaic irrigation, landfill gas flaring, etc.) to estimate greenhouse gas emission reductions.
 - Marginal cost reduction (MAC) curves have been developed to combine measures of economic effectiveness (€ or \$/tCO₂-eq) and environmental effectiveness (tCO₂-eq reduced).
- Evaluated indicators:
 - Reduction of greenhouse gas emissions (CO₂, CH₄, N₂O depending on the measure).
 - Energy saving (primary and final).
- Linkage to economic diversification and adaptation:
 - Measures such as a just transition in coal regions (replacing former coal sites with RES) are assessed through investment projections, job impacts and greenhouse gas reductions.
 - Adaptation measures that also mitigate emissions (e.g., efficient irrigation with photovoltaics, forest management, etc.) apply the same IPCC regression model to reduce emissions.

The methodology, main assumptions and parameters used for the projections under the scenarios in addition to the BTR1 are presented in detail in the separate technical report *Climate Change Mitigation*, from 2025. Table 11 provides a brief overview of the most important assumptions used to develop the mitigation scenarios.

Table 11 Key assumptions.

Sector	Key assumptions
Energy	GDP, average growth rate of 4.4%
	Population, decrease by 10%
	Domestic fuel prices for the period 2012-2023 (Energy Regulatory Commission)
	Fuel prices – gas, coal, oil (World Energy Outlook (WEO) 2017-2023)
	Price of CO ₂ emissions (UNDP Study on CO ₂ Tax in North Macedonia 2021 and WEO 2017-2023)
	Import price of electricity for the period 2012-2023 (HUPX)
IPPU	Greenhouse gas emissions depend on the growth of the industrial production index in the specific industry. Based on this assumption, an analysis of the correlation between emissions and value added in each industrial category is made. However, this assumption does not apply to the category Use of products as substitutes for ozone-depleting substances, where the main source of emissions are imported appliances (such as refrigerators and air conditioners). For this category, it is assumed that the import of appliances depends on GDP.
Agriculture	The total number of livestock will gradually decrease and in 2030 will be about 5% lower than in 2022. At the same time, the structure of herds remains almost unchanged, without significant shifts between livestock types.
	Manure management systems will remain the same as in 2022.
	Garbage storage and use practices remain traditional.
FOLU	The conversion of land between different categories will be maintained at the same level and there will be no additional changes to the areas.
	The emission factors remain the same and no changes in the methodology are expected.
	It is assumed that this volume of burned areas will remain the same in the future, with no trend of increase or decrease in WOM.
Waste	Population, decrease by 10%
	The amount of waste will remain at the same level, i.e. it will not decrease, by 2030.
	The percentage distribution (food, gardening, diapers, paper, textiles, wood and other waste) will be the same as in 2023 by region.
	Per inhabitant protein intake is unchanged after 2022.

3 RELEVANT INFORMATION ON CLIMATE CHANGE IMPACTS AND ADAPTATION

Climate change adaptation was not addressed in the revised 2021 NDC. Despite this, the Republic of North Macedonia has made significant progress in implementing adaptation measures and developing a roadmap for the development of the first National Adaptation Plan (NAP). During the reporting period and in the absence of a NAP, progress has been made in governance, planning, early warning, infrastructure, agriculture, health and adaptation based on micro-climate characteristics. This section provides an overview of the activities implemented between 2020 - 2022, with measurable results and ongoing challenges. The preparation of the first NAP began in 2025 as part of a project implemented by UNDP with funds from the Green Climate Fund (GCF).

3.1 NATIONAL CONDITIONS, INSTITUTIONAL SETTING AND LEGAL FRAMEWORK

Climate change adaptation in the Republic of North Macedonia is gradually being institutionalized through national and local planning frameworks, although challenges remain in terms of capacity, financing and monitoring systems. The provisions in the draft Law on Climate Action represent important steps towards establishing an integrated system.

Adaptation is gradually being integrated into sectoral policies, with several ministries having designated focal points and including climate risks in their strategies, while at the local level municipalities are developing adaptation plans. In this regard, the preparation of the first National Adaptation Plan is underway, while climate risk screening tools have been piloted in the public investment management process for 15 projects. The sectoral strategies for agriculture and forestry (2021), health (2022) and water economy (2022) have been updated with adaptation components, and spatial planning has been improved through the integration of flood, drought and forest fire risk maps.

In addition, specific activities are being implemented in key sectors. In water resources management, flood management plans for priority basins have been adopted, an early warning system for droughts has been established and is operational since 2021, and water utilities in 10 municipalities have developed contingency plans, with measures contributing to reducing water losses by around 8%. In agriculture, risk management activities are being implemented, including a pilot crop insurance project covering around 7,000 farmers, installation of agrometeorological stations and expansion of advisory services covering around 60% of small farms. In the Forestry sector, measures are being implemented for afforestation and restoration of degraded areas, with around 6,500 hectares of forests being restored with climate-resistant species. At the same time, early fire detection systems have been established in high-risk regions, contributing to reducing response times by around 25%, and local capacities have been strengthened through training of fire brigades in 40 municipalities.

In the health sector, measures to address climate risks are being developed, in particular through the preparation of heat and health action plans in the five largest cities, covering over 40% of the population. In addition, early warning systems for heat waves and vector-borne diseases are integrated into national platforms, and investments in health infrastructure are contributing to improving conditions, including the energy efficiency of facilities.

In parallel, early warning and climate information systems are being significantly improved, with the Hydrometeorological Service developing advanced systems for forecasting climate risks. Multi-hazard early warning systems cover around 70% of the population, and new communication mechanisms, such as mobile alerts, are being tested in practice.

In the area of infrastructure, energy and transport, measures are being implemented to integrate climate risks into planning and investments. This includes risk assessment of new infrastructure projects, improvement of drainage and water management systems, as well as activities to reduce the risk of flooding and erosion, with direct benefits for the population. For example:

- A screening has been conducted for the assessment of climate risk applied to new highway sections financed by international financial institutions; upgraded systems for drainage and treatment of wastewater from highways and expressways on the territory of the country.
- Vegetation has been cleared and drainage channels have been cleaned along two priority European corridors on the territory of the Republic of North Macedonia – Corridor VIII and X.
- Urban stormwater management projects in parts of Skopje and Tetovo, reducing the risk of flooding for around 80,000 residents.

Adaptation funding is increasing from \$24 million in 2020 to \$53.82 million in 2022, including funds from the central budget, international financial institutions and donors (in the form of projects), and activities are being undertaken to

strengthen capacities and knowledge. In parallel, a process of introducing Climate Budget Tagging has been launched in pilot ministries, which allows for identification of adaptation-related costs, although this mechanism is not yet fully institutionalized.

In terms of capacity building, more than 500 officials, planners and designers have been trained in adaptation planning, climate risk assessment and implementation of appropriate practices. In addition, universities and research institutes have developed national vulnerability assessments for several key sectors, including agriculture, water, health, forestry and infrastructure. At the local level, a mentoring programme was implemented in 2021, supporting 17 municipalities in integrating climate aspects and a gender perspective into local policies and budgets, especially in areas such as environmental protection, local economic development and energy efficiency. A significant part of the measures from the annual programmes have not been implemented or transferred to the following years, mainly due to limited finances, lack of data and human and institutional capacities.

In terms of monitoring and evaluation, a draft framework of indicators has been developed, including for tracking financial flows related to adaptation. The progress monitoring (source: *Third Biennial Climate Change Update Report of the Republic of North Macedonia*, Chapter 6: Other relevant information (Adaptation), p. 104) shows that:

- 40% of the planned adaptation measures are in the implementation phase.
- 20% are completed or included in sector strategies.
- 40% remain to be implemented, mainly due to finances, capacity or technical barriers.

3.1.1 INDICATORS FOR MONITORING ADAPTATION PROGRESS

Possible indicators for monitoring progress in adaptation fall into categories such as climate risk management, resilience and adaptive capacity, population well-being and climate indices, measuring changes in vulnerability, exposure and impacts. Effective indicators are context-specific, assess progress towards measurable targets and are often grouped under themes such as integration into planning, institutional capacity, finance, stakeholder engagement, use of climate information and impacts on health and food systems.

Note: Objectives and priorities will be determined and may change in the first National Adaptation Plan that began to be developed in 2025.

Table Table 12

<i>Table 12 Possible indicators for monitoring adaptation progress</i>			
Dimension	Indicator	2025 target	2030 target
Finance	% of funds allocated as adaptation in municipalities	3%	6%
Planning	Planning sectors with climate action strategies included	5	All primary sectors
Local self-governments (municipalities)	Municipalities with implemented local adaptation plans	6	12
Early warning	Population covered by early warning system(s) for natural disasters and climate change	70%	95%
Water	Percentage of losses due to leakage from outdated systems in larger utilities	<25%	<20%
Agriculture	Areas under resistant varieties/practices	+50,000 ha	+120,000 ha
Forestry	Average annual burned forest area	-20%	-40%
Health	Heatwave-related mortality (reference-adjusted)	-10%	-20%

Source: 4th National Communication, "ShapingSEQ" and UNDP Framework 2026-2030

3.1.2 POSSIBLE FUTURE ADAPTATION PROJECTS

Based on the various initiatives and projects for adaptation in the period up to 2022, an Indicative List of Priority Adaptation Projects in the coming period 2025 - 2030 has been prepared (Table 13).

<i>Table 13 Indicative list of priority adaptation projects in the coming period 2025 - 2030:</i>				
Possible Project	Sector	Reason	2025-2030 budget (mil. USD\$)	Results
Restoration of flooded areas in three river basins	Water/ Nature	Flow reduction, biodiversity protection	52.65	25,000 people protected from floods; 2,500ha restored

Reducing water losses in the network and drought resistance	Water	Energy savings and uninterrupted water supply	70.2	losses < 20%; 10 municipalities with drought plans
Smart agriculture	Agriculture	Resistance for higher yields and a reliable food source	93.6	+100k ha planted with more resistant varieties
Urban heatwave and stormwater programmes (in 5 cities)	Urbanism/ Health	Heat waves, flash floods	81.9	warming of 1.5°C significantly intensifies the effect of the so-called urban heat island (UHI); 500 ha of urban greenery
Power grid resilience	Energy	Functioning in extreme conditions	58.5	–30% network failures
Integrated forest fire management	Forestry/Crisis Management	Preventing catastrophic fires	29.25	–40% burned area; rapid response and prevention
National network for early warning / warning of natural disasters	Intersectoral	Impact-based warnings	40.95	95% coverage
Source: NC4 and BUR3				

3.2 CLIMATE CHANGE VULNERABILITY ASSESSMENT

The results of climate projections show that the Republic of North Macedonia will have a warmer and drier climate by 2050, with an increase in hot temperature extremes and a decrease in extremely low temperatures. In addition to the projections for drier conditions, an increase in extreme rainfall is also expected, which will result in an increased risk of flash floods. In the summer period, an increase in the number of consecutive dry days is expected, which will lead to more frequent droughts. The growing season is also expected to shift, which will result in a longer growing season. Climate projections show that these climate extremes, including droughts, floods and heat waves, will increase in frequency and magnitude in the future (Source: HMS, 2025).

The Republic of North Macedonia is particularly vulnerable to climate change and variability, as well as extreme climate events. The most affected sectors are water management, agriculture (crop production, soil and livestock farming), forestry and biodiversity. The Republic of North Macedonia recognizes the need to address the effects of climate change by promoting effective adaptation measures for key vulnerable sectors. From a health perspective, it is necessary to recognize vulnerable groups, such as the elderly, chronically ill, children, people working outdoors and socially vulnerable categories, in the context of climate change.

The summary of the vulnerability analysis and proposed adaptation measures by sector include:

1. **Water management:** In years of intensive water use, the WEI (Water Exploitation Index) reached around 20%, and in periods of maximum, such as in 2012, up to 35%. As irrigation covers less than 10% of arable land and climate change causes more frequent and intense heat waves and droughts, losses in agricultural production can be expected in the coming period.
2. **Forestry:** The Macedonian Forestry sector will face increased tree mortality due to insect and fungal infestations, more days with heavy rainfall, dry spells and more forest fires. Forest fire trends have changed, with the period between two serious fires decreasing. In 2018, forestry economy activities were significantly disrupted due to heavy rainy days, which disrupted wood production. In the summer of 2019, a large part of the springs in the forested area around Shtip dried up. This was accompanied by an intense attack of fungi and insects.

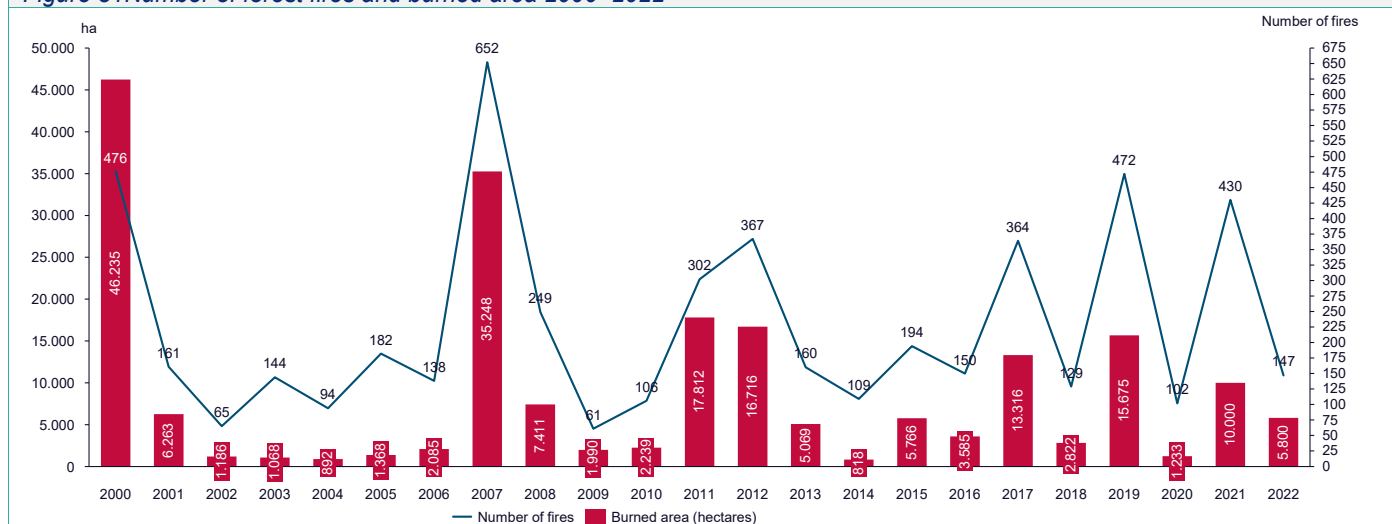
The main sources of exposure of forests in the Republic of North Macedonia to climate change are:

- Increase in temperature: consequence – longer growing period;
- Increase in extreme events, floods, strong winds, droughts: consequences – threat to infrastructure, human life, disappearance of biodiversity, changes in the distribution of seasons, canopy density;
- Increased forest fire activity: consequences – threat to infrastructure, reduced wood supply, increased greenhouse gas emissions, reduction of sinks, etc.;
- Increased occurrence of "new" natural pests and diseases: consequences – reduced wood supply, reduced growth and yield, poor wood quality and quantity, changes in species composition;
- Changes in forest productivity: consequences – problems with wood supply, uncertainty in forest management, nitrogen deposition and reduction of sinks.

Special emphasis should be placed on the serious problems with forest fires that have been active in our territory over the past 20 years. In the period 2000–2020, there were a total of 4,677 fires with a burned area of 188,797 hectares. The most critical fires were in 2000, when 4.6% of all forests burned, then in 2007 with another 3.5%, the fires in 2011 (17,812 hectares), 2017 (13,316 hectares) and 2019 (15,675 hectares) (Figure 31). Climate change and human reckless behaviour are closely related to the increase in the number of fires.

Almost 30% of the approximately 430 forest fires in 2021 were of high intensity. The areas in the Maleshevija, near the Pletvar mountain pass, and others were most affected. The most massive forest fires in this period occurred from June to September.

Figure 31 Number of forest fires and burned area 2000–2022



Source: Vulnerability and adaptation to climate change agriculture, forestry and other land uses, Skopje 2022, team analysis

3. **Agriculture:** Drought occurs almost every season in most agricultural areas of the country and is expected to become more severe with climate change, further reducing crop yields. Extreme rainfall causes soils with low permeability to become waterlogged, destroying sensitive crops. Irrigation is prioritized as one of the best adaptation options for crop production in the Republic of North Macedonia. Climate change has a serious negative impact on livestock productivity and welfare, resulting in frequent and prolonged heat stress. Adaptation should include technical solutions for ventilation, air circulation, and aeration.
4. **Biodiversity** is highly sensitive to climate change with consequences such as invasion of non-native species and movement and migration of endangered plant and animal species. Following the third national report, the first national red list of priority fauna has been prepared, as well as the adoption of policy instruments for management and planning of bio-corridors and improved monitoring and management of protected areas. However, a comprehensive assessment of vulnerability and modelling of biodiversity dynamics to climate change is lacking.

3.2.1 SECTORAL VULNERABILITY AND ADAPTATION ANALYSES

Climate change is envisaged to affect, with small variations, the different geographical regions of the country in terms of: the intensity, frequency and duration of precipitation; changes in temperature/variables in terms of duration, intensity, etc. The various effects of climate change on the Republic of North Macedonia include the following:

- Drought can cause loss of arable land and changes in cropping periods/seasons. Drought can lead to changes in groundwater levels, especially at the surface of the saturation zone. It can also affect groundwater resources in confined and unconfined aquifers. Changes in salinity, moisture and drainage capacity caused by drought can also lead to changes in the shorelines of lakes and water bodies.
- Perennial water bodies may experience drying out due to lowering of the floodplain surface. Rainfall-dependent water bodies may also dry up due to prolonged dry periods, but at the same time may cause flash floods during extreme rainfall events (The risk of such flash floods is greater in urban areas with impervious surfaces as they will result in greater runoff and reduced concentration time).
- River flooding and long-term changes in river morphology in areas with projected increases in precipitation. Changes in runoff capacity caused by increased runoff which may mean additional dam storage needs, possible risks of dam breaches due to extreme precipitation, flash floods and depending on where these flash floods occur, additional risks of erosion and landslides. Variability of water resources (changes in incident precipitation, seasonal changes in precipitation, extreme precipitation) leading to flash floods.

- Heat waves can increase the risks of heat exhaustion, especially for people in urban areas with the additional effects of heat islands, and can also affect the flora landscape, plant health and cultivation.
- Altered growing periods and productivity due to drought (changes in pH, nutrient losses/salinity) and redistribution of annual rainfall cycles.
- Increase in pest and disease cases (risks to humans and agriculture).
- Changes in species migrations in relation to spatial and temporal shifts.
- Recognition of urban heat islands as a climate and public health risk in urban areas, considering that local analyses in Skopje show significant temperature differences between vegetated and non-vegetated urban areas.
- Habitat regions may shift with climate change and changes in flora distribution (new regions may become more suitable habitats for different species, while other hotspots and habitats may no longer be preferred habitats for species).
- Disasters caused by extreme events such as floods, dam failures, landslides, etc. For example, runoff from mining areas caused by intense flooding or altered river flow patterns. This can contaminate productive land, groundwater, etc.
- New vulnerable zones may emerge with changes in climate variables. Disasters related to spills and leaks from chemical and other high-risk industries located in landslide risk areas, seismic zones, dam failure zones, etc. This may result in lost lives, lost habitats, causing health hazards, etc.

3.3 INFORMATION RELATED TO PREVENTING, MINIMIZING AND DEALING WITH LOSSES AND DAMAGES RELATED TO THE IMPACTS OF CLIMATE CHANGE

The concept of "loss and damage" emerged during international climate negotiations, as part of a global effort to define how to respond to loss and damage caused by the impacts of climate change. "Loss and damage" refers to impacts of climate change that go beyond what humans can adapt to or where adaptation options are not available. They can include economic and non-economic losses, and the scope can encompass slow-onset events (such as droughts and sea level rise), as well as extreme weather events (e.g. floods, heat waves, storms, etc.). The concept of loss and damage in the context of climate impacts at the national level was first introduced in the Fourth National Communication on Climate Change (4th National Communication, 2023). The Policy Brief on Loss and Damage from Climate Change in the Context of the Republic of North Macedonia and the Disaster Risk Reduction Report of the 4th National Communication on Climate Change were developed as background documents, which served as the basis for a comprehensive and concise analysis.

The key global framework for climate-related loss and damage is the Warsaw International Mechanism for Loss and Damage (WIM), established under the United Nations Framework Convention on Climate Change (UNFCCC) at COP19 in Warsaw in 2013. As the primary mechanism under the UNFCCC process, confirmed by the Paris Agreement, its purpose is to address loss and damage arising from the impacts of climate change, including extreme weather events and slow-onset changes, in particular in developing countries that are particularly vulnerable to these adverse effects. It also serves as a platform for cooperation, knowledge sharing and support for vulnerable countries facing unavoidable climate impacts. The WIM works with the Santiago Network established in 2021 (at COP26) to provide technical assistance to affected countries. The Sendai Framework for Disaster Risk Reduction 2015-2030 is an international agreement adopted by the United Nations to reduce the risks and losses from disasters worldwide. The Sendai Framework incorporates the reduction of disaster losses and damages within its main goals, i.e. to reduce economic losses relative to global GDP by 2030, as well as to significantly reduce damage to critical infrastructure and disruption of essential services by 2030. The Sustainable Development Agenda links loss and damage from climate change to the need to reduce risks, strengthen resilience and protect the economy, infrastructure and essential services, and the Paris Agreement recognizes the importance of preventing, reducing and addressing loss and damage, including it as one of the pillars of the UN Framework Convention on Climate Change, alongside mitigation and adaptation. The Republic of North Macedonia has acceded to and adopted these global mechanisms, but reporting to the Sendai Framework remains limited and a consolidated report has not yet been submitted to the Sendai Framework Monitoring Committee, even though it has entered the last five years of its implementation.

In the Republic of North Macedonia, there is no designated individual institution responsible for addressing climate risk losses and damages. In this context, the competent institution for overseeing efforts to protect the environment and adapt to climate change, including the development and implementation of policies and programmes aimed at reducing climate-related risks, as well as areas related to climate risk losses and damages, is the Ministry of Environment and Physical Planning (MoEPP). This Ministry also coordinates national efforts to fulfil obligations under the United Nations Framework Convention on Climate Change, as well as access to international climate funds, such as through the Green Climate Fund (GCF), etc.

Other institutions that have a role and responsibilities in losses and damages from climate risks are the Crisis Management Centre (CMC), the Directorate for Protection and Rescue (DPR), sectoral ministries, such as agriculture, water economy and forestry, finance, economy and labour, etc. administrations and institutes, as well as local self-government units.

The CMC ensures continuity in interdepartmental and international cooperation, consultations and coordination in crisis management, prepares and updates a single assessment of risks and hazards, proposes measures and activities for dealing with crisis situations and provides expert, organizational and administrative support to the Steering Committee and the Assessment Group. The DPR carries out the work of protection and rescue from natural disasters and other accidents, through activities for prevention, preparedness and response, risk and hazard assessment, preparation and adoption of strategic planning documents in the field of protection and rescue, etc. The DPR also contributes to public awareness campaigns, community preparedness initiatives and development of technical standards for safety and protection.

Sectoral ministries have an important role in addressing climate losses and damages through development and implementation of sectoral strategies and policies, adaptation measures, risk assessment and coordination of activities for prevention, recovery and resilience building in areas such as agriculture, environment, infrastructure, energy, etc.

The Hydrometeorological Directorate (HMD) is responsible for managing the national network for observing and providing meteorological, climatological and hydrological services, including early warning of natural disasters, forecasts and monitoring to support sectors such as agriculture, water economy, forestry, health, disaster risk reduction and firefighting services, etc., thereby contributing to the reduction of climate losses and damages. The Institute of Public Health (IPH) has a significant role in addressing climate losses and damages in the health sector through monitoring climate-sensitive health risks, assessing population vulnerability, supporting heat and cold wave management plans, disease surveillance and supporting national policies and strategies for adaptation to climate change.

At the local level, local self-government units are actively involved in crisis management and protection and rescue through the implementation of local policies and measures for prevention, preparedness, response and recovery from crises and disasters. Within their competences, municipalities participate in the assessment of local risks and hazards, the development and implementation of protection and rescue plans, coordination with the entities of the systems, at national and local levels, as well as in taking measures to protect the population, infrastructure and natural resources from the consequences of climate change and natural disasters. They also have an important role in raising public awareness and knowledge of the population, local climate adaptation, damage and loss assessment, revitalization, etc., including the development of strategies for risk reduction and adaptation to climate change. Several municipalities, including Karbinci, Konche, Veles, Gostivar, Mavrovo-Rostushe, Kavadarci, Kriva Palanka, Rankovce, Dojran and Valandovo, have adopted local strategic plans for disaster risk reduction for the period up to 2025. These plans aim to increase resilience and preparedness against hazards related to climate and disaster risks.

In the normative system of the Republic of North Macedonia, regarding losses and damages from climate risks, there is no jurisdiction of an individual legal act and this area is primarily regulated by the following key laws:

- The Law on Crisis Management ("Official Gazette of the Republic of Macedonia" No. 29/05, 41/14, 104/15 and 215/21) establishes the Crisis Management System and the CMC as an independent state body responsible for prevention, early warning and management of crisis situations. The Law defines the organization and functioning of the system, decision-making processes, use of resources, as well as coordination and cooperation between institutions, through an approach based on multiple risks, hazards and sectors. In the context of climate losses and damages, the Law provides for the assessment of risks and hazards, proposing measures for risk reduction and crisis management, as well as planning and implementation of recovery activities. According to Article 5, paragraph 2, item 3, municipalities and the City of Skopje are responsible for adopting revitalization programmes after the end of a crisis situation, thus having an important role in the reconstruction and management of the consequences of climate and natural disasters.
- The Law on Protection and Rescue ("Official Gazette of the Republic of Macedonia" No. 36/04, 49/04, 86/08, 124/10, 18/11, 41/14, 129/15, 71/16, 106/16, 83/18, 215/21) establishes a comprehensive system for protection of the population, material goods, natural resources, biodiversity and cultural heritage from disasters, as well as regulates protection and rescue at the national and local levels. The Law determines the responsibilities of the central and local authorities, public and private entities and the civil society sector, covering planning, preventive measures, emergency intervention, training, financing and supervision of protection and rescue activities. In the context of climate-related losses and damages, the Law provides a legal basis for preparedness, coordinated response and recovery activities, including the implementation of urban-technical and humanitarian measures to eliminate the consequences of natural disasters and other accidents, in accordance with Article 2, paragraph 1, item 25, thus supporting both emergency intervention and long-term recovery and increasing resilience.

The legal framework is supported by several strategic documents:

- National Strategy for Protection and Rescue (adopted every five years by the Parliament)
- National and local assessments of threats from natural disasters and other accidents, National Rescue and Protection Plan (adopted by the Government)
- Annual protection and rescue programme.

During the reporting period, the Republic of North Macedonia has not nominated a National Loss and Damage Authority/Body.

A more detailed and comprehensive analysis for the National Designated Loss and Damage Authority. This analysis should examine in more detail the country's existing institutional, legal and financial frameworks related to climate risk, identify gaps in institutional capacity, assess the most vulnerable sectors, and evaluate potential coordination and resource mobilization mechanisms.

4 INFORMATION ON FINANCIAL SUPPORT, SUPPORT FOR TECHNOLOGY DEVELOPMENT AND SUPPORT FOR TRANSFER AND CAPACITY BUILDING

The adopted methodological framework applies consistent assumptions and data treatment across all reporting elements. The figures for the support needed are taken from the nationally calculated measures under the ENDC, the Long-Term Climate Action Strategy (LTCAS) and the 2021 National Energy and Climate Plan. For the sake of current comparability, they have been further estimated at 2025 prices using the national GDP deflation rate (as published by the State Statistical Office and the Ministry of Finance). Given that the preparation of this report is in 2025, all 2025 price estimates have been converted into US dollars at the average market exchange rate for 2025, ensuring comparability with international reporting standards. Conversely, support received is recorded as nominal commitments in the year of project approval or signing and is converted into US dollars using the annual average exchange rate applicable for that year, referring to data from the National Bank of the Republic of North Macedonia, the European Central Bank or the IMF's International Financial Statistics.

Where relevant, the amounts shown have been further adjusted to reflect climate relevance using the OECD Rio Markers methodology applying coefficients of 100% for activities with climate objectives as a primary objective and 40% for those with significant climate relevance. All assumptions, conversion factors and data sources are provided in the notes to the table for full transparency and tracking. The analysis of the support needs highlights the scale of investments needed to achieve the country's climate objectives. According to the ENDC, implementing all identified mitigation measures by 2030 would require around €25 billion (US\$29.63 billion) in 2021 prices, which, when expressed in 2025 prices and converted into US dollars, corresponds to an indicative need of around US\$35 billion.

Investment priorities are mostly in terms of renewable energy and grid modernization, energy renovation of buildings, electrification of transport, circular waste and wastewater management systems, climate-smart agriculture, and improved hydrometeorological and early warning systems.

Cross-sectoral enablers – such as project preparation capacities, monitoring, reporting and verification (MRV) systems, transparency frameworks and financial risk reduction mechanisms – have also been identified as key to translating national strategies into investment programmes that are eligible for financing by investors and lenders. Between 2020 and 2022, the Republic of North Macedonia received support from various forms of international assistance aimed at strengthening mitigation and adaptation capacities, as well as mainstreaming a gender perspective in climate action. This included financial and technical assistance from bilateral and multilateral partners, the European Union, international financial institutions and United Nations agencies.

The portfolio of support received, presented in the Annex, includes grants, concessional loans and blended financial operations. Support was particularly important in four areas: (i) strengthening institutional and management capacities for climate action, including readiness for direct access to international funds; (ii) strengthening sectoral implementation capacities in energy efficiency, integration of renewables, management of waste, water resources and agriculture; (iii) promoting technology transfer in areas such as low-carbon energy systems, digital tools, monitoring, reporting and verification systems, industrial emissions management and early warning of climate hazards; and (iv) enhancing capacity building and awareness among public institutions, municipalities and civil society to foster a more inclusive and participatory approach to climate change management.

Technology development and transfer have had a key role in strengthening national implementation capacity. Supported by the Green Climate Fund (GCF), the Global Environment Facility (GEF), the European Union and bilateral partners such as GIZ and UNDP, several projects have introduced innovative low-emission technologies, including smart grid management systems, heating and cooling based on renewables, industrial energy efficiency technologies and modern hydrometeorological networks. These interventions have combined infrastructure and equipment with tailored training, knowledge exchange and operational guidelines to ensure their sustainable use and replication across sectors. Such support has been instrumental in bridging the gap between policy design and practical implementation of mitigation and adaptation measures.

In parallel with technological progress, capacity-building support has been vital to improving the country's institutional preparedness and absorptive capacity. Through preparedness and technical assistance programmes, the Republic of North Macedonia has strengthened its policy coordination mechanisms, monitoring, reporting and verification systems

and national climate finance architecture. The ENDC Financing Strategy and the ENDC Implementation Roadmap highlight the need for continuous improvement in project preparation capacities, financial modelling, risk assessment and gender-sensitive and inclusive approaches. In addition, initiatives in hydrometeorology, air quality monitoring and energy management in the public sector have contributed to the institutionalization of technical expertise and creation of data-driven policy frameworks. More information is contained in *the report* posted on the klimatskipromeni.mk portal⁸ for *financial assistance, technology development and transfer and capacity building (2025)*. The analysis confirms that the Republic of North Macedonia has clearly defined and quantified its climate investment needs and is already mobilizing significant international support in key priority areas. The progress achieved in 2020–2022 demonstrates the country's increased capacity to design, report and implement climate-related actions in line with the Paris Agreement. In the future, establishing a permanent national climate finance monitoring mechanism, strengthening project preparation capacities and developing a priority list of projects, as well as expanding technical and financial partnerships will be crucial to accelerating the implementation of the key documents ENDC, NECP and LTCAS.

4.1 INTERNATIONAL FINANCIAL SUPPORT RECEIVED

The transition to low-carbon and climate-neutral technologies in the Republic of North Macedonia is significantly facilitated by the availability of international financial and technology transfer support mechanisms. Some of the key institutions, such as the European Bank for Reconstruction and Development (EBRD), the Green Climate Fund (GCF) and various United Nations agencies, including UNDP, UNIDO and others, have a central role in facilitating the adoption of low-carbon technologies in the industrial sector. These organizations and institutions offer a combination of concessional loans, grants and technical assistance designed to address the primary financial barriers to the adoption of climate-neutral technologies. For example, the EBRD's Green Economy Financing Facility (GEFF) has supported small and medium-sized enterprises in accessing green technologies through local financial institutions, often in conjunction with investment incentives and capacity-building measures.

Several organizations actively fund climate initiatives in the Republic of North Macedonia:

- The Global Environment Facility (GEF) brings together several multilateral funds to address the planet's most pressing challenges in an integrated manner. Its financing helps developing countries address complex challenges and work towards meeting international environmental goals. Over the past three decades, the GEF has provided more than \$26 billion in financing, primarily in grants, and has mobilized a further \$153 billion for priority country-led projects. GEF financing is provided by participating donor countries and made available to developing countries and countries with economies in transition to meet the objectives of international environmental conventions and agreements. Funds approved by the Council are transferred through 18 GEF agencies to government agencies, civil society organizations, private sector companies, research institutions, among a wide range of potential partners, to implement projects and programmes in recipient countries. The development of this document – BTR1, among others, is supported within the framework of a project funded by GEF in the amount of 1,233,000.00 US dollars. The project started in July 2024.
- Green Climate Fund (GCF): Supports projects focused on climate change adaptation and mitigation, including preparedness activities and financial mechanisms for sustainable development. The GCF provides up to \$1 million per country per year for preparedness activities and additional \$3 million for National Adaptation Plans (NAPs). The Republic of North Macedonia received \$820,076 for capacity-building projects focused on human capital development in health, education and social protection, as well as \$1,946,505.00 for the preparation of the First National Adaptation Plan.
- United Nations Development Programme (UNDP): Manages the Green Finance Facility, which provides affordable financing for small businesses and households to invest in renewable energy and energy efficiency. The UNDP Green Finance Facility supports loans to small and medium-sized enterprises and households to invest in renewable energy and energy efficiency. The Facility has mobilized \$46.7 million, of which \$6.5 million is for household loans and \$3.9 million for technical assistance. Expected results include 10.7 MW of renewable energy generation, 80,000 tonnes of avoided greenhouse gas emissions, and 86,000 MWh of energy.
- European Investment Bank (EIB): Collaborates with the National Bank of the Republic of North Macedonia to improve climate risk assessment and green investment strategies. The Bank is collaborating with the country to improve climate risk assessment and green investment strategies. While specific funding amounts are not readily available, the partnership aims to strengthen financial systems for climate change resilience.

However, the effectiveness of these instruments depends significantly on institutional absorptive capacity, regulatory clarity and the existence of local implementing partners. Limited technical readiness and insufficient awareness among industry actors often prevent the full use of available resources. Simplifying access procedures, improving information and offering practical technical support are crucial to maximize impact. The UNIDO report (2023) highlights the importance of aligning these financing opportunities with national policy objectives, such as those articulated in the

⁸ <https://api.klimatskipromeni.mk/data/rest/file/download/49bdc7c8adfafd92f620a2e5e0bc3c0ca6d9ae3d691c2cd3b6b3723923dd4bea.pdf>

NECP and enhanced NDC, to ensure coherence and maximize long-term climate benefits. Establishing a national coordination platform to connect industries with relevant financing options and to monitor project implementation could further improve the use and efficiency of international climate finance. Other funding opportunities include support for transparency and reporting - continued support through CBIT, GEF, UNDP which is vital for formalizing MRV platforms and national transparency mechanisms: mitigation - investments in mitigation activities and measures, including renewable energy sources, fossil fuel substitution, energy efficiency (World Bank); donor and EU programmes - continued funding from IPA, joint programmes with GEF/UNDP/UNECE to support renewable energy deployment, municipal greenhouse gas inventories and energy efficiency; other green financing mechanisms as resources needed to stimulate public-private investments through grants, low-interest loans, green bonds, to mobilize contributions from the private sector, especially SMEs and households.

Specific funding needs for technology transfer and innovation, deployment of clean technology (gasification, wind, solar, hydropower, storage, but also advisory technical assistance, feasibility analysis and operational training), circular economy and industrial practices (support for the adoption of circular economy models, tools such as Q-SCAN for industry), private sector involvement (to improve the capacity of the private sector through climate risk assessment, projects and sectoral incentives to determine the investment share in mitigation measures).

Methodological approach. The OECD Rio Marker methodology is applied to determine the share of international finance that can be attributed to climate-related objectives. Each project is checked against two markers: **Climate Change Mitigation** and **Climate Change Adaptation**. If both markers are applied, the contribution follows OECD rules to prevent double counting.

Attribution coefficients. Climate-attributable shares are obtained using OECD aggregate coefficients based on the Rio markers: Score 2 (Main objective / Climate-specific project) is counted as 100% climate finance; Score 1 (Significant objective / Climate-relevant) is counted as only 40% climate finance; projects marked as screened but not climate-targeted, as well as non-targeted, are treated as 0% of total climate finance. If a project has mitigation and adaptation markers, attribution follows OECD practice to avoid double counting (e.g. limiting the combined climate share of the project amount). This process ensures that the values displayed as “support received” correspond to the share of service providers’ commitments adjusted according to the Rio markers, which is the most accurate substitute for climate finance available for the period 2020-2022.

4.1.1 FINANCIAL SUPPORT RECEIVED IN THE PERIOD 2020-2022

This section presents the international support recorded as committed/pledged for the reporting period 2020-2022, in line with the requirements of Article 9 of the Paris Agreement. The portfolio under review includes climate-related operations/projects financed by external donors, together with national co-financing. For greater clarity, the total amount of the project portfolio includes both international (donor) and domestic contributions.

Within this portfolio, the total contribution of international donors in the amount of **\$198,205,109** (Table 14) represents **the total international commitment/pledged financial support** attributable to the period 2020–2022. This amount includes the amounts of donor funding, i.e. the budgets of projects that are ongoing or have been initiated during the reporting period of the BTR1 (2020–2022), regardless of the subsequent disbursement schedule. Therefore, it should be interpreted as a measure of external support oriented toward the issue of a created list of projects, and not as a measure of cash flow, as it is possible that some of the project amounts may not have been implemented at all.

To identify the climate-related share of these commitments, the analysis applies **the Rio Marker Methodology** described above. Using agreed coefficients for activities marked as **core** (climate objective is the main focus), **significant** (climate objective is explicitly stated, while not the primary focus) and **screened/non-targeted**, the portfolio is weighted to obtain climate finance. Based on the adjustment and by applying coefficients of 100%, 40% and 0%, respectively, it is estimated that out of the budgeted \$198,205,109, the amount of climate finance for the period 2020-2022 is **\$96,414,444**. This value represents the Rio Marker-adjusted share of pledged international finance and is therefore the most relevant approximation of climate-focused support within the framework of the issue.

The difference between these two figures is important for proper interpretation and transparency. The total donor commitment (\$198.2 million) limited the amount of funding exclusively from international donors, showing the scale of external financial commitments over the mentioned period. Climate finance (\$96.4 million) then applies the Rio marker attribution to those commitments, thus obtaining an estimate of the finance directly aligned with climate objectives.

Table 14 Committed international support

Total amount of commitments	Value (USD)	Climate change financing as %
Total amount of committed international financial support for climate-related projects	198,205,109	48.6%

Amount of committed *international climate finance

96,414,444

*Note: The report uses the term committed financial support because the amounts shown refer to project budgets that may not have been fully received.

All amounts are presented in the original currency and converted to US dollars using the exchange rates recorded for each entry. Where amounts are recorded at the multi-year project level, but it is not specified how much is spent or they are budgeted by year, they are allocated to the period 2020–2022 based on the project approval and implementation periods documented in the source data. This approach preserves comparability across entries and avoids climate-related increments for periods outside the scope of this report.

Here two important caveats should be highlighted that are important for these results. First, donor project budget amounts are different from disbursements. They reflect the value of the contracted funding, not the timing of actual spending. Each analysis of implementation or absorption will be considered separately using disbursement data. Second, the Rio marker assignment provides a standardized, conservative assessment of climate relevance, but does not replace project-level climate impacts. It is a classification-based method that is applied consistently across the entire international finance reporting portfolio.

In summary, during 2020–2022, the Republic of North Macedonia's climate-related portfolio totalled **\$198.2 million**, which corresponds to the amount of committed international support. After applying the Rio marker coefficients, **\$96.4 million** is estimated as climate change finance within those commitments. These figures refer to the reporting under Article 9 of the Paris Agreement on committed external financial support, while subsequent sections of the report will separately cover implementation models and other analytical aspects using the relevant available and collected data.

Climate-specific (CS) or climate-relevant (CR) projects

In the Rio Marker system, climate-specific activities are those that have climate as a primary objective, while climate-relevant activities are those that include climate as an explicit, but secondary objective. This distinction is reflected both in the scale of commitments and in the degree to which they are converted into climate finance.

Of the US\$198,205,109 in committed international support, Main Objective/CS represents US\$65,294,000 (≈32.9%) and Relevant/CR represents US\$132,911,109 (≈67.1%) (Table 15). Applying the Rio marker yields a total climate change financing of US\$96,414,444, consisting of US\$43,250,000 (≈44.9%) as climate-specific and US\$53,164,443 (≈55.1%) as climate-relevant finance.

Contribution rates vary as expected: for **climate-specific finance**, around ≈66.2% of commitments are converted into climate-contributing finance ($43.25 \div 65.294$), reflecting its primary climate focus, while for **climate-significant finance**, around ≈40.0% are converted ($53,164,443 \div 132,911,109$). Taken together, the climate share of commitments for the entire portfolio is ≈48.6% ($96,414,444 \div 198,205,109$).

Table 15. Climate-specific (CS) or climate-relevant (CR) projects

Type	Total amount of committed international financial support for climate-related projects in USD\$	Amount of committed international climate finance in USD\$
Climatic-specific (CS)	65,294,000	43,250,000
Climate-relevant (CR)	132,911,109	53,164,443
Total	198,205,109	96,414,444

Funding objective: mitigation, adaptation or cross-sectoral

The composition of committed international financial support for climate change varies depending on the purpose of the financing, reflecting the balance between investments aimed at reducing greenhouse gas emissions and those that increase climate impact resilience. Each category contributes differently to both the volume of committed international financial support and the share attributed to climate according to the Rio Marker Methodology.

In the period 2020–2022, adaptation emerges as the dominant focus of committed international financial support, totalling \$100,907,310 (≈50.9%) and generating \$46,895,986 (≈48.6%) in climate-related finance. This highlights the strong orientation of support towards climate resilience, risk reduction and institutional strengthening to address the impacts of climate change.

Committed international financial support for mitigation measures amounts to US\$52,164,651 (≈26.3%) and US\$28,592,484 (≈29.7%) in climate finance allocated through Rio markers, reflecting the country's engagement in energy efficiency, renewable energy and emission reduction initiatives.

Activities that simultaneously integrate both mitigation and adaptation dimensions account for US\$45,133,149 (≈22.8%) in total committed international financial support and US\$20,925,974 (≈21.7%) in amounts allocated to climate change.

The share of climate finance as a percentage of total committed international financial support is approximately 54.8% for mitigation, 46.5% for adaptation and 46.4% for cross-sectoral issues. Overall, the total share of climate finance for all purposes remains at 48.6% of the total committed international financial support, which is in line with the broader portfolio trend noted in the previous section. This distribution highlights the dominant focus on adaptation and resilience-building, while maintaining significant support for mitigation and cross-sectoral interventions that facilitate long-term pathways for low-carbon and climate change resilience development.

Providers of international financial support

The composition of international climate support varies considerably across providers, reflecting the different engagement modalities, thematic priorities and financing instruments used by each partner. The analysis below maintains a perspective based on committed international financial support, showing both the total amount of committed international finance and the corresponding climate share allocated by the Rio markers. The European Union (EU), the World Bank (WB) and Switzerland emerge as the three largest providers, together accounting for US\$162.94 million (≈82.2%) of total committed international financial support and US\$70.67 million (≈73.3%) of climate finance determined by the Rio markers (Table 16).

- The World Bank provided the largest volume of committed international financial support of \$77.9 million, of which \$31.16 million (≈ 40.0%) was climate finance under the Rio markers.
- Switzerland follows with \$50.96 million → \$20.39 million (≈ 40.0%), while the EU registered \$34.08 million → \$19.12 million (≈ 56.1%), reflecting the strong climate orientation of IPA and thematic projects funded by the EU.

Among multilateral climate funds, the Global Environment Facility (GEF) shows a high contribution rate - \$12.06 million and → \$9.83 million (≈81.5%) - followed by the Green Climate Fund (GCF) with \$3.69 million → \$2.39 million (≈64.8%). These results confirm the dedicated climate focus of these mechanisms, in line with their mandates under the UNFCCC framework.

The Joint Sustainable Development Fund and the EBRD Blended Finance, which combines concessional and non-concessional elements, recorded \$9.34 million in commitments and \$3.74 million (≈40.0%) in climate finance, mainly supporting low-carbon investments and green finance assets.

Financial support from bilateral donors such as Sweden, USAID, GIZ and the International Vishegrad Fund (IVF) is entirely climate finance, as their programmes are fully climate-oriented and explicitly designed to address mitigation, adaptation or green management priorities.

Similarly, Germany's bilateral contribution (≈\$3.45 million → \$3.44 million) also shows fully climate-relevant finance, primarily through GIZ and related technical cooperation activities. The Multilateral Fund under the Montreal Protocol provided \$0.75 million of which \$0.36 million (≈47.6%) was determined as climate finance, in line with its focus on the phase-out of ozone-depleting substances and related climate co-benefits. The FAO Tariff Plan Programme recorded \$0.38 million, which is fully attributed to climate objectives (100%), reflecting the direct integration of climate-smart agriculture into its programme.

The total funds are aligned with \$198.2 million in international commitments and \$96.4 million in climate finance identified by the Rio markers, giving an overall contribution rate of 48.6% - fully in line with the overall portfolio performance. This allocation confirms the leading role of multilateral development financing institutions and European partners in supporting the transition of the Republic of North Macedonia towards a low-carbon and climate change resilience development model.

Table 16. Distribution of funding by donor (2020-2022)

Donor	Total amount of committed international financial support for climate-related projects in USD\$	Amount of committed international climate finance in USD\$
EU	34,076,183	19,118,703
FAO TCP	381,000	381,000
GCF	3,687,651	2,390,406
GEF	12,056,698	9,828,645
Germany	3,445,099	3,442,260
GIZ	209,725	209,725
International Vishegrad Fund	23,160	23,160

SDG Fund (+ EBRD credit)	9,340,000	3,736,000
Multilateral Fund (Montreal Protocol)	751,904	357,762
Sweden	5,027,583	5,027,583
Switzerland	50,959,037	20,392,132
USAID	347,069	347,069
World Bank	77,900,000	31,160,000
Total	198,205,109	96,414,444

4.2 FINANCIAL SUPPORT NEEDED

According to the 2021 ENDC and its Financing Strategy, the total investment required to implement all mitigation measures by 2030 in the WAM scenario was **€25.03 million** (2021 prices) (Table 17). Updating this amount to 2025 prices using the cumulative inflation in the Eurozone (2021–2025) and translating it according to the European Central Bank reference exchange rate (€/€), the estimated need increases to ≈€29,877 million, equivalent to ≈\$34,890 million (\$).

Table 17. Estimated investment needs for the implementation of the ENDC by sector with the WAM scenario (at 2021 prices and updated at 2025 prices, in millions of euros and US dollars)

Sector	2021 prices (billion EUR)	2021 prices (\$ billions)	2025 prices (billion EUR)	2025 prices (\$ billions)
Energy	24.86	29.46	29.67	34.65
AFOLU	110	130	131	153
Waste	58.6	69.44	69.9	81.7
Total	25.02	29.66	29.87	34.89

The total financing needs for the implementation of all ENDC measures are now estimated at approximately \$34.9 billion (2025 prices). According to the ENDC Financing Strategy, the expected financing structure is highly diversified. It is anticipated that approximately 4% (approximately \$1.4 billion) will be fully covered by domestic public sources, mainly through the central and municipal budgets. It is expected that approximately 43%, or \$15.0 billion, will come from non-governmental sources, including private investment, donor programmes and consumer-financed schemes. The remaining 54%, equal to approximately \$18.9 billion, will require mixed or blended finance, combining international public financing with private co-investment and concessional instruments. Consequently, the estimated amount of international financial support needed – through concessional loans, guarantees, equity participation and grants – ranges between \$20 and \$22 billion for the period 2024-2030. This support will be essential to catalyse additional private capital, mitigate financial and regulatory risks and ensure the acceptable implementation of the ENDC portfolio. Therefore, the Republic of North Macedonia prioritizes the mobilization of international public and private climate finance through blended and risk-sharing mechanisms, while using targeted grant support and technical assistance to strengthen enabling policies, institutional capacity and social transition measures that safeguard inclusiveness and long-term sustainability.

4.3 SECTORS FOR WHICH INTERNATIONAL FINANCE IS REQUESTED AND KEY BARRIERS

The Republic of North Macedonia needs international financial support primarily in the energy, buildings, transport, industry, agriculture, forestry and other land use (AFOLU) and waste sectors. These are the key areas where investments in decarbonization will have the greatest impact on achieving the national emission reduction target and advancing the transition to a climate-resilient economy. The Energy sector remains a central pillar of the ENDC, with measures aimed at transforming electricity generation, modernizing the transmission and distribution grid and greater integration of renewable energy sources. Financing is needed to develop large-scale and distributed renewable energy projects, strengthen the grid infrastructure, introduce energy storage and enable flexible operation of the electricity system. However, the sector faces significant barriers, including the high capital value of projects, limited long-term financing in domestic currency, evolving regulatory frameworks and the need for investments in grid balancing and interconnection.

At the same time, future climate and infrastructure projects need to integrate a gender perspective and social inclusion principles, by assessing the different impacts and benefits on women and men, as well as on different vulnerable groups.

This includes using gender-disaggregated data, incorporating gender analysis and inclusion plans into project preparation, and ensuring equal access to finance, technologies, training and opportunities arising from the green transition.

In the Buildings sector, support is needed for thorough renovation of existing residential and public buildings, installation of heat pumps and construction of passive buildings. These measures are among the most cost-effective ways to reduce emissions and improve energy security. The main barriers are the split subsidies between owners and users, the limited access to affordable financing for households and small and medium-sized enterprises, and the absence of large-scale aggregation mechanisms that would enable economies of scale and standardized results-based financing.

The Transport sector is seeking international financing for electrification of the national rolling stock fleet, instalment of charging infrastructure and the modernization of the railway network. Barriers in this sector are related to high costs, early market development, network externalities and the need for political and regulatory support to create sustainable markets for electric mobility.

In the Industry sector, investments in energy efficiency, modernization of production processes and introduction of advanced technologies are crucial. However, companies face challenges due to competing investment priorities, uncertain payback periods and limited access to long-term credit and guarantee mechanisms.

The AFOLU sector, which covers agriculture, forestry and other land use, requires targeted funding for afforestation, fire risk management, improved fertilizer management and other soil carbon sequestration measures. These activities provide both mitigation and adaptation benefits, but are constrained by fragmented land ownership, small owner structures and lack of robust monitoring and verification systems required for results-based payments.

Finally, the Waste sector needs investments in landfill gas recovery, mechanical-biological treatment, and recycling systems. Barriers include low creditworthiness of municipalities, limited experience with public-private partnerships, and insufficient tariff recovery, which limits the ability of local self-governments to attract private or commercial financing without combined support and technical assistance.

4.4 DISTRIBUTION OF FUNDING BY SECTOR

The Water Supply, Sanitation and Wastewater Treatment sector received the largest volume of international financial support during the reporting period, amounting to US\$52.83 million, of which US\$25.42 million (≈48.1%) was attributed to climate change financing. This reflects the continued emphasis on improving wastewater systems, integrated water resources management, and adaptation to floods and droughts.

The Agriculture sector follows with \$50.88 million in total commitments and \$20.58 million (≈40.4%) in climate-related financing. This is in line with national priorities for climate-smart agriculture, soil conservation and sustainable land management, supporting rural resilience and food security.

Environmental protection is in third place, with \$37.65 million and \$23.14 million (≈61.5%) designated as climate change financing. This sector includes biodiversity protection, pollution reduction, and institutional capacity building under programmes funded by the EU, GEF, and other partners.

Energy production, distribution, and efficiency received \$28.41 million in funding, of which \$11.97 million (≈42.1%) was designated as climate change financing. This funding supports renewable energy initiatives, energy efficiency programmes, and public infrastructure modernization to reduce emissions.

Humanitarian assistance – disaster prevention and preparedness also represents a significant component, with a total of \$22.02 million in total project funding of which \$10.87 million (≈49.4%) is estimated to be climate-related. These projects focus on early warning systems, flood resilience, and community preparedness to reduce vulnerability to climate-related disasters.

Smaller, but important contributions were noted in the government sector and the civil society in the areas of horizontal actions (\$2.33 million → \$2.01 million, ≈86.4%), other multi-sectoral (\$4.00 million → \$2.34 million, ≈58.3%), education (\$63,091 → \$63,091, 100%) and transport and storage areas (\$14,196 → \$14,196, 100%). This represents governance reforms, awareness-raising programmes and enabling activities that support broader climate goals.

Across all sectors, total committed international financial support is **\$198.21 million**, and total climate finance identified with Rio Markers is equal to **\$96.41 million**, resulting in an overall allocation rate of 48.6%. The model emphasizes a strong focus on adaptation, particularly in water, agriculture and environmental protection, complemented by mitigation-oriented investments in energy efficiency and cross-sectoral governance measures that improve institutional resilience and policy integration.

4.5 CONTRIBUTION OF INTERNATIONAL SUPPORT TO THE ENDC AND THE LONG-TERM GOALS OF THE PARIS AGREEMENT

The financial support required under Article 9 of the Paris Agreement will have a decisive role in implementing the 63 policies and measures defined in the 2021 ENDC and ensuring the achievement of the country's 2030 emission reduction target. The support will directly contribute to mitigation goals, accelerate the transition to low-emission and climate-resilient development, and strengthen the Republic of North Macedonia's alignment with the long-term goals of the Paris Agreement. International support will catalyse private sector investment by reducing risks and financing costs through concessional loans, guarantees, and blended instruments. These interventions will unlock significant private and commercial capital needed to finance renewable energy, energy efficiency, and low-carbon emissions transport at scale. The requested assistance will also enable technology transfer and capacity development in key sectors such as renewable energy integration, smart grid management, electric mobility and industrial decarbonization. Through international partnerships, the country will gain access to advanced technologies, management systems and innovative financial models that will sustain long-term transformation.

In addition, support will be targeted at institutional and policy reforms, including the introduction of a carbon tax/charge, improving the legal framework for energy markets and public-private partnerships (PPPs), and developing monitoring, reporting, verification and accreditation (MRVA) systems. These efforts will improve transparency, efficiency and governance in climate action. Finally, the financial assistance will provide multiple sustainable development benefits: improved energy security and affordability, improved air quality and public health, creation of green jobs and promotion of a just transition for communities affected by the phasing out of coal-intensive activities.

4.6 FINANCIAL ACCESS AND REQUIRED INSTRUMENTS

To effectively address sector-specific barriers and mobilize resources for the implementation of the Enhanced Nationally Determined Contribution (ENDC), the Republic of North Macedonia proposes a comprehensive and diversified financing approach. This approach combines different financial instruments and uses both domestic and international public finance to leverage private capital and ensure long-term financial sustainability of climate actions. The country seeks to fully utilize the UNFCCC Financial Mechanism, including the Green Climate Fund (GCF), the Global Environment Facility (GEF) and the Adaptation Fund (AF), as well as to strengthen cooperation with multilateral development banks (MDBs) such as the World Bank (WB), the European Investment Bank (EIB), the European Bank for Reconstruction and Development (EBRD), the Food and Agriculture Organization (FAO), UN agencies - the United Nations Development Programme (UNDP) and the United Nations Industrial Development Organization (UNIDO), etc. In parallel, regional and bilateral capacities - such as the Western Balkans Investment Framework (WBIF) and the EU Instrument for Pre-Accession Assistance (IPA III) - will be mobilized to co-finance investments aligned with EU accession priorities and the Paris Agreement.

The following instruments are expected to form the core of the country's Climate Action Financing Strategy:

- Concessions and policy-based loans will finance large infrastructure projects, including renewable energy generation, transmission and distribution upgrades, storage systems, public building renovations and rail network modernization. These loans, provided through institutions such as the GCF, EIB, WB and EBRD, will offer long repayment terms and grace periods that align with the project life cycle.
- Guarantees and initial loss coverage mechanisms will be key to attracting commercial financing by reducing perceived risks in sectors such as energy efficiency, decentralized solar deployment, and industrial modernization. Instruments of this type — offered through the Green Climate Fund (GCF) Private Sector Facility, the EBRD's Green Economy Financing Facilities (GEFFs), or bilateral export loan agencies — will help reduce financing costs and expand access to private loans.
- Debt from equity and development finance institutions will support Independent Power Producer projects and public-private partnerships in renewable energy and low-carbon technologies. Participation by institutions such as the IFC, EIB and GCF in blended capital funds can catalyse further private investments.
- Grants and technical assistance will be requested from the GEF, the Adaptation Fund, UNDP, FAO and bilateral donors to prepare projects, enable policy reforms and build capacity in monitoring, reporting and verification (MRV), financial structuring and stakeholder engagement. These resources will also finance social measures linked to just transition, ensuring that vulnerable groups and workers in carbon-intensive sectors benefit from the energy transition.

- Results-based and nature-based financing, including access to voluntary carbon markets and results-based payment mechanisms under REDD+ or Article 6 of the Paris Agreement, will be mobilized to support forestry, land restoration and soil carbon sink projects that deliver measurable and verifiable emission removals. FAO and GCF collaboration will be particularly relevant for agriculture and land use programmes.
- Regional and blended financial instruments from the EU, in particular through the European Investment Bank (EIB), the WBIF and the EU IPA III instrument, will be used for cross-border energy and transport infrastructure, as well as for scaling up investments in energy transition aligned with the Green Agenda for the Western Balkans.

This integrated financing framework reflects the strategic approach of the Republic of North Macedonia, where international public financing - channelled through the UNFCCC Financial Mechanism, multilateral banks and UN agencies - acts as a catalyst for private investments, strengthens national institutions and reduces fiscal pressure on the state budget. By combining concessional, market-based and results-based instruments, the country aims to ensure that the implementation of the ENDC is financially sustainable and socially inclusive, while fully aligned with the goals of the Paris Agreement and the 2030 Agenda for Sustainable Development.

In 2023, the Republic of North Macedonia joined the EU LIFE programme, enabling LIFE funds to support the public and private sectors, citizens and civil society for activities related to climate change, biodiversity protection, circular economy and clean energy transition. Closer cooperation between all LIFE partners will contribute to a greener, more sustainable continent in line with the objectives of the European Green Deal. Projects funded by the LIFE programme will be appropriately reported in the following BTRs.

4.7 SUPPORT RECEIVED FOR TECHNOLOGY TRANSFER

During 2020–2022, the Republic of North Macedonia received investment, technical and institutional support that drove the development of the project cycle - planning and piloting → implementation → lessons learned - while in parallel strengthening domestic capacities of ministries, utilities, municipalities, academia and SMEs. Details of each individual project (technology type, entities, status and results) are provided in the Common Tabular Format (CTF-FTC), and this section synthesizes the results of the technology transfer.

Scope and modalities of support. Support covered smart grid enabling (loss reduction analytics, advanced metering, renewable integration), large-scale and distributed clean energy, building renovation with heat pumps, district heating modernization, efficient municipal services (e.g., LED street lighting), clean transport enablers, wastewater and solid waste methane solutions (MBT, landfill gas capture), flood and watershed risk reduction measures and ecosystem restoration. Cross-sectoral activities strengthened MRV/transparency systems, environmental information platforms, readiness to access climate finance, and standardized procurement/financing models (e.g., performance contracts and risk reduction opportunities).

4.7.1 LESSONS LEARNED AND OTHER DEFICIENCIES

Results are strongest where “people + procedures + platforms” have thrived together: trained operators and installers, clear operational and management/quality assurance/quality control, and digital data systems. Challenges for projects included fragmented information across institutions, differences between commitment and payment deadlines, and uneven climate-specific labelling during design. These challenges are being addressed through improved documentation, integration of MRV, and the monitoring mechanisms presented in this report. The support received in 2020–2022 did more than just provide equipment—it transferred capacity, codified repeatable practices, and established the data and funding foundations needed to sustain and scale up the technology within the framework of the implementation of the ENDC/NECP and the Long-Term Climate Strategy.

4.8 SUPPORT NEEDED FOR DEVELOPMENT AND TRANSFER OF TECHNOLOGIES

(a) Plans, needs and priorities

- The needs for technology development and transfer in the Republic of North Macedonia arise jointly from the Enhanced (Revised) Nationally Determined Contribution ENDC (2021–2030), the National Energy and Climate Plan (NECP 2021–2030) and the Long-Term Climate Strategy and Action Plan (LTCSAP) (2020–2050). Together, these documents define a coherent vision for decarbonization, adaptation and sustainable growth built on four technological pillars:

1. Energy and industry transformation (ENDC+ NECP) – deployment of electricity production from renewable sources (solar, wind, hydropower and biomass combined heat and power); modernization of transmission/distribution networks through smart grids, advanced metering and storage systems; rehabilitation and expansion of hydropower plants; and increased electrification of transport supported by charging networks and interconnections (e.g. 400 kV Bitola – Elbasan transmission line).
2. Buildings and urban systems (ENDC + NECP) – comprehensive programmes for building renovation and installation of heat pumps, use of solar thermal collectors, modernization of LED street lighting and digital tools for building energy management that can be financed through the Energy Efficiency Fund.
3. Agriculture, forestry and waste (ENDC + LTCSAP) – application of climate-smart irrigation, methane capture capacities and mechanical-biological treatment, forest fire prevention and afforestation, and irrigation technologies with biochar or photovoltaic systems to reduce non-CO₂ emissions and strengthen adaptation.
4. Cross-sectoral innovation and governance (LTCSAP + ENDC + NECP) – establishing an integrated MRV and transparency system, digitalization of climate data, research and innovation programmes, and green financing mechanisms to leverage private capital for the diffusion of clean technology.

(b) Development and transfer of technologies to build capacities

Capacity building is central to all three frameworks. Key needs include:

- Testing, certification and training of installers for heat pump technologies and building energy efficiency.
- Expertise in system operations, forecasting and balancing for network operators and utilities.
- Technical and vocational training for e-mobility servicing, operation and maintenance of renewable energy sources and energy audits.
- Integrated measurement and review (MRV) systems and quality assurance/quality control (QA/QC) protocols that enable consistent reporting under the Enhanced Transparency Framework.
- SMEs research and innovation programmes to localize clean technologies and encourage public-private partnerships.
- Integrating a gender perspective and social inclusion into capacity development programmes, by ensuring equal access for women and men to technical training, new green jobs, innovations and technologies, as well as by encouraging greater participation of women and vulnerable groups in sectors related to energy, climate technologies and green transition.

The detailed Technology Needs Assessment (TNA) for the Republic of North Macedonia has been conducted (a separate document (2025) has been prepared) by the Association of Engineers - Engineering Institution of Macedonia (ASEEIM) - Skopje, within the project "Development of the First Biennial Transparency Report of North Macedonia and the combined Second Biennial Transparency Report and Fifth National Communication on Climate Change under the UNFCCC (BTR1 and BTR2/NC5)", supported by the United Nations Development Programme - UNDP as an implementing partner, and funded by the Global Environment Facility (GEF). The findings of that document will be provided in the next transparency submission - BTR2/NC5.

4.9 RECEIVED AND NECESSARY CAPACITY BUILDING SUPPORT

As a non-Annex I country under the UNFCCC and a candidate country for EU membership, the Republic of North Macedonia relies on a combination of domestic resources and international climate finance, technology transfer and capacity building to achieve its climate goals. Meeting the 2030 ENDC targets requires significant external support to bridge financial, technological and institutional capacity gaps.

Climate finance and technical support are not only necessary to reduce greenhouse gas emissions, but also to build climate resilience in agriculture, water management, health systems and infrastructure. The Gender Equality and Climate Change Action Plan (2021–2030) further requires that all climate-related support be gender-responsive, ensuring equal access and benefits for women, men and vulnerable groups.

During 2020–2022, the Republic of North Macedonia received capacity-building assistance from multilateral funds and bilateral partners that supported the implementation of the ENDC, NECP and the Long-Term Climate Change Strategy. The portfolio activities (more details are provided in the Common Tabular Format (or CTF-FTC) include training, advisory services, diagnostics, guidelines/tools and peer learning. The process involved a large number of national institutions, municipalities and public utility companies, civil society organizations, academic institutions and private companies, and were implemented at the national level with complementary regional and local activities.

Main areas covered: Support focused on: (i) management and coordination of climate action steps; (ii) transparency and information management (e.g., inventory/MRV practices and environmental data systems); (iii) access to finance

and project preparation (development of project lists, public procurement models and performance-based contracting); and (iv) sectoral skills in priority domains such as energy efficiency and renovation, integration of renewables, waste and wastewater management, hydrometeorology, climate-smart agriculture and industrial environmental management.

The support received for capacity building is an integral part of the donor programmes. Key initiatives include:

- Training of experts in the preparation of a greenhouse gas inventory according to IPCC (UNDP) guidelines.
- Establishing guidelines for assessing gender-responsive climate projects (MoEPP and MLSP, supported by GCF).
- Workshops on designing climate-resilient infrastructure as part of study visits for energy regulators in EU Member States (Energy Community Secretariat).

Capacity building needs (urgent)

- National climate change finance monitoring and reporting system.
- Sectoral expansion of MRV for mitigation and adaptation.
- Gender-responsive budgeting for climate policies.
- Training of local self-governments on climate risk screening.

All plans and strategies emphasize that capacity building must extend beyond public institutions to include citizens, civil society organizations, local governments, and the private sector.

Efforts will focus on:

- Strengthening public access to climate information through the national climate data portal;
- Expanding education and awareness-raising campaigns on energy efficiency, sustainable consumption and climate adaptation;
- Supporting participatory planning at the local level and climate-resilient community initiatives, especially in vulnerable municipalities;
- Promoting gender-responsive and inclusive participation in decision-making on climate and energy issues.
- Strengthening the capacities of the health sector to address climate-sensitive health risks.

Opportunities for enhanced support:

- EU accession process as a long-term driver of climate change finance.
- Regional cooperation within the framework of the Green Agenda in the Western Balkans.
- Development of public-private partnerships for renewable energy and infrastructure resilience.
- Scaling up gender-responsive climate initiatives to attract targeted donor funding.

Capacity building support will strengthen national systems to:

- Improve the accuracy and transparency of data in reporting under the Paris Agreement;
- Increase the efficiency and accountability of the implementation of the ENDC;
- Enable sustainable access to international climate change finance;
- Accelerate the transition to a low-carbon and climate-resilient economy;
- Improve public understanding, trust and participation in climate action.

In line with Article 11 of the Paris Agreement, the Republic of North Macedonia needs sustained capacity-building support that strengthens institutions, trains experts and engages society at all levels. This support will bridge existing gaps in knowledge, coordination and implementation capacity, ensuring that climate change ambition is matched by readiness for implementation. The specific activities and timelines for the planned capacity-building programmes are presented in the Common Tabular Format (CTF, Excel Spreadsheet), the Finance, Technology and Capacity-Building (FTC) Table.

5 INFORMATION REGARDING FLEXIBILITY IN REPORTING

The Republic of North Macedonia, as a developing country, would like to utilize the following three flexibilities in reporting in the BTR1:

1. SF6 emissions have not been estimated due to lack of activity data. Therefore, the Republic of North Macedonia is using the flexibility for developing countries to report three mandatory greenhouse gases (CO₂, CH₄, N₂O) and two additional greenhouse gases (PFC and HFC).
2. The Republic of North Macedonia requests flexibility in reporting the end year for this First Biennial Transparency Report - BTR1 (the country reports -3 years, instead of -2 years).
3. The last flexibility is in relation to the requirement in paragraph 85 of the MPGs for estimated emission reductions for some of the measures for which it is not possible to make such an estimate.

6 IMPROVEMENT IN REPORTING OVER THE YEARS

As this is the First Report under the Enhanced Transparency Framework (BTR1), a technical review in line with the Paris Agreement has not yet been carried out. However, to ensure transparency and continuity, key improvements compared to the 3rd BUR are presented in Annex 3. Additionally, in the greenhouse gas inventory, Chapter 12 “Recalculations, improvements and capacity building” presents:

- Key improvements compared to the previous inventory
- Implementation of recommendations from the previous inventory by 2019
- Improvements in data and methodologies
- Areas for further capacity building

In terms of **climate finance, technology transfer and capacity building needs, the challenges are:** In recent years, the country has made progress in developing climate change adaptation and mitigation activities, through the articulation of strategies at sectoral, national and regional levels. Despite this progress, there are still some needs to be met and challenges to be overcome in terms of financing, capacity and technical assistance in the different areas of climate change management.

7 OTHER INFORMATION CONSIDERED RELEVANT TO ACHIEVE THE OBJECTIVE OF THE PARIS AGREEMENT

7.1 RESEARCH AND DEVELOPMENT

The Republic of North Macedonia's investment in research and development remains low, around 0.3% to 0.4% of GDP, well below the EU average of 2.2%, as well as compared to some countries in the region such as Serbia (1.1%) and Croatia (1.4%). Funding for scientific and research activities is implemented through the Programme on Scientific and Research Activities of the Ministry of Education and Science, whereby the largest allocation of budget funds for research in 2023 is aimed at financing scientific and research projects to support research infrastructure in academic institutions and public research institutes (44 projects with a total budget of over 3.5 million euros), grants to encourage researchers to publish in international journals with an impact factor (funds have been awarded to approximately 330 applications, with a total budget of 200,000 euros), support for young scientists through full scholarships for postgraduate and doctoral studies at the top 100 universities according to the Shanghai List (10 full scholarships have been awarded, a total budget of 650,000 euros) and support for researchers to participate in scientific conferences, study visits and other events (100 researchers, total budget 32,000 euros). The science budget for 2022 and 2023 has been significantly increased compared to 2021 (approximately 3.5 million euros from the previous 1.3 million euros).

However, investment in research and innovation remains low, i.e. at 0.38% of GDP, while the private sector's share in total research is even lower, i.e. at around 0.1% of GDP. It is particularly important to highlight that the projected science budget for 2025 has doubled compared to the budget allocation in 2024. Research and development provide the intellectual and scientific basis for innovation, enabling the transformation of abstract ideas into concrete products or solutions. Insufficient investment in scientific research hinders innovation, economic competitiveness and the ability to access EU funding programmes such as Horizon Europe (the country became a full associate member of Horizon Europe in January 2021). Opportunities for international cooperation in research and innovation can be found within Horizon Europe, the EU's key research and innovation funding programme until 2027. The Republic of North Macedonia is actively involved in the European Commission's 9th Framework Programme for Research and Innovation - Horizon Europe.

This Programme provides an important platform for researchers, innovators and institutions from North Macedonia to participate in Horizon Europe projects on an equal footing with their counterparts in EU Member States. Such participation is vital for fostering integration into the European Research Area and improving national research capacities. The performance of the Republic of North Macedonia in Horizon Europe has shown a significant improvement compared to the previous programme, Horizon 2020. So far, local entities have participated in 394 eligible project proposals out of a total of 535 submitted, demonstrating the country's increased commitment to exploiting international research opportunities. In terms of eligible project proposals, 34 Macedonian entities submitted 71 successful projects, resulting in 62 grant agreements.

The Republic of North Macedonia signed an agreement to join the EU LIFE programme for environment and climate action on 3 July 2023, in Brussels. As the country is a new associate country to the EU LIFE programme, there is an obvious lack of experience and knowledge capacity related to the targeted issues among the National Focal Point (NCP) staff in the relevant ministries. The main contact for the LIFE programme and CINEA is the Ministry of Environment and Physical Planning - MOEPP. The Ministry is directly responsible for supporting the sub-programmes for nature and biodiversity and climate change mitigation. For the coverage of the topics of circular economy and clean energy transition, the competent authorities are the Ministry of Economy and the Ministry of Energy, Mining and Mineral Resources, respectively. Human resources are fragmented and ministries are still not well-equipped, nor are they sufficiently experienced with the LIFE programme, which imposes the inevitable need for substantial knowledge capacity building, through coherent activities to create a functional network at a higher level on the LIFE MK virtual platform.

The Fund for Innovation and Technological Development (FITD) was the central public institution for supporting innovation in the Republic of North Macedonia. FITD aimed to facilitate, promote and encourage innovative activities and technological development, improve access to finance, develop innovative infrastructure and enable cooperation in the field of innovation. FITD provided support for increasing innovative activity and improving technological development among small and medium-sized enterprises, supported cooperation between the academia and the industry, and promoted the benefits of innovation and technological development. The Fund for Innovation and Technological Development allocated almost 138 million euros to support innovation and research through 1,177 co-financed projects. With the reorganization of the state administration bodies in 2024, FITD ceased to exist as a separate institution.

In August 2025, the Agency for Innovation, Scientific and Technological Development and Entrepreneurship of the Republic of North Macedonia – INOVA was established, as a state agency responsible for implementing measures and activities to promote innovation, competitiveness, science and technological development, green and digital transformation in small and medium-sized enterprises, as well as for promoting entrepreneurship among young people and the unemployed. INOVA is the legal successor of two institutions: the Fund for Innovation and Technological Development and the Agency for Promotion of Entrepreneurship.

Key instruments for financial support through INOVA are co-financed grants for newly established startups and spin-off companies, for establishment, operation and investments in business-technological accelerators, for technological upgrading, for smart specialization (green and digital technologies), as well as co-financed grants and favourable loans for the commercialization of innovations.

7.1.1 Access to finance and green and digital transition

The Republic of North Macedonia has limited participation in the large EU research infrastructure in the fields of energy, environment, natural sciences and engineering. In order to improve the representation and access of researchers to these and similar networks, appropriate efforts must be undertaken, in particular aimed at:

- Raising awareness and introducing the potential of these infrastructures.
- Conducting training and building capacities for the use of these infrastructures.
- Providing political support for access to these infrastructures (mandate).
- Providing financial assistance for membership in major European infrastructures.
- Supporting the development of national infrastructures that are compatible with European ones, as well as their integration with European ones.
- Co-financing projects led by our researchers and organizations, which are expected to grow into pan-European infrastructures.

As a recommendation, a National Climate Research Portal could be developed that would aggregate databases of projects, publications, strategic documents, and climate indicators in real time, accessible to researchers, policymakers, and the public.

It is also recommended to subsidize fees for open access publishing and access to international journals for research institutions through a national digital library fund.

To ensure long-term impact and policy relevance, all recommendations should be incorporated into the “National Innovation Strategy and the Revised Education Strategy”, ensuring alignment with the Green Agenda for the Western Balkans, the EU Climate Law and Sustainable Development Goal (SDG) 13.

Table 18. Number of projects and project costs for different funding sources

Programme	Projects ready for support	Number of projects	Cost (USD)
EU-H2020	22	23	5,444,778
EU LIFE	1	4	1,260,546
IPA	1	2	254,808
BalkanMed	3	3	239,886
British Embassy Skopje	0	1	Not published
COST	0	3	Not published
ERASMUS+	0	6	Not published
UNDP	1	1	1,419,801

Source: Third Biennial Update Report on Climate Change of the Republic of North Macedonia. Skopje, 2020/2021. Additional data are taken from the World Bank (North Macedonia Climate Public Finance Review, 2024)

Programmes such as COST, ERASMUS+ and the British Embassy in Skopje are represented in terms of the number of projects, but do not have publicly available financial data in this dataset. This may be due to different funding modalities or reporting structures. Overall, the dataset highlights a strong reliance on EU structural and research funds for the implementation of environment, climate and energy related projects in the country (Table 18). The conclusion from the collected data on international funding and participation in research programmes shows that the Republic of North Macedonia is increasing its engagement in Horizon Europe and LIFE programmes, which is an encouraging fact.

The analysis of projects by type of support - mitigation, adaptation, capacity building and cross-sectoral projects, clearly shows the following results: in the period 2020 - 2022, the largest number by type of support of the total number of domestic and internationally funded projects of **74% is for mitigation projects, 5.7% for adaptation, 12.8% for capacity building and 7.15% for cross-sectoral projects.**

However, the country still falls short of its potential, with limited technical and administrative capacity to support proposal development, project coordination, and sustainable partnerships. Foreign-funded projects are larger in financial size, but less frequent, while domestic projects are more numerous, but smaller in scale.

A recommendation could be to establish a National Support Body for EU Research Programmes, which would offer pre-submission review, networking and grant writing support for Horizon, LIFE, Green Climate Fund and other programmes and donors. It could also be suggested to establish a Co-financing Mechanism for EU projects, enabling local institutions to meet the requirements for appropriate funds, thus increasing competitiveness. By the end of 2022, the R&D workforce was composed of 2,092 women and 1,720 men, with women accounting for 54.9% of the total. This majority is even more pronounced at the highest educational levels. In 2023, there were 1,154 women employed with a PhD compared to 1,057 men employed with the same qualification. This represents 52.2% of all R&D employees with a PhD.

In conclusion, from the collected data on research papers in the field of climate change and related topics, it is evident that there is a huge focus on environmental science (56% of publications), with a significant underrepresentation in key strategic domains such as electromobility, green finance and smart cities. Research remains fragmented, often project-driven and lacking continuity or policy alignment. Despite the existence of valuable research results and project data, there is no centralized open access platform for climate-related scientific knowledge. Limited access to international journals and databases limits the visibility and impact of national research on the global stage. It is recommended to design and implement National Research Centres, modelled after Horizon Europe, targeting cross-sectoral challenges such as “Climate Resilient Cities”, “Artificial Intelligence in Climate Change”, “Decarbonization of the Western Balkans”, “Circular Agro-Innovations”, etc. It is also recommended to provide long-term mandatory funding for interdisciplinary research clusters, with mandatory multi-institutional partnerships and greater inclusion of climate change study programmes in higher education.

7.2 RESEARCH ON CLIMATE CHANGE HAZARDS, SYSTEMS FOR IDENTIFICATION OF THE PROBABILITY OF NATURAL DISASTERS CAUSED BY CLIMATE CHANGE AND WARNING SYSTEM

The Republic of North Macedonia is facing intensifying climate risks – marked by rising temperatures, intense rainfall and vulnerability of most sectors – that require urgent, coordinated action. The Fourth National Communication on Climate Change highlights the country's commitments under the UNFCCC, but also reveals critical gaps in terms of infrastructure, institutional capacity and territorial inequality. Strengthening meteorological systems, investing in adaptive technologies and addressing social inequalities are essential to building resilience. The Long-Term Climate Action Strategy must integrate scientific data, local circumstances and inclusive policy design to protect ecosystems, livelihoods and development goals by 2100.

The conclusions of studies and research papers dealing with the problem of identifying the probability of severe climate change events and an early warning system in the Republic of North Macedonia indicate that the problem should be considered as a high priority. The country is facing increased risks from climate change-related hazards, with floods, extreme weather conditions and fires becoming more frequent and severe, which is becoming a huge problem for management and timely response.

While research and innovation in early warning systems and research initiatives such as NOTHAS and WRF modelling are a good start, significant gaps remain in institutional coordination, public awareness, and resource allocation. Strengthening people-centred, multi-hazard early warning systems and investing in inclusive, data-driven resilience strategies are essential to protecting communities and improving national response preparedness.

7.3 APPLICATION OF ARTIFICIAL INTELLIGENCE (AI) IN RESEARCH

Artificial intelligence (AI) is playing an increasingly important role in climate change research, offering tools that can accelerate understanding, predicting, and solving climate challenges. Below are some ways AI is being applied:

Climate modelling and predictions – AI algorithms analyse vast amounts of data from satellites, weather stations, and ocean sensors to create more accurate models of future climate scenarios.

Precision agriculture – With the help of AI, farmers can optimize resources (water, fertilizers) and adapt to climate conditions, which increases the resilience of agriculture to climate shocks.

Sustainable energy management – AI is being used to optimize energy consumption in industry and households, as well as to better manage renewable sources such as solar and wind energy.

Climate risk monitoring – Artificial intelligence systems can detect early signs of floods, droughts or forest fires, enabling faster response, i.e. preparedness and damage reduction.

Policy and scenario analysis – artificial intelligence can simulate the effects of different climate policies and help make informed decisions at the local and global levels.

Key contributions from artificial intelligence are expected in the following areas:

- Data analysis - artificial intelligence can analyse complex climate data to identify patterns and anomalies that would be difficult for humans to detect;
- Predictive modelling - machine learning models can predict climate events, helping us prepare for and mitigate their impact, and
- Optimization - AI can optimize energy use and reduce waste, contributing to a lower carbon footprint. Although direct applications of AI are still limited, there is great potential for its integration into automatic processing of satellite data to monitor forest fires, predict floods in vulnerable areas, and optimize the use of renewable energy sources.

Although there are initiatives to integrate artificial intelligence into education, the Republic of North Macedonia has not yet adopted formal legal frameworks or ethical guidelines for the use of artificial intelligence in the educational process.

Coordinated action is needed between the Government, educational institutions and the civil society sector to develop regulations that will ensure the responsible and ethical use of artificial intelligence in education. The recommendations that are applied at the national level can be divided into recommendations that relate to institutions and recommendations related to curricula.

The World Meteorological Organization (WMO) recently launched a major initiative to integrate artificial intelligence and machine learning into global weather, climate and water systems. The focus is on strengthening services across the entire weather-climate-water cycle. The goal is to help hydrometeorological services and everyone benefit from the life-saving potential of artificial intelligence through early and more reliable warnings of floods, droughts and heatwaves, especially in vulnerable regions.

7.4 EDUCATION AND PUBLIC AWARENESS RAISING ON CLIMATE CHANGE

7.4.1 NATIONAL CIRCUMSTANCES AND INSTITUTIONAL SETTING

The education system in the Republic of North Macedonia reflects the needs of society for an educational, scientific and lasting role in the economic, social, technological and cultural development of society as a whole. Consequently, the Ministry of Education and Science facilitates the continuous development of the system of education, moral education and science in the Republic of North Macedonia.

The Macedonian education system is decentralized. The management of primary and secondary schools is under the responsibility of the municipalities, except for secondary schools in the capital, which are under the responsibility of the City of Skopje. The state provides financial resources for education in the municipalities in the form of block grants. The management of all schools for students with special needs is under the direct responsibility of the Ministry of Education and Science.

Teaching in Macedonian schools is conducted in four languages. In addition to the Macedonian language as the official language of the country, students have the opportunity to choose to study in Albanian, Turkish or Serbian. In some schools, students have the opportunity to choose non-mandatory (elective) subjects for learning the culture and language of the Vlachs or Roma. The curricula for subjects in primary and general secondary education and for general subjects in vocational education are prepared by the Bureau for the Development of Education, and for vocational

subjects by the Centre for Vocational Education and Training. Quality assurance in educational institutions is under the supervision of the State Educational Inspectorate. There are 21 higher education institutions in the country, seven of which are public universities. In recent years, the number of students (full-time and part-time) studying at Macedonian universities has been constantly increasing.

A special priority of the Republic of North Macedonia is adult education, an activity regulated by the Law on Adult Education and the Law on Vocational Education. The adult education system is promoted by the Centre for Adult Education, an institution established by the government with the aim of contributing to the realization of the socio-economic needs of Macedonia through adult education, to meet the needs of the labour market and to assist individuals in their personal development. The Republic of North Macedonia participates in the Erasmus+ programme as a participating country in the programme. The country has completed the referencing of the National Qualifications Framework with the European Qualifications Framework, a process carried out by the Ministry of Education and Science.

The Ministry of Education and Science is the main government body responsible for education and training, with a mandate for the implementation of education. The strategies and programmes of the national institutions foresee cross-sectoral cooperation in the implementation of various measures and activities. The decentralization process in the Republic of North Macedonia is still ongoing and remains one of the main priorities of the Government. Governance in the education sector is divided between the Parliament and the Government through the Ministry of Education and Science and local self-government through the municipalities.

Private schools: Approximately 2% of secondary schools are private institutions, funded through tuition and other private sources. These schools operate independently of government funding and are not subject to the same regulations as public schools.

Vocational Education and Training (VET): VET schools can generate additional funds through income-generating activities, such as providing training for external users, offering various services and producing and selling products, dual education, etc. A specific regulation regulates the acquisition and distribution of these funds, ensuring that they are used for purposes such as the purchase of didactic materials, equipment, maintenance and professional development.

International aid: Non-governmental organizations (NGOs) and international aid agencies contribute to funding education through grants and donations targeted at specific educational initiatives. These funds are used for technological upgrades, teacher training programmes, and infrastructure development, especially in public institutions that have limited resources.

European Union programmes: The Republic of North Macedonia participates in EU-funded programmes such as Erasmus+, which supports education, training, youth and sport. These programmes offer opportunities for mobility, cooperation and development in the education sector.

The education system of the Republic of North Macedonia is regulated by a comprehensive legal framework covering primary, secondary, vocational and higher education. This framework is designed to ensure accessibility, quality and inclusiveness in education, aligning with both national priorities and international standards.

7.4.2 LEGAL FRAMEWORK

The main constitutional and legal provisions regulating education in the Republic of North Macedonia are: the Constitution of the Republic of North Macedonia: Article 44 guarantees the right to education, stating that education is accessible to all under equal conditions. Article 47 encourages scientific and technological development, setting the basis for educational development. The Law on Primary Education (2008), Compulsory nine-year education for children aged 6 to 15, in order to provide basic knowledge and skills. The Law on Secondary Education (1995, amended in 2020): Requires adolescents aged 15 to 19 to attend secondary school for four years, promoting further academic and vocational development. The Law on Vocational Education and Training (VET) (2006, amended in 2019): Focuses on aligning vocational education with the needs of the labour market, improving employability through practical skills. The Law on Higher Education (amended in 2019 and 2021): Regulates education at the university level, ensuring quality standards and encouraging research and innovation.

Education is further regulated by strategic and policy documents: Comprehensive Education Strategy 2018–2025: which outlines a vision for an inclusive, integrated education system that equips individuals with the necessary knowledge and skills. The Strategy emphasizes the need for infrastructure modernization, human resource development, and legislative improvements.

7.4.3 PRIORITIES AND RECOMMENDATIONS

At the institutional level:

- Advocacy for introduction and intensification of climate change education should be a long-term goal of the Government of the Republic of North Macedonia (until 2050) by including this requirement in key strategic documents. Inclusion of guidelines for development of green competencies and climate literacy in the upcoming Smart Specialization Strategy, which will replace the existing Innovation Strategy and Competitiveness Strategy. Coordination of new policies with the existing Industrial Policy Strategy 2018-2027, Education Strategy 2018-2025 and Gender Equality Strategy 2022-2027. Coordination with the national designated body and the national coordination mechanism in relation to the Green Climate Fund (GCF) in order to monitor climate change priorities, activities and initiatives.

Recommendations for higher education:

- Strategic commitments (in the Higher Education Strategy) and efficient mechanisms (at the level of action plans and measures) are needed to include aspects of climate change and sustainable development, including gender aspects, in higher education curricula, which has recently become part of the basic concept of natural and technical sciences in higher education programmes in Europe and beyond.
- To place emphasis on the inclusion of climate change in existing and new educational programmes (risks/mitigation/adaptation), as a result of the increased national and international development of the topic on a scientific basis, especially in relation to the requirements arising from the EU Green Agenda.
- To support and legally implement in the existing Law on Higher Education the European Union's flagship recommendation for a Youth Guarantee, with which the state will ensure that all young people receive a quality offer of employment, opportunities for continued education and learning, an internship or traineeship within a period of four months when they leave formal education or become unemployed.
- To initiate the establishment of Climate Change Knowledge Centres at the faculties of universities in the country, especially those that already have climate change-related programmes. More details on this topic will be reported in the BTR2.

7.5 YOUTH AND CLIMATE CHANGE

Climate change is one of the greatest threats facing children and young people around the world. UNICEF's latest report on the risks of climate change to children finds that 1 billion children are at "extremely high risk" of the impacts of climate change. That's almost half of all children in the world. It is clear that children bear the largest burden of climate change and that the climate crisis is a children's rights crisis.

On 20 October 2021, the Youth Climate Change Summit was held in Skopje under the leadership of UNICEF, where a Youth Declaration on Climate Change was adopted (available at: <https://www.unicef.org/northmacedonia/mk/>) calling on decision-makers to take concrete measures on climate change and to create more opportunities and space for young people to influence climate change-related decisions. At the Summit, young people led two panel discussions with domestic and international representatives, where they engaged in a dialogue on global, European and national climate and energy policies, and on how to participate through activism, education, entrepreneurship and innovation. The panelists encouraged young people to take an active role and reaffirmed their support for creating a space where the voice of young people would be heard and support for youth-led climate actions would be provided.

The declaration, adopted at the end of the Summit, calls for intergenerational solidarity and exemplary leadership by all institutions and includes five specific demands: creating a space where young people will lead solutions; decision-makers to rethink economic models and find ways to stimulate industries to operate sustainably; promoting repair, reuse and durable products with a longer lifespan; decentralizing energy production with a focus on energy cooperatives, especially for solar energy; and introducing climate change education with experiential learning.

The three-year programme of UNICEF and the Swedish International Development Cooperation Agency is fully integrated into the reform of the education system that the country has launched since the start of the 2021 school year in primary education (source: <https://www.unicef.org/northmacedonia/mk/mladinski-samit-za-klimatski-promeni-usvoena-mladinska-deklaracija>). In addition to regular environmental classes, students will have the opportunity to learn, discuss and reflect on the environment in extracurricular activities.

Through UNDP, young people were actively involved in the development of NDCs 2.0 during 2020 and 2021. More information about these activities is available on the website in the national contributions section – <https://api.klimatskipromeni.mk/data/rest/file/download/22f68612077454fc69fc0d8338f06e21a6763fd6dd3a866b4b6c7cf7999612ae.pdf>

7.6 ASPECTS RELATED TO GENDER EQUALITY

Climate change affects men and women differently due to their roles, access to resources and representation in decision-making. Understanding the risks and different impacts of climate change on women and men is essential for

addressing those risks and achieving sustainable development. To do this, their different needs and interests must be identified, and the contribution of women, as well as men, in developing solutions must be encouraged. This inclusive approach will result in more effective and sustainable outcomes. To ensure gender-responsive implementation of the national climate agenda, the country should ensure that gender equality is addressed systematically and in a mutually reinforcing manner. A gender perspective should be taken into account when developing strategies for resource mobilization, implementing climate finance instruments and ensuring equal participation in the allocation of financial resources, especially at the local level.

Given that a gender perspective enables more targeted, fairer and more effective policies, integrating gender perspectives into climate reporting within the Biennial Transparency Report (BTR) and National Communication (NC) is not only an equality commitment, but also improves the effectiveness of mitigation and adaptation measures.

The 2020-2022 analysis reinforces the point that traditional gender roles persist across industries. Women are concentrated in low-emission service sectors, while men dominate high-emission and climate-critical sectors (energy, transport, construction). More information can be found in the detailed analysis, published at <https://api.klimatskipromeni.mk/data/rest/file/download/c1fc962a594ab981c101c15d1b952487b4eeae4f6d31346cd46d78efb50f1f75.pdf>

The country has adopted a series of strategic and legislative documents that set the legal and strategic framework that obliges the state to include a gender perspective in the creation of all public policies, including policies related to climate change. The National Gender Equality Strategy (2022-2027) provides a comprehensive framework for the promotion of gender equality and the empowerment of women in all spheres of society. Specific objective 2.3 links gender issues and climate change: Strengthened mechanisms for environmental protection and the creation of gender-responsive and climate-resilient climate change policies.

The National Gender Equality Strategy 2022-2027 identifies the main challenges for gender equality in the area of climate change for the following period:

- Lack of a systematic approach to addressing gender issues and climate change in national and local policies in order to create effective and sustainable mechanisms for gender equality and climate change;
- Lack of gender-disaggregated statistical data to create effective gender-sensitive climate actions;
- Need to strengthen administrative capacities on gender issues and climate change;
- Inclusion of gender indicators in the system for monitoring, reporting and verifying the level of implementation of the climate actions envisaged in the country's strategic documents;
- Lack of gender-responsive mechanisms for access to new technologies for climate change mitigation and adaptation. Absence of gender-responsive mechanisms for access to new technologies for climate change mitigation and adaptation.
- Low representation of women in mechanisms for creating climate-responsible agricultural policies and practices.

A key priority in the field of climate change is the inclusion of a gender perspective in policies, measures and strategies adopted at national and local levels. This requires greater participation of women in decision-making structures, as well as the participation of gender equality experts who will highlight the different impacts of climate change on women, especially women from vulnerable categories, thus establishing early intervention and risk reduction measures that will be targeted at them. It is particularly important to take into account the differences in the needs and requirements of women and men in agriculture, energy, water resources, telecommunications, transport, protected area management and tourism. It is also important to strengthen the capacities of policymakers and climate change mitigation measures to include a gender perspective.

The total labour force in the Republic of North Macedonia maintains a consistent male majority. This trend has been stable throughout the period under review (2020-2022), serving as a fundamental benchmark for understanding the national labour market. For example, during the reporting period, men represented 58.5% of the total labour force. Women made up the remaining 42.5%. The consistent male majority in the labour force indicates that the gender gap is not a temporary statistical anomaly, but a structural feature of the economy. This implies that the challenge is not only a lack of available female workers, but also a lack of accessible and equal opportunities for them.

The most striking feature of the national workforce is the extreme concentration of men in specific industries, reflecting deep-rooted cultural norms and significant barriers to entry for women in those sectors. Industries that are physically demanding or technologically specialized are overwhelmingly male dominated. This marked concentration of men in these areas is a clear indicator of structural segregation. The reasons for this go far beyond simple preference and may include a lack of inclusive infrastructure, hiring bias, and a work environment that discourages women's participation. Women are underrepresented in the very sectors where mitigation investments and adaptation infrastructure will be concentrated. This limits both their influence in decision-making and their access to climate-related jobs.

Within the framework of the preparation of the BTR1, several workshops and events were held during 2025 with the participation of more than 380 people, of which about 55% were women (more information about the events is available at <https://klimatskipromeni.mk/>). The implementation of gender indicators and the action plan within the project is also being monitored, which will be reported in the next BTR.

7.7 COOPERATION, GOOD PRACTICES, EXPERIENCE AND LESSONS LEARNED

The Republic of North Macedonia actively participates in national and international initiatives for cooperation and knowledge sharing, demonstrating a strong commitment to collective efforts in addressing the impacts of climate change. The country values the exchange of experiences and practices as essential for improving resilience and adaptive capacities. Some of the key achievements in the reporting period are:

- Completed comprehensive assessments of legal and policy gaps regarding legislation and climate action strategies, along with updated action plans and roadmaps for action.
- Amendments to the draft Law on Climate Action have been finalized and the Long-Term Climate Strategy and Action Plan has been updated.
- A draft legal framework for a monitoring, reporting and verification (MRV) system has been prepared, including draft regulations, rulebooks and the structure for an electronic greenhouse gas (GHG) registry.
- A draft Decree on Monitoring and Reporting of Greenhouse Gas Emissions has been developed, supported by practical templates and tools with guidance for effective implementation.
- Updated greenhouse gas inventory and modelling projections.

A recent example, the Climate Change Administrative Capacity Assessment was developed within the framework of the project “Strengthening the Institutional and Technical Capacities of North Macedonia to Enhance Transparency under the Paris Agreement” (CBIT project), implemented by the Ministry of Environment and Physical Planning with financial and technical support from GEF and UNDP in 2020. The task was carried out by a team of HEAT International experts with the aim of advancing the climate change agenda and capacity building, by conducting a systemic and institutional assessment of the capacity of the national administrative capacity to fulfil the following commitments:

- commitments as a non-Annex I Party to the UNFCCC and a Party to the Paris Agreement, as well as those it would undertake if it became a Party to Annex I;
- obligations arising as a member of the Energy Community (EnC);
- future obligations as a candidate country for accession to the European Union, which will also require the transposition and implementation of the EU Acquis in energy and climate. Based on the assessment and elaboration of the requirements, as well as the assessment of the existing administrative capacities, it can be concluded that the administrative capacity of several institutions, primarily the MoEPP, will need to be strengthened. Within the framework of the project, some of the MoEPP employees gained knowledge by working together with the HEAT team.

With the planned measures, a total of eight climate change-related job posts are proposed. They are systematized in the current Climate Change Department. The advantage of this approach is that all climate change-related issues will be addressed within one organizational unit under the supervision of a head of department. The disadvantage is that certain job posts could be better integrated into other existing units within the MoEPP. This applies in particular to job posts whose primary tasks relate only to the development of a greenhouse gas inventory and/or the administration of the monitoring, reporting and verification platform, which could be incorporated within the NEIS in the MoEPP (details are provided in the recommendations section above). This process is active and the final decision on the systematization of climate action-related posts will be aligned with the legal provisions of the draft Law on Climate Action, which is in the adoption procedure.

The implementation of a national climate change administrative system requires adequate resources. Establishing and maintaining appropriate organizational relationships, establishing and adjusting data flows, recruiting and retaining expertise, developing and implementing systems and tools, and delivering new results require careful planning and maintenance of resources. Calculations show that the annual total budget for the Climate Change Unit in the MoEPP could range from almost €130,000 (US\$152,100) to almost €165,000 (US\$193,050), depending on how internal administrative capacity on climate change is strengthened.

All of the above activities covered by the report have improved data quality, created new opportunities, strengthened administrative capacity for climate change, and increased transparency in reporting in accordance with the obligations of the Paris Agreement.

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ANNEXES

Annex 1 Improvements in calculations in the national greenhouse gas inventory system

Annex 2 Results of analysis of key categories (level and trend) for 1990/2022

Annex 3 Key improvements compared to the previous biennial report

Annex 4. Detailed overview of climate change mitigation policies and measures analysed in the 2025 WAM Scenario.

TABLES (ACCOMPANYING PART OF BTR1)

Common Tabular Format - NDS and FTC Tables (in a special Excel format according to ETF requirements)

Annex 1. Improvements in the national greenhouse gas inventory system compared to the previous one

Sector	Improvement introduced in this inventory	Description of the improvement	Expected impact
Energy	Standardization of input data and conversion factors	Additional QC checks were conducted to ensure consistency of net calorific values and conversion factors used in the IPCC Inventory Software (version 2025).	Improved consistency of calculations and reduction of methodological inconsistencies
Energy	Audit of fuel consumption data	The fuel consumption data were additionally checked and aligned with the breakdown in the national energy balances.	Improved consistency of activity data and time series
Energy	Improved QA/QC procedures	Additional data quality checks have been introduced to identify inconsistencies in the nomenclature of energy sources and conversion factors.	Increased transparency and reliability of emissions estimates
Industrial processes and product use	Updated data on F-gases	Updated data on imports of fluorinated gases provided by the Ozone Department of the MoEPP were used.	Improved accuracy of emissions estimates
Industrial processes and product use	Improved time series consistency	An additional check of the activity data was conducted in order to improve the consistency of the emission estimates in the time series.	Improved reliability of emissions trends
Agriculture – livestock farming	Application of Tier 2 methodology for key categories	Additional data on farm structure, feeding systems and manure management were used in order to continue the application of the Tier 2 methodology for dairy cows and pigs.	Improved accuracy of emissions estimates
Agriculture	Improving calculations of direct and indirect N ₂ O emissions from agriculture	IPCC Inventory Software (version 2025) allows the inclusion of all animal categories	More realistic emissions estimates
Land and land use changes	Improved spatial data analysis	A combination of national statistical data and satellite imagery (Landsat and Sentinel) was used to assess land use changes.	Improved representativeness of activity data

Land and land use changes	Application of Object-Based Analysis (OBIA)	Satellite images were classified using the OBIA methodology, which allowed for better identification of land use categories.	Improved spatial accuracy of data
Land and land use changes	Inclusion of perennial plants in the category of fruit plantations	Sinkholes are included from the category of fruit plantations for perennial plants (orchards and other permanent plantations).	Improved completeness and representativeness of carbon removal estimates
Waste	Including regional data distribution	Waste generation and treatment estimates were further disaggregated by statistical regions, allowing for better spatial representativeness of activity data.	Improved spatial detail and transparency of assessments
Waste	Recalculation of emissions from medical waste incineration	Emissions from medical waste incineration were recalculated based on updated activity data.	Improved accuracy of emissions estimates
Waste	Inclusion of data from wastewater treatment plants	The inventory includes data on wastewater treatment and sludge generation from wastewater treatment plants, improving the completeness of the wastewater category.	Improved inventory completeness
Waste	Improved classification of industrial wastewater	Industrial wastewater data was revised because some industry categories were not included in the calculations.	Improved inventory completeness

Annex 2. Key categories (level and trend) in 1990 and 2022

Assessment of the level of key categories for 1990 and 2022

IPCC category	GHG	1990 Ex,t(Gg CO ₂ Eq)	Ex,t (Gg CO ₂ Eq)	Lx,t	Cumulative sum of Lx,t
Energy industries – solid fuels	CO ₂	3658.26	3658.26	0.25	0.25
Forest land that remains forest land	CO ₂	-2531.10	2531.10	0.17	0.42
Road transport – liquid fuels	CO ₂	2266.80	2266.80	0.15	0.58
Land converted to forest land	CO ₂	-727.61	727.61	0.05	0.63
Solid waste disposal	CH ₄	659.31	659.31	0.04	0.67
Manufacturing industries and construction – liquid fuels	CO ₂	588.98	588.98	0.04	0.71
Enteric fermentation	CH ₄	534.96	534.96	0.04	0.75
Energy industries – liquid fuels	CO ₂	478.87	478.87	0.03	0.78
Energy industries – gaseous fuels	CO ₂	456.03	456.03	0.03	0.81
Cement production	CO ₂	365.79	365.79	0.02	0.84
Cooling and air conditioning	HFCs, PFCs	286.87	286.87	0.02	0.86
Direct N ₂ O emissions from managed soils	N ₂ O	286.25	286.25	0.02	0.87
Arable land that remains arable land	CO ₂	-155.07	155.07	0.01	0.89
Manufacturing industries and construction – solid fuels	CO ₂	154.98	154.98	0.01	0.90
Coal exploitation and handling	CH ₄	152.47	152.47	0.01	0.91
Land converted into pasture	CO ₂	142.51	142.51	0.01	0.92
Land converted into arable land	CO ₂	120.81	120.81	0.01	0.92
Unspecified - liquid fuels	CO ₂	118.57	118.57	0.01	0.93
Wastewater treatment and discharge	CH ₄	115.63	115.63	0.01	0.94
Manure management	N ₂ O	110.70	110.70	0.01	0.95
Manure management	CH ₄	91.67	91.67	0.01	0.95

Trend assessment of key categories (1990, 2022)

IPCC category	GHG	Calculation for 1990 Ex ₀ (Gg CO ₂ - eq)	Calculation for 2022 Ext (Gg CO ₂ - eq)	Trend Estimation (T _{xt})	Contribution to the trend in %	Cumulative sum of the contribution to the trend
Road transport – liquid fuels	CO ₂	639.82	2266.80	0.12	0.24	0.24
Land converted to forest land	CO ₂	-89.39	-727.61	0.04	0.08	0.32
Energy industries – solid fuels	CO ₂	5689.78	3658.26	0.03	0.07	0.39
Energy industries – gaseous fuels	CO ₂	0.00	456.03	0.03	0.06	0.45
Solid waste disposal	CH ₄	295.87	659.31	0.03	0.06	0.50
Forest land that remains forest land	CO ₂	-1654.78	-2531.10	0.03	0.06	0.56
Other sectors – liquid fuels	CO ₂	545.31	56.62	0.02	0.05	0.61
Manufacturing industries and construction – liquid fuels	CO ₂	1197.05	588.98	0.02	0.04	0.64
Cooling and air conditioning	PFC	0.00	286.87	0.02	0.04	0.68
Manufacturing industries and construction – solid fuels	CO ₂	566.33	154.98	0.02	0.03	0.72
Enteric fermentation	CH ₄	1017.21	534.96	0.01	0.03	0.74
Land converted into pasture	CO ₂	-15.58	142.51	0.01	0.02	0.77
Production of ferroalloys	CO ₂	266.65	33.77	0.01	0.02	0.79
Land converted into arable land	CO ₂	-27.79	120.81	0.01	0.02	0.81
Cement production	CO ₂	292.57	365.79	0.01	0.02	0.83
Direct N ₂ O emissions from managed soils	N ₂ O	188.96	286.25	0.01	0.02	0.85
Zinc production	CO ₂	186.23	0.00	0.01	0.02	0.87
Energy industries – liquid fuels	CO ₂	481.55	478.87	0.01	0.02	0.88
Unspecified - liquid fuels	CO ₂	0.00	118.57	0.01	0.02	0.90

Annex 3. Key improvements compared to the last biennial reporting

The following table summarizes the key improvements, changes and new developments implemented by the Republic of North Macedonia since the Third Biennial Update Report (Third BUR, submitted in August 2020), as documented in the subsequent First Biennial Transparency Report (BTR1, covering the period 2020 - 2022):

Aspect	Third BUR (2020)	New Status BTR1 (2022)	Link
Legal framework	There was no comprehensive legislation to address climate change.	A Draft Law on Climate Action has been adopted, which provides the legal basis for the national climate framework.	Chapter 1 of BTR1
Obligations towards the NDC	The initial NDC was used. Prepared in parallel with the NECP, not all measures were taken into account.	More ambitious targets, with the ENDC submitted in 2021, commit to reducing net greenhouse gas emissions by 82% by 2030 compared to 1990 levels. Compliance with the adopted NECP.	Chapter 1 and 2 of BTR1, ENDC, NECP
UN reporting system	Third Biennial Climate Change Report	Transition to a Biennial Transparency Report (BTR1), aligned with the Enhanced Transparency Framework (ETF)	Chapter 2 of BTR1, Technical Report on Climate Governance and Monitoring, Reporting and Verification (MRV) in the Republic of North Macedonia
Monitoring, reporting and verification system	Not formally established; partially covered by other mechanisms	A formal monitoring, reporting and verification (MRV) system will be established under the Draft Law on Climate Action.	See above.
Greenhouse gas inventory	Greenhouse gas emissions and sinks calculated with GWP from AR4 and using IPCC software version 2.54 - as of 6 July 2017. AFOLU emissions are based on many assumptions.	Greenhouse gas emissions and sinks calculated with GWP from AR5 and using IPCC software 2.98, 25 June 2025.	Chapter 2 of BTR1, NID
Policies and Measures (PAMs) and projections	47 policies and measures. Energy only model.	63 policies and measures (including 16 enabling PAMs) Models for all sectors. Recalculations according to the updated inventory until 2022.	Chapter from BTR1, ENDC
Monitoring of the implementation of the NDC	Not covered.	NDC monitoring established, indicators analysed/proposed	Chapter 2 of BTR1
Financial, technical assistance and capacity building	Primary reliance on GEF and UNDP for financial/technical support.	The Republic of North Macedonia has joined the EU LIFE programme, providing access to EU funds for climate action, biodiversity and the clean energy transition. Greater scope in collecting available data.	Chapter 4 of BTR1
Adaptation	Vulnerability and adaptation assessments have been prepared for several sectors. No adaptation indicators. No NAP developed.	BTR1 includes a more structured and developed approach to adaptation, defining a National Vision and Goals for Adaptation and Specific Implementation of Adaptation by Sector. A project to prepare the first NAP in preparation.	Chapter 3 of BTR1
Research and development, innovation	Analysis of research and development and innovation for support needs and barriers	Increased engagement in international funding and participation in research programmes related to climate	Chapter 7 of BTR1

		change. Specific chapter on the topic.	
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Annex 4. Detailed overview of Policies and Mitigation Measures, Actions and Plans (PAMs) that are analysed in the WAM scenario (see document: Climate Change Mitigation Measures from 2025)

Detailed description of policies and measures

- **Energy**
 - Energy supply

PAM1 REDUCING NETWORK LOSSES

MAIN OBJECTIVE: Reducing losses in electricity and heat networks

DESCRIPTION: Technical measures to reduce electricity losses in distribution include replacing overhead lines with underground ones (where possible), moving to a voltage level of 20 kV, installing new transformer stations to shorten 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 substation operation through automatic control.

 Time frame	 Type	 Sector	 Gases	 Range
2025 – 2030	Technical	Energy supply	CO ₂ , CH ₄ , N ₂ O	National
 Relevant planning documents, legal and regulatory acts	• Energy Development Strategy until 2040 • MEPSO Development Plan • Rulebook on the manner and conditions for determining regulated maximum revenue and regulated average tariffs for electricity transmission, organisation and management of the electricity market and electricity distribution • Rulebook on regulating the prices of thermal energy and system services • Balkan Energy Group (BEG) Development Plan			
 Methodology	• Bottom-up modelling and least-cost optimization using the MARKAL model. IPCC methodology			
 Assumptions	• Technical interventions will reduce losses in electricity transmission and distribution from 12% to 8%, while losses in the district heating system will be reduced from 12% to at least 10.5%.			
Implementation status	• In the implementation phase			
Steps taken	• Development Plan for the Power Transmission System for the Period 2025 – 2035 (MEPSO AD – October 2024) • Development Plan for the Electricity Distribution System for the Period 2023-2027 (Elektrodistribucija DOOEL. Skopje - November 2022) • A general investment plan has been developed in the electricity distribution network for the next 20 years. • Implementing measures to improve operations and reduce losses in the heat distribution system			
 Planned steps	• Replacement of outdated and unreliable primary equipment of 400 kV and 110 kV with an average age of over 30 years (circuit breakers, instrument transformers and surge arresters) and replacement of secondary equipment (relay protection, remote control and management systems, power supply, electricity metering) • Replacement of old electrical transformer with new transformers at a voltage level of 20 kV • Reducing reactive power in the electrical network • Rehabilitation of the hot water distribution network, replacement of existing pumps in heating substations with new energy-efficient pumps and other measures to improve energy efficiency (modernization of the SCADA system, integration of distribution networks). • Installation of modern regulation and monitoring equipment in heating substations to control and reduce heat consumption • Implementation of the Strategy for Reconstruction/Revitalization of the Electricity Transmission Network developed by MEPSO. (Sopotnica-Bitola, Kichevo-Sopotnica, Oslomej-Kichevo) • Oslomej-Gostivar, Strumica 1-Strumica 2, Valandovo-Strumica 2, Dubrovo-Valandovo)			
 Indicators	Value in the last reporting year		Target value	
	2024		2030	
	Progress		Network losses have been reduced (%)	
		14.6% for electricity	10.5% for electricity	
		12.5% heat	10% heat	
Emission reduction (Gg CO ₂ -eq)			2030	

		104.4
Other	Primary energy savings (ktoe)	15
 Finance	Budget	• 170 million euros
	Source of funding	• Electricity and heat distribution companies, MEPSO (16 million euros)
 Implementing entity	• Electricity transmission system operator • Electricity distribution system operators • Heat distribution companies	
 Monitoring entity	• Energy Regulatory Commission, Ministry of Energy, Mining and Mineral Resources	
 Contribution to achieving the Sustainable Development Goals	direct	indirect
		 

PAM2. LARGE HYDROPOWER PLANTS

MAIN OBJECTIVE: Increasing domestic production capacity from renewable energy sources

DESCRIPTION: Construction of new large hydropower plants taking into account environmental and social impacts

 Time frame	 Type	 Sector	 Gases	 Range
2030 – 2030	Technical	Energy supply	CO ₂ , CH ₄ , N ₂ O	National
 Relevant planning documents, legal and regulatory acts	• Energy Development Strategy of Macedonia until 2040 • National Water Strategy • Development Plan of ESM AD (AD Elektrani na Makedonija). • Energy Law • Water Law • Environmental Law • Law on Concessions and Public Private Partnership			
 Methodology	• Bottom-up modelling and least-cost optimization using the MARKAL model. IPCC methodology			
 Assumptions	• The construction of large hydropower plants is planned according to the following dynamics: ◦ Chebren – 2035 ◦ Vardar River Valley – 2030-2040 ◦ Vardar Tunnel – Kozjak, Veles and Gradec 2040 ◦ Globochica II – 2035			
Implementation status	• In the implementation phase			
Steps taken	• Feasibility/pre-feasibility studies have been developed • Chebren Feasibility Study			
Planned steps	• Invitation to tender for construction of other hydropower plants, selection of the most advantageous bidder and commencement of construction • Analyses by MEPSO and ERC on the implementation of the Capacity Mechanism in accordance with Regulation 2019/943 on the internal electricity market and in accordance with state aid rules			
 Indicators	Value in the last reporting year		Target value	
	2018		2030	

Progress	Additional capacity (MW)	installed	/		0
Emission reduction (Gg CO ₂ -eq)					2030
Other			Primary energy savings (ktoe)		0
	Finance	Budget	• ~2500 million euros		
		Source of funding	• Public-Private Partnership, ESM		
	Implementing entity		• Government of the Republic of North Macedonia • ESM AD (AD Elektrani na Makedonija). • Ministry of Environment and Physical Planning • Energy Regulatory Commission • MEPSO • Ministry of Energy, Mining and Mineral Resources		
	Monitoring entity		• Ministry of Energy, Mining and Mineral Resources, Ministry of Environment and Physical Planning		
	Contribution to achieving the Sustainable Development Goals		direct	indirect	
					

PAM3 INCENTIVES FEED-IN TARIFF

MAIN OBJECTIVE: Incentives feed-in tariff

DESCRIPTION: Construction of new small hydropower, wind and biogas plants with feed-in tariffs that will stimulate construction

 Time frame	 Type	 Sector	 Gases	 Range
2030 – 2030	Technical, regulatory	Energy supply	CO ₂ , CH ₄ , N ₂ O	National
 Relevant planning documents, legal and regulatory acts	• Energy Development Strategy of the Republic of North Macedonia until 2040 • Renewable Energy Action Plan / National Energy and Climate Plan • Energy Law • Decree on measures to support RES • Decision on the total installed capacity for preferential electricity producers • Rulebook on preferential producers using a feed-in tariff • Decision on a national mandatory target for the share of renewable energy sources in gross energy consumption			
 Methodology	• Bottom-up modelling and least-cost optimization using the MARKAL model. IPCC methodology			
 Assumptions	• Through incentives feed-in tariffs, additional capacity is envisaged by 2040 of: ○ 124 MW wind power plants ○ 13 MW biogas power plants ○ 27 MW small hydropower plants - will be built.			
Implementation status	• In the implementation phase			
 Steps taken	• Decree on measures to support the production of electricity from renewable energy sources adopted by the Government (5.04.2019). • Decision on the total installed capacity for preferential electricity producers adopted by the Government (5.04.2019). • Rulebook on preferential producers using a feed-in tariff adopted by the Energy Regulatory Commission (6.06.2019)			

				• Temporary preferential producer status granted on (28.12.2020) • 114 MW wind power plants (ESM 13 MW Bogdanci, THOR 36 MW, Sveti Nikole/Shtip, Kaltun 34 MW Demir Kapija/Gevgelija, EUROING 30 MW Bogdanci) • 4 MW biogas power plants • 27 MW small hydropower plants		
Planned steps				• New feed-in tariffs will be granted on a first-come, first-served basis to producers of electricity from qualified renewable energy sources until the quota set for each technology in the Decision on the total installed capacity for preferential producers of electricity is reached. • The possibility of waiving the granted feed-in tariff in exchange for acquiring ownership or an extended concession period of the constructed SHPP should be considered and possibly permitted by the relevant law. • Construction of power plants		
Indicators				Value in the last reporting year		Target value
				2016-2018		2030
	Progress	Additional capacity (MW)	installed	17.6		159
	Emission reduction (Gg CO ₂ -eq)					2030
						123.3
	Other	Primary energy savings (ktoe)				20.3
	Finance	Budget		• 557 million euros		
		Source of funding		• 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 Energy, Mining and Mineral Resources • Private investors		
	Monitoring entity			• Energy Regulatory Commission		
	Contribution to achieving the Sustainable Development Goals			direct		indirect
						

PAM4 INCENTIVES FEED-IN PREMIUM

MAIN OBJECTIVE: Increasing domestic production capacity from renewable energy sources

DESCRIPTION: Construction of solar and wind power plants with feed-in premium tariffs to stimulate construction

Time frame	Type	Sector	Gases	Range
2030 – 2030	Technical, regulatory	Energy supply	CO ₂ , CH ₄ , N ₂ O	National
• Energy Development Strategy of the Republic of North Macedonia until 2040 • Energy Law • Decree on measures to support RES • Decision on the total installed capacity for preferential electricity producers • Decision on a national mandatory target for the share of renewable energy sources in gross energy consumption • Annual programme on financial support for production of electricity from RES				

	Methodology	- Through incentives premium feed-in energy, it is planned to build additional capacity by 2025: 200 MW solar power plants		
	Assumptions	- Through incentives premium feed-in energy, it is planned to build additional capacity by 2040: 200 MW solar power plants 64 MW wind power plants		
	Implementation status	In the implementation phase		
	Steps taken	- A Decree on measures to support the production of electricity from renewable energy sources was adopted, as well as a Decision on the total installed capacity for preferential electricity producers (5.04.2019). - Tender for awarding a contract for a premium for the right to use electricity produced by photovoltaic power plants built on land owned by the Republic of North Macedonia (21.07.2019) - Tender for granting the right to use a premium for electricity produced by 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 a right of use has been established (2.10.2019) - In the following period (2021–2022), additional procedures were implemented with around 75 MW new capacities.		
	Planned steps	- Construction of photovoltaic power plants for which a premium for the right of use is awarded - Conducting new tenders for awarding a contract for a premium for the right to use electricity produced by a photovoltaic power plant built on land owned by the Republic of North Macedonia, on average once per year. - Conducting new tenders for awarding a premium for the right to use electricity produced by 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 a right to use has been established, on average once per year.		
	Indicators	Value in the last reporting year	Indicative trajectory	Target value
	Progress	Installed capacity (MW)	/	200
	Emission reduction (Gg CO ₂ -eq)			2030
				108
	Other	Primary energy savings (ktoe)		21.5
	Budget	160 million euros		
	Source of funding	Private, incentives from the central government budget		
	Implementing entity	- Government of the Republic of North Macedonia - Ministry of Energy, Mining and Mineral Resources - Private investors		
	Monitoring entity	Ministry of Energy, Mining and Mineral Resources		
	Contribution to achieving the Sustainable Development Goals	direct	indirect	
				

PAM5. BIOMASS POWER PLANTS (CHP OPTIONAL)

MAIN OBJECTIVE: Increasing domestic production capacity from renewable energy sources

DESCRIPTION: This measure envisages construction of distributed small biomass power plants (CHP optional) with incentives feed-in tariffs. In addition to increasing the share of RES with these CHP plants, they should also contribute to increasing the flexibility of the electricity system and ensuring security of supply. It is envisaged to use biomass from industrial and municipal solid waste, taking into account the sustainability of biomass at the national level.

 Time frame	 Type	 Sector	 Gases	 Range
2030 – 2030	Technical, regulatory	Energy supply	CO ₂ , CH ₄ , N ₂ O	National
 Relevant planning documents, legal and regulatory acts	• Energy Development Strategy of the Republic of North Macedonia until 2040 • Energy Law • Decree on measures to support RES • Decision on the total installed capacity for preferential electricity producers • Rulebook on preferential producers using a feed-in tariff • Decision on a national mandatory target for the share of renewable energy sources in gross energy consumption			
 Methodology	• Through incentives feed-in tariffs, it is planned to build biomass power plants with a capacity of 5 MW by 2025.			
 Assumptions	• Through incentives feed-in tariffs, it is planned to build biomass power plants with a capacity of 15 MW by 2040.			
Implementation status	• In the implementation phase			
 Steps taken	• Decree on measures to support the production of electricity from renewable energy sources adopted by the Government (5.04.2019). • Decision on the total installed capacity for preferential electricity producers adopted by the Government (5.04.2019). • Rulebook on preferential producers using a feed-in tariff adopted by the Energy Regulatory Commission (6.06.2019) • Temporary preferential producer status granted to 3.15 MW (28.12.2020)			
Planned steps	• Amendment to the Regulation on measures to support the production of electricity from renewable energy sources to ensure different treatment (tariff amount, period, etc.) for CHP plants using industrial and municipal solid waste • Implementation of the plan for development/construction of regional landfills • Attracting investors through meetings through chambers of commerce • Construction of power plants			
 Indicators	Value in the last reporting year		Target value	
	2018		2030	
	Progress	Installed capacity (MW)	/ 10	
	Emission reduction (Gg CO ₂ -eq)		2030	
			21	
Other	Primary energy savings (ktoe)	3		
 Finance	Budget		• 24.3 million euros	
	Source of funding		• 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 Energy, Mining and Mineral Resources • Private investors			
 Monitoring entity	• Ministry of Energy, Mining and Mineral Resources			
	direct	indirect		

PAM6. ROOFTOP SOLAR POWER PLANTS

MAIN OBJECTIVE: Increasing domestic production capacity from renewable energy sources

DESCRIPTION: Construction of rooftop solar power plants, on private as well as public buildings, regardless of whether they are consumers or systems from which the total electricity produced will be used for own purposes or stored. One of the possibilities for increasing the installed capacity of rooftop solar systems is through renewable energy communities.

 Time frame	 Type	 Sector	 Gases	 Range
2030 – 2030	Technical, regulatory	Household, commercial and industrial sector	CO ₂ , CH ₄ , N ₂ O	National
 Relevant planning documents, legal and regulatory acts	- Energy Development Strategy of Macedonia until 2040 - Energy Law - Bylaws on renewable energy - Solar Strategy 2022 (European Commission)			
 Methodology [for estimating emissions]	Bottom-up modelling and least-cost optimization using the MARKAL model. IPCC methodology			
 Assumptions	It is planned to build 800 MW solar capacity by 2030.			
Implementation status [idea, planning phase, in implementation phase]	In the implementation phase			
 Steps taken	- A Rulebook on renewable energy sources has been adopted. - The Code on Distribution Network has been adopted. - Programme on promotion of renewable energy sources and improvement of energy efficiency in households for 2021, adopted (subsidies planned) - Through the project "Design and Implementation of Photovoltaic Systems in Rural Municipalities", photovoltaic systems were installed on the rooftops of 108 public buildings. - Several companies have installed PV systems on the rooftops (such as Vitaminka, Makprogres, Max, AgroGama, Maktois, Frotirka, Palteks, Alpikom, Evropa 92, ABMG, Fikoplast, Birosef) - Few hospitals in Skopje have installed photovoltaic systems on the rooftops (such as the Polyclinic Bukuresht, Bit Pazar and Chair hospitals)			
Planned steps	- Adoption of the new Law on Renewable Energy Sources - Information campaigns			
 Indicators	Value in the last reporting year	Indicative trajectory		Target value
	2016-2018	2020	2025	2030
	Progress	Installed capacity (MW)		256
	Emission reduction (Gg CO ₂ -eq)			2030
				84.6
Other	Primary energy savings (ktoe)		15.4	
 Finance	Budget		699 million euros	
	Source of funding		Private, donors, subsidies from national and local budgets, energy efficiency fund	
 Implementing entity	Government of the Republic of North Macedonia			

	• Energy Regulatory Commission • Ministry of Energy, Mining and Mineral Resources • Ministry of Finance • Elektrodistribucija Skopje • Electricity suppliers • Electricity end users
 Monitoring entity	• Ministry of Energy, Mining and Mineral Resources
 Contribution to achieving the Sustainable Development Goals	direct indirect   

PAM7. RES WITHOUT INCENTIVES

MAIN OBJECTIVE: Increasing domestic production capacity from renewable energy sources

DESCRIPTION: Construction of wind, solar and biogas power plants at various locations in Macedonia, carefully selected to avoid environmental impacts compared to the benefits of the electricity produced.

 Time frame	 Type	 Sector	 Gases	 Range
2030 – 2030	Technical, regulatory	Energy supply	CO ₂ , CH ₄ , N ₂ O	National
 Relevant planning documents, legal and regulatory acts	• Energy Development Strategy of the Republic of North Macedonia until 2040 • Plans on development of electricity transmission and distribution networks • Energy Law • Law on Urban Planning, Construction Law, Environmental Law, Water Law and Law on Construction Land. • Law on Strategic Investments • Bylaws on renewable energy • Network codes on electricity transmission and distribution			
 Methodology	• Bottom-up modelling and least-cost optimization using the MARKAL model. IPCC methodology			
 Assumptions	• The following capacities are projected to be built by 2040 under a scenario without incentives: ◦ Wind – 950 MW ◦ Solar energy – 1600 MW ◦ Biogas – 10 MW			
Implementation status	• In the implementation phase			
 Steps taken	• A Decree on measures to support the production of electricity from renewable energy sources has been adopted (5.04.2019). • A Decision has been adopted on the total installed capacity for preferential electricity producers (5.04.2019). • The Code on Electricity Network has been adopted. • Construction of the 100 MW Oslomej PV plant has begun			
Planned steps	• Development of a methodology for selecting the best location for construction of solar and wind power plants • Planning battery storage capacity and establishing a regulatory framework			
 Indicators	Value in the last reporting year		Target value	
	2016-2018		2030	
Progress	Installed capacity (MW)		2.7	
			1800	

Emission reduction (Gg CO ₂ -eq)			2040
			219.8
Other	Primary energy savings (ktoe)		31.4
 Finance	Budget		• 1700 million euros ()
	Source of funding		• Private, ESM
 Implementing entity	• Government of the Republic of North Macedonia • Ministry of Energy, Mining and Mineral Resources • Ministry of Transport • Electricity DSO • Electricity market operator • AD "Elektrani na Makedonija" (ESM AD) • Private investors		
 Monitoring entity	• Ministry of Energy, Mining and Mineral Resources		
 Contribution to achieving the Sustainable Development Goals	direct		
	indirect	  	

PAM8DEVELOPMENT OF THE BIOFUELS MARKET

MAIN OBJECTIVE: The share of RES in the Transport sector is almost zero and this is the main reason for not meeting the country's 2020 target. In order to meet the 2030 RES target in the Transport sector, but also the overall RES target, it is necessary to have a functioning biofuels market.

DESCRIPTION: Increasing the share of biofuels in line with the requirements of the revised RES Directive (2018/2001).

 Time frame	 Type	 Sector	 Gases	 Range
2030 – 2030	Regulatory, policy	Energy	CO ₂ , CH ₄ , N ₂ O	National
 Relevant planning documents, legal and regulatory acts	• Energy Development Strategy of the Republic of North Macedonia until 2040 • Biennial progress report on the increased use of renewable energy sources			
 Methodology	• Bottom-up modelling and least-cost optimization using the MARKAL model. IPCC methodology			
 Assumptions	• The Biofuels Law, as well as the action plan, will be adopted in accordance with the requirements of the RES Directive (2018/2001). • The share of biofuels in 2030 will be 10%			
Implementation status	• In the implementation phase			
Steps taken	• A draft version of the Biofuels Law has been developed. • Development of a study on the target of RES in transport in 2030 in the EC countries • Development of a study on biofuels in Macedonia			
 Planned steps	• Adoption of the Biofuels Law • Completing the legal framework for biofuels by adopting the set of bylaws arising from the Biofuels Law • Development and adoption of the Biofuels Action Plan, which will, among other things, specify measures to support domestic biofuel producers and obligations for oil traders to meet the national biofuels share target. • Allocation of annual funds in the state budget to support the production of biofuels			

Indicators			Value in the last reporting year	Indicative trajectory		Target value
			2018	2020	2025	2030
	Progress	% of biofuels	0	0	5	10
Emission reduction (Gg CO ₂ -eq)						2030
						96
	Other	Primary energy savings (ktoe)				
	Finance	Budget	• not available			
		Source of funding	• Central government budget, consumers			
	Implementing entity		• Government of the Republic of North Macedonia • Ministry of Energy, Mining and Mineral Resources • Ministry of Finance • Ministry of Environment and Physical Planning • Energy Regulatory Commission • Oil traders			
	Monitoring entity		• Ministry of Energy, Mining and Mineral Resources			
Contribution to achieving the Sustainable Development Goals			direct	indirect		
						

- Households and unspecified

PAM9 BINDING ENERGY EFFICIENCY SCHEME

MAIN OBJECTIVE: Fulfilling the obligation under Article 7 of the Energy Efficiency Directive

DESCRIPTION: The average annual final consumption for the period 2014-2016 is used to set the scheme. The measure implements the possibilities of Article 7 of the Energy Efficiency Directive, i.e. Article 14 of the Law on Energy Efficiency, for excluding consumption in the Transport sector (paragraph 1) from the sum of the average annual consumption and reducing consumption in the Industry sector (paragraph 2).

 Time frame	 Type	 Sector	 Gases	 Range
2026 – 2040	Technical, regulatory	All sectors (except transport and part of industry according to Annex I of Directive 2003/87/EC)	CO ₂ , CH ₄ , N ₂ O	National
 Relevant planning documents, legal and regulatory acts	• Law on Energy Efficiency • EE Directive			
 Methodology	• Bottom-up modelling and least-cost optimization using the MARKAL model. IPCC methodology			
 Assumptions	• 1. Ultimate energy saving targets from: ○ 0.35% in 2021 – 2030 ○ 0.2% in 2031 – 2030 of the average annual energy sales to end consumers in the period 2014 - 2016, with the exception of consumers in the Transport sector, as well as industries from Annex I of Directive 2003/87/EC			

		2. Up to 30% of the costs will be covered through subsidies from distribution companies or suppliers.
Implementation status		In the implementation phase
Steps taken		The Law on Energy Efficiency has been adopted.
Planned steps		- The Decree on the Obligation Scheme, which will elaborate in detail the obligation schemes (obliged parties, methodology for calculating annual energy savings, annual energy savings targets, measures for achieving the targets, etc.), should be drafted, adopted and implemented by the end of 2026. - One of the recommendations made in Appendix III as part of the Guidelines on developing a building renovation strategy is to develop an ambitious binding energy efficiency scheme that focuses on implementing holistic and detailed building renovation.
Indicators		Target value
		2030
Progress indicators	Primary energy savings (ktoe)	2030
		10.3
	Final energy savings (ktoe)	10.3
	Emission reduction (Gg CO ₂ -eq)	15.2
Finance	Budget	93 million euros
	Source of funding	Consumers through their bills
Implementing entity		- Government of the Republic of North Macedonia - Ministry of Energy, Mining and Mineral Resources - Regulatory Commission for Energy, Water Services and Municipal Waste Management - Distribution system operators - Electricity and gas suppliers
Monitoring entity		Ministry of Energy, Mining and Mineral Resources
Contribution to achieving the Sustainable Development Goals	direct	indirect
		 

PAM10SOLAR THERMAL COLLECTORS

MAIN OBJECTIVE: Reducing energy costs and improving efficiency

DESCRIPTION: Electric hot water heaters are one of the largest consumers of energy with a major impact on electricity bills. On the other hand, the reduced investment costs for purchase and installation of solar thermal collectors are of great importance as they can reduce consumers' hot water bills. These systems also serve to save energy and can meet at least 50% of the annual hot water needs, depending on the hot water needs. In addition, solar thermal collectors can be used in combination with electricity and central heating systems.

 Time frame	 Type	 Sector	 Gases	 Range
2025 – 2030	Technical	Households and commercial sector	CO ₂ , CH ₄ , N ₂ O	National
Relevant planning documents, legal and regulatory acts	- Energy Development Strategy of North Macedonia until 2040 - Energy Law - Law on Energy Efficiency - Bylaws on renewable energy - Programme on Renewable Energy Promotion			
Methodology	Bottom-up modelling and least-cost optimization using the MARKAL model. IPCC methodology			

	Assumptions	The share of solar thermal collectors in hot water demand by 2030 will be 55% in households and 40% in the commercial sector.		
	Implementation status	In the implementation phase		
	Steps taken	Previously implemented programmes on renewable energy sources promotion and energy efficiency improvement in households		
	Planned steps	Continuing with the adoption and implementation of annual programmes with incentive measures for installation of solar thermal collectors		
Indicators		Value in the last reporting year	Target value	
		2016-2018	2030	
	Progress	Number of newly installed solar collectors	7195*	
		Average area per collector (m ²)	3	
	Emission reduction (Gg CO ₂ -eq)		2030	
			14.8	
	Other	Final energy savings (ktoe)	5.2	
		Primary energy savings (ktoe)	7.4	
	Finance	Budget	45 million euros	
		Source of funding	Private, energy efficiency fund, incentives from the central government budget, donors	
	Implementing entity		- Government of the Republic of North Macedonia - Ministry of Energy, Mining and Mineral Resources - End users - Municipalities and the City of Skopje	
	Monitoring entity		Ministry of Energy, Mining and Mineral Resources	
	Contribution to achieving the Sustainable Development Goals		direct	indirect
				 

* Only those who have applied for subsidies from the Ministry of Economy

PAM11 MARKING OF ELECTRICAL APPLIANCES AND EQUIPMENT

MAIN OBJECTIVE: Increased energy savings in households, public and commercial buildings

DESCRIPTION: The placing on the market of energy-related products that are correctly designed and labelled is necessary to ensure that products sold in Macedonia comply with EU regulations, as well as to contribute to greater energy savings by their users (households, public and commercial entities). The correct labelling of energy-related products must be respected, so that buyers and end users are provided with relevant information on the energy consumption of these products.

	Time frame		Type		Sector		Gases		Range
	2026 – 2030		Regulatory		Households and commercial sector		CO ₂ , CH ₄ , N ₂ O		National
	Relevant planning documents, legal and regulatory acts		- Energy Development Strategy of North Macedonia until 2040 - Law on Energy Efficiency - Fourth Energy Efficiency Action Plan						

		• Rulebook on labelling of energy consumption and other resources of energy-using devices. • Regulation on eco-design of energy-related products				
	Methodology [for estimating emissions]	• Bottom-up modelling and least-cost optimization using the MARKAL model. IPCC methodology				
	Assumptions					
	Implementation status [idea, planning phase, in implementation phase]	• In the implementation phase				
	Steps taken	• Rulebook on labelling of energy consumption and other resources of energy-using devices, adopted in September 2016 by the Ministry of Economy • Regulation on eco-design of energy-related products, adopted by the Government in 2012 • Market inspectors are trained on the basic rules and requirements for eco-labelling and eco-design arising from the Law on Energy Efficiency.				
	Planned steps	• Adoption of the new Rulebook on labelling of energy consumption and other resources of energy-using devices, which will include the latest EU technical regulations for certain products. • Adoption of the new Decree on eco-design of energy-related products, which will include the latest EU technical regulations for certain products. • Information campaigns that will be aimed at the producers of these products, and more importantly, at retailers and consumers • Continuous education of market and environmental inspectors on this topic				
	Indicators	<table><tr><th>Value in the last reporting year</th><th>Target value</th></tr><tr><td>2016-2018</td><td>2030</td></tr></table>	Value in the last reporting year	Target value	2016-2018	2030
Value in the last reporting year	Target value					
2016-2018	2030					
	Progress	<table><tr><td>Number of devices sold (A+++, A++, A+, A)</td><td>7789</td></tr></table>	Number of devices sold (A+++, A++, A+, A)	7789		
Number of devices sold (A+++, A++, A+, A)	7789					
	Emission reduction (Gg CO ₂ -eq)	<table><tr><td></td><td>2030</td></tr><tr><td></td><td>42.4</td></tr></table>		2030		42.4
	2030					
	42.4					
	Other	<table><tr><td>Final energy savings (ktoe)</td><td>1.6</td></tr><tr><td>Primary energy savings (ktoe)</td><td>2.3</td></tr></table>	Final energy savings (ktoe)	1.6	Primary energy savings (ktoe)	2.3
Final energy savings (ktoe)	1.6					
Primary energy savings (ktoe)	2.3					
	Finance	<table><tr><td>Budget</td><td> • 36 million euros </td></tr><tr><td>Source of funding</td><td> • Private energy efficiency fund </td></tr></table>	Budget	• 36 million euros	Source of funding	• Private energy efficiency fund
Budget	• 36 million euros					
Source of funding	• Private energy efficiency fund					
	Implementing entity	• Ministry of Energy, Mining and Mineral Resources • State Market Inspectorate, State Environment Inspectorate • Manufacturers and suppliers of electrical equipment and household appliances • End users				
	Monitoring entity	• Ministry of Energy, Mining and Mineral Resources				
	Contribution to achieving the Sustainable Development Goals	<table><tr><th>direct</th><th>indirect</th></tr><tr><td></td><td></td></tr></table>	direct	indirect		 
direct	indirect					
	 					

PAM12/INCREASED USE OF HEAT PUMPS

MAIN OBJECTIVE: More efficient use of electricity

DESCRIPTION: Phasing out heating devices with electric (resistance) heaters, as well as inefficient biomass stoves and replacing them with heat pumps in line with EU climate and energy policy.

Heating systems also play a major role in the cooling sector and significant savings can be achieved. What is particularly important and is one of the recommendations of the UNDP Green Cooling Study for Macedonia is to adopt regulations for labelling of devices. There are 12 more recommendations in the study that are of fundamental importance for these systems and all of them need to be implemented.

 Time frame	 Type	 Sector	 Gases	 Range
2025 – 2030	Regulatory, political, technical	Households and commercial sector	CO ₂ , CH ₄ , N ₂ O	National
 Relevant planning documents, legal and regulatory acts	- Energy Development Strategy of North Macedonia until 2040 - Law on Energy Efficiency - Fourth Energy Efficiency Action Plan - Programme on Energy Efficiency of Municipalities - EU climate and energy policy			
 Methodology	Bottom-up modelling and least-cost optimization using the MARKAL model. IPCC methodology			
 Assumptions	It is assumed that heating units with electric heaters will gradually be replaced by heat pumps.			
Implementation status	In the implementation phase			
Steps taken	- The Law on Energy Efficiency has been adopted. - Programmes on promotion of renewable energy sources and improvement of energy efficiency in households - Starting in 2019, the City of Skopje and other municipalities (Aerodrom, Kochani, Kavadarci, Bitola, etc.) are subsidizing heat pumps. A total of 2103 households were subsidized for heat pumps in 2019. - The state-owned electricity production company "Elektrani na Severna Makedonija" (ESM) has allocated funds of 10 million euros to subsidize households that replace their inefficient stoves and boilers burning firewood, coal and oil with highly efficient heat pumps (inverter air conditioners). Hence, each household that has replaced its inefficient stoves and boilers with highly efficient heat pumps will be reimbursed up to 1,000 euros. This subsidy is available only to households in the cities with the highest air pollution in the country, including Bitola, Kichevo, Tetovo and the Skopje region. Subsidies for purchase of highly efficient heat pumps are provided to 5,200 households in the Skopje region, 2,500 households in the Bitola region, 1,500 households in Tetovo and 800 households in Kichevo, during 2020. - UNDP project to improve air quality by replacing wood stoves and introducing energy efficiency measures in at least 100 households in the Municipality of Aerodrom			
Planned steps	- Adoption of the Law on the Use of Energy from Renewable Sources - Adoption of a Decision on prohibition of the sale of heating appliances with resistance heaters. - Adoption of the Rulebook on licensing installers of equipment and systems for production of energy from renewable sources - Implementation of the requirements related to heat pumps under Directive 2018/2001 on promotion of the use of energy from renewable sources (recast) - Continuation of subsidy programmes at national and municipal levels. Subsidy opportunities also through projects from international donor institutions. - Citizen awareness campaign conducted in cooperation with civil society organisations - Introducing a ban on the use of coal for household heating			
Indicators	Value in the last reporting year		Target value	
	2016-2018		2030	
Progress	Number of heat pumps sold		37226	
 Emission reduction (Gg CO ₂ -eq)			2030	
			281.7	
Other	Final energy savings (ktoe)		106.1	

	Primary energy savings (ktoe)		142.0
 Finance	Budget	• 180 million euros	
	Source of funding	• Private fund, energy efficiency fund, incentives from the central and local budget, donors	
 Implementing entity	• Ministry of Energy, Mining and Mineral Resources • End users • Civil society organisations		
 Monitoring entity	• Ministry of Energy, Mining and Mineral Resources		
 Contribution to achieving the Sustainable Development Goals	direct	indirect	
			

PAM13 INFORMATION CAMPAIGNS AND NETWORK OF INFORMATION CENTRES FOR ENERGY EFFICIENCY (EE)

MAIN OBJECTIVE: Implementing information campaigns that will raise public awareness about the importance, effects and benefits of energy efficiency

DESCRIPTION: Although a number of campaigns are being carried out to promote energy efficiency by various stakeholders, there is still a lack of knowledge about the benefits of EE. Article 12 of the EE Directive stipulates that the country should take appropriate measures to promote and facilitate the efficient use of energy by small energy consumers, including domestic consumers. This can be done using various mechanisms. One of them is the establishment of EE information centres in local self-governments. Following the examples from the EU, in addition to this measure, several others should be implemented, such as:

- ▶ Education, starting from kindergartens,
- ▶ Training of employees in public institutions at central and local level,
- ▶ Creating an energy savings calculation tool that will show the financial and environmental effects of implementing a certain measure.

 Time frame	 Type	 Sector	 Gases	 Range
2026 – 2030	Informative	Households and commercial sector	CO ₂ , CH ₄ , N ₂ O	National
 Relevant planning documents, legal and regulatory acts	- Energy Development Strategy of North Macedonia until 2040 - Law on Energy Efficiency			
 Methodology	Bottom-up modelling and least-cost optimization using the MARKAL model. IPCC methodology			
 Assumptions	Investing in public awareness campaigns that will increase the share of more efficient appliances (with a higher efficiency class) in the total number of devices to 80% by 2030.			
Implementation status	In the implementation phase			
 Steps taken	- Energy efficiency platform, for educating the population and journalists and sharing experiences with the private sector on successfully implemented energy efficiency measures. - The Energy Info Centre of the City of Skopje has been opened - Free advice to users on reasonable electricity consumption provided by the EVN Customer Service Centre			
Planned steps	- Broadcasting TV commercials, announcements, campaigns and documentaries - Expansion of the Energy Efficiency Platform - Continuous work on existing and opening of new information centres.			
Indicators	Value in the last reporting year		Target value	
	2016-2018*		2030	
Progress	Number of devices sold (A+++, A++, A+, A)		31155	
	Emission reduction (Gg CO ₂ -eq)		2030	
			117.9	
	Final energy savings (ktoe)		39.8	
Other	Primary energy savings (ktoe)		58.6	
 Finance	Budget		16 million euros + 361 million euros (investment in advanced technologies)	
	Source of funding		Private sector, donors, central and local government	
 Implementing entity	- Ministry of Energy, Mining and Mineral Resources - Energy suppliers - End users			
 Monitoring entity	Ministry of Energy, Mining and Mineral Resources			

Contribution to achieving the Sustainable Development Goals	direct	indirect	
			

*In the 4th NEEAP this measure is listed as Public awareness campaigns and a network of energy efficiency information centres and Increased use of more efficient biomass stoves

PAM14RECONSTRUCTION OF EXISTING RESIDENTIAL BUILDINGS

MAIN OBJECTIVE: To meet the requirements under the Law on Energy Efficiency

DESCRIPTION: The measure covers renovations of residential buildings, including window replacement, initiated by the owners and/or supported by commercial banks and funds. This measure will ensure the issuance of energy performance certificates for buildings, as a prerequisite for the commissioning of the renovations.

 Time frame	 Type	 Sector	 Gases	 Range
2025 – 2040	Technical, regulatory	Households	CO ₂ , CH ₄ , N ₂ O	National
 Relevant planning documents, legal and regulatory acts	- Energy Development Strategy of North Macedonia until 2040 - Law on Energy Efficiency - Rulebook on energy performance of buildings - Rulebook on energy audits			
 Methodology	Bottom-up modelling and least-cost optimization using the MARKAL model. IPCC methodology			
 Assumptions	Existing residential buildings, even when meeting the standard for at least Class C. The annual renovation rate taken into account is 2%.			
Implementation status	In the implementation phase			
 Steps taken	31 collective housing buildings were renovated (energy efficiency measures implemented) within the framework of the USAID/Habitat project on energy efficiency in residential buildings. - Financial support for the rehabilitation of collective housing buildings with the implementation of energy efficiency measures provided by some municipalities. - Call for applications for reimbursement of 50% of the costs for replacing windows and installing PVC and aluminium windows, but not more than 500 euros, provided by the Ministry of Economy. - The Law on Energy Efficiency has been adopted. - Programmes on promotion of renewable energy sources and improvement of energy efficiency in households - UNDP project to improve air quality by replacing wood stoves and introducing energy efficiency measures in at least 100 households in the Municipality of Aerodrom - The Regional Energy Efficiency Programme (REEP)¹ for the Western Balkans was established in June 2017 by the EBRD with the support of the European Union (EU) and in partnership with the Energy Community Secretariat to address financial, regulatory, technical and other barriers to sustainable energy investments in the region. As part of the expansion of the REEP Programme, the EBRD established the Western Balkans Green Economy Financing Facility (WB GEFF – Residential) in the form of credit lines totalling up to €85 million allocated to participating financial intermediaries in the six countries (North Macedonia, Albania, Bosnia and Herzegovina, Kosovo, Montenegro and Serbia), for on-lending to eligible sub-borrowers to finance energy efficiency investments in residential buildings. These energy efficiency improvements and/or renewable energy installations are undertaken by private individuals in individual apartments or family houses or measures implemented at building level by housing collectives - groups of individuals, housing associations, housing management companies. The credit lines are supported by investment incentives financed by a grant of up to 20% of the investment costs or the amount of the sub-loan provided to sub-borrowers to stimulate the undertaking of investments in energy efficiency and renewable energy sources. The disbursement of the sub-loans is carried out through four commercial banks in the country (Ohridska Banka, Sparkasse Banka, ProCredit Banka and NLB Banka). - North Macedonia is a leader in the Western Balkans in disbursing sub-loans and verifying completed sub-projects under the World Bank's GEFF. By the end of 2020,			

		there were approximately 1,670 verified sub-projects from all partner commercial banks in North Macedonia for an amount exceeding approximately €12 million. The average sub-loan amount was approximately €7,200.	
Planned steps		• Building topology development • To develop and adopt a Strategy for supporting the reconstruction of residential, public and commercial buildings. • To adopt bylaws on energy performance of buildings and energy audits • To establish a System for Verification of Energy Performance Certificates for Buildings and a Register of Issued Certificates. • Establishment of an Energy Efficiency Fund. • Continued government financial support for reimbursement of the costs of window replacement	
Indicators		Value in the last reporting year	Target value
		2016-2018*	2030
	Progress	Area under renovation (m²)	1481469
		Energy consumption per heated/cooled area (kWh/m²)	158
	Emission reduction (Gg CO ₂ -eq)		2030
			20.5
	Other	Final energy savings (ktoe)	40.1
		Primary energy savings (ktoe)	47.8
 Finance	Budget	• 2390 million euros	
	Source of funding	• Private, donors through commercial energy efficiency loans, energy efficiency fund	
	Implementing entity	• Ministry of Energy, Mining and Mineral Resources • Donors and financial institutions • Households	
	Monitoring entity	• Ministry of Energy, Mining and Mineral Resources	
Contribution to achieving the Sustainable Development Goals		direct	indirect
			  

*Savings are displayed together with the renovation of existing commercial buildings and the construction of new buildings (in the 4th NEEAP they are displayed as Window replacement, Renovation of existing buildings (res+com), Construction of new residential buildings and Construction of new commercial buildings)

PAM15RECONSTRUCTION OF EXISTING CENTRAL GOVERNMENT BUILDINGS

MAIN OBJECTIVE: Reconstruction of existing public buildings in order to meet the objectives of the Energy Efficiency Directive and the Law on Energy Efficiency

DESCRIPTION: Considering the state of energy performance of public buildings at the central level and the role they should have, it is essential to encourage their renovation. Article 10 of the Law on Energy Efficiency is of great importance as it can be a starting point for expanding the reconstruction.

In the absence of more recent information on the public building stock, the calculations take into account the heated surface of the building stock from the National Programme for EE in Public Buildings (draft version) (including the healthcare sector, universities, student dormitories, scientific institutions, social care institutions, social work centres, as well as the state administrative sector - Ministry of Energy, Mining and Mineral Resources, Ministry of Education and Science, Ministry of Environment and Physical Planning and Ministry of Transport). In addition, the specific consumption given in the document is used (on average 214 kWh/m²).

This measure provides for the reconstruction, including the replacement of windows, of existing public buildings under the jurisdiction of the central government. The measure will ensure the issuance of energy performance certificates for the buildings, as a prerequisite for the commissioning of the reconstructions.

 Time frame	 Type	 Sector	 Gases	 Range
2026 – 2030	Technical, regulatory	Central government buildings	CO ₂ , CH ₄ , N ₂ O	National
 Relevant planning documents, legal and regulatory acts	- Energy Development Strategy of North Macedonia until 2040 - Law on Energy Efficiency			
 Methodology	Bottom-up modelling and least-cost optimization using the MARKAL model. IPCC methodology			
 Assumptions	Annual renovation rate of 3% of existing central government buildings			
Implementation status	In the implementation phase			
 Steps taken	- The Draft National Programme for Energy Efficiency in Public Buildings in the Republic of North Macedonia (Phase I) was developed within the framework of the GEF Sustainable Energy Project. "Resilient Skopje" – A Climate Change Strategy has been developed for the City of Skopje. - Plan for the reconstruction of buildings used by public sector entities at the state level for the period 2025–2028 (three-year framework) – covers 14 public buildings with a total usable area of 102,992 m2, in which 33 institutions operate, which are used daily by more than 5,000 people)			
Planned steps	- To develop and adopt a Strategy for supporting the reconstruction of residential, public and commercial buildings. - To adopt bylaws on energy performance of buildings and energy audits - Preparation of a National Inventory of Public Buildings. - Establishment of an Energy Efficiency Fund.			
 Indicators	Value in the last reporting year		Target value	
	2016-2018*		2030	
	Progress	Area under renovation (m ²)	151030	
		Energy consumption per heated/cooled area (kWh/m ²)	214	
	Emission reduction (Gg CO ₂ -eq)			2030
				20.9
	Other	Final energy savings (ktoe)	5.3	
Primary energy savings (ktoe)		7.3		
 Finance	Budget		94 million euros for the renovation of (89,000 m2)	
	Source of funding		Central government budget, donors	
 Implementing entity	- Ministry of Energy, Mining and Mineral Resources - Ministry of Finance - Local self-government - Municipal public enterprises - Donors and financial institutions			
 Monitoring entity	Ministry of Energy, Mining and Mineral Resources			
 Contribution to achieving the Sustainable Development Goals	direct		indirect	
			 	

*Savings are shown together with the measure Renovation of existing local government buildings (in the NEEAP it is listed as Renovation of existing central and local self-government buildings and Construction of new central and local self-government buildings)

PAM16 RECONSTRUCTION OF EXISTING LOCAL SELF-GOVERNMENT BUILDINGS

MAIN OBJECTIVE: Reconstruction of existing public buildings in order to meet the objectives of the Energy Efficiency Directive and the Law on Energy Efficiency

DESCRIPTION: A strategy for reconstruction of existing buildings used by public sector entities at the state level should set an example and encourage local self-government units to pay special attention to buildings under their jurisdiction.

The calculations take into account the heating area of the housing stock from the National Programme for EE in Public Buildings (draft version) (including primary and secondary schools, kindergartens, student dormitories, municipalities and buildings of the City of Skopje). Additionally, the specific consumption given in the same document is used (on average 214 kWh/m²).

This measure provides for reconstruction, including the replacement of windows, of existing buildings used by public sector entities under the jurisdiction of local self-governments. The measure will ensure the issuance of energy performance certificates for buildings as a prerequisite for the commissioning of the reconstructions.

 Time frame	 Type	 Sector	 Gases	 Range
2026 – 2030	Technical, regulatory	Local government self-buildings	CO ₂ , CH ₄ , N ₂ O	National
 Relevant planning documents, legal and regulatory acts	- Energy Development Strategy of North Macedonia until 2040 - Law on Energy Efficiency			
 Methodology	Bottom-up modelling and least-cost optimization using the MARKAL model. IPCC methodology			
 Assumptions	Annual renovation rate of 1.5% of existing local self-government buildings.			
Implementation status	In the implementation phase			
Steps taken	- The Draft National Programme for Energy Efficiency in Public Buildings in the Republic of North Macedonia (Phase I) was developed within the framework of the GEF Sustainable Energy Project. "Resilient Skopje" – A Climate Change Strategy has been developed for the City of Skopje. - The Law on Energy Efficiency has been adopted.			
Planned steps	- To develop and adopt a Strategy for supporting the reconstruction of residential, public and commercial buildings. - Bylaws on energy performance of buildings, energy audits and energy efficiency programmes and plans of municipalities to be adopted - Regular adoption of energy efficiency programmes and plans by municipalities and reports on their implementation - Fully developed information system for monitoring and managing energy consumption and MVP tool - Establishment of an Energy Efficiency Fund.			
Indicators	Value in the last reporting year		Target value	
	2016-2018		2030	
Progress	Area under renovation (m ²)		See PAM 15	
	Energy consumption per heated/cooled area (kWh/m ²)		See PAM 15	
 Emission reduction (Gg CO ₂ -eq)			2030	
			20.9	
Other	Final energy savings (ktoe)		5.3	
	Primary energy savings (ktoe)		7.3	
 Finance	Budget		180 million euros	
	Source of funding		Local self-government budget, donors	

 Implementing entity	- Ministry of Energy, Mining and Mineral Resources - Ministry of Finance - Local self-government - Municipal public enterprises - Donors and financial institutions
 Monitoring entity	Ministry of Energy, Mining and Mineral Resources
 Contribution to achieving the Sustainable Development Goals	direct indirect   

PAM17 RECONSTRUCTION OF EXISTING COMMERCIAL BUILDINGS

MAIN OBJECTIVE: Reconstruction of existing commercial buildings in order to meet the objectives of the Energy Efficiency Directive and the Law on Energy Efficiency

DESCRIPTION: Data on the commercial building stock is lacking, but according to the third NEEAP, the surface area of commercial buildings is estimated at almost 8 million m². This measure covers the reconstruction of existing commercial buildings, including window replacement, initiated by the owners and/or supported by commercial banks and funds. The measure will ensure the issuance of energy performance certificates for buildings, as a prerequisite for the commissioning of the reconstructions.

 Time frame	 Type	 Sector	 Gases	 Range
2026 – 2030	Technical, regulatory	Commercial sector	CO ₂ , CH ₄ , N ₂ O	National
 Relevant planning documents, legal and regulatory acts	- Energy Development Strategy of North Macedonia until 2040 - Law on Energy Efficiency			
 Methodology [for estimating emissions]	Bottom-up modelling and least-cost optimization using the MARKAL model. IPCC methodology			
 Assumptions	Annual renovation rate of 3% of existing commercial buildings.			
Implementation status [idea, planning phase, in implementation phase]	In the implementation phase			
Steps taken	The Law on Energy Efficiency has been adopted.			
 Planned steps	- To develop and adopt a Strategy for supporting the reconstruction of residential, public and commercial buildings - To adopt bylaws on energy performance of buildings and energy audits - Establishment of an Energy Efficiency Fund - One of the recommendations given in Appendix III as part of the Guidelines for developing a building renovation strategy is to conduct an analysis of the housing stock, covering the non-housing stock, similar to the survey provided by the SSO of households.			
Indicators	Value in the last reporting year		Target value	
	2016-2018		2030	
 Progress	Area under renovation (m ²)		SEE PAM 14	
 Emission reduction (Gg CO ₂ -eq)			2030	
			63.6	
			12.3	
			16.9	
Other	Final energy savings (ktoe)			
	Primary energy savings (ktoe)			
Finance	Budget		360 million euros	

 Source of funding	Private, donors through commercial energy efficiency loans, energy efficiency fund
 Implementing entity	- Ministry of Energy, Mining and Mineral Resources - Ministry of Finance - Commercial building owners
 Monitoring entity	Ministry of Energy, Mining and Mineral Resources
 Contribution to achieving the Sustainable Development Goals	direct indirect   

PAM18 CONSTRUCTION OF NEW BUILDINGS

MAIN OBJECTIVE: Construction of new buildings that will meet the minimum criteria prescribed in the Rulebook on Energy Performance of Buildings

DESCRIPTION: An energy-efficient building reduces maintenance and utility costs, but in many cases improves durability, reduces noise, increases comfort and creates a healthy and safe indoor environment. A further objective of energy-efficient building is to limit damage to the ecosystem and reduce the use of natural resources such as energy, land, water and raw materials. This measure will ensure the issuance of energy performance certificates for buildings, as a prerequisite for the commissioning of the building.

 Time frame	 Type	 Sector	 Gases	 Range
2020 – 2040	Technical, regulatory	Households	CO ₂ , CH ₄ , N ₂ O	National
 Relevant planning documents, legal and regulatory acts	• Energy Development Strategy of North Macedonia until 2040 • Law on Energy Efficiency			
 Methodology [for estimating emissions]	• Bottom-up modelling and least-cost optimization using the MARKAL model. IPCC methodology			
 Assumptions	• Construction of new residential buildings, meeting minimum energy performance requirements as the first criterion (in accordance with national legislation and cost-effectiveness calculations)			
Implementation status [idea, planning phase, in implementation phase]	• In the implementation phase			
 Steps taken	• Financial support for construction of new buildings at the municipal level • The Law on Energy Efficiency has been adopted.			
Planned steps	• To adopt bylaws on energy performance of buildings and energy audits • Establishment of an Energy Efficiency Fund			
Indicators	Value in the last reporting year		Target value	
	2016-2018		2030	
 Progress	Area under renovation (m ²)		See PAM 14	
 Emission reduction (Gg CO ₂ -eq)			2030	
			21.3	
Other	Final energy savings (ktoe)		12.9	
	Primary energy savings (ktoe)		15.1	
 Finance	Budget		• 360 million euros	
	Source of funding		• Private, donors through commercial energy efficiency loans, energy efficiency fund	
 Implementing entity	• Ministry of Energy, Mining and Mineral Resources • Donors and financial institutions			

	Investors (households)
 Monitoring entity	Ministry of Energy, Mining and Mineral Resources
 Contribution to achieving the Sustainable Development Goals	direct
	indirect
	   

PAM19 CONSTRUCTION OF PASSIVE BUILDINGS

MAIN OBJECTIVE: Every new building should be a nearly zero-energy building.

DESCRIPTION: The measure provides for construction of new passive residential buildings in accordance with EU Directive 2010/31/EU. This measure will ensure the issuance of energy performance certificates for buildings, as a prerequisite for the commissioning of the building.

 Time frame	 Type	 Sector	 Gases	 Range
2026 – 2030	Technical, regulatory	Households	CO ₂ , CH ₄ , N ₂ O	National
 Relevant planning documents, legal and regulatory acts	• Energy Development Strategy of North Macedonia until 2040 • Law on Energy Efficiency			
 Methodology [for estimating emissions]	• Bottom-up modelling and least-cost optimization using the MARKAL model. IPCC methodology			
 Assumptions	• Construction of new passive buildings, meeting the standard for at least A+ Class (15 kWh/m2) starting in 2025 and continuously increasing their number, so that in 2040, more than 90% of new buildings are considered to be passive.			
Implementation status [idea, planning phase, in implementation phase]	• In the implementation phase			
Steps taken	• The Law on Energy Efficiency has been adopted.			
 Planned steps	• To develop and adopt a Strategy for supporting the reconstruction of residential, public and commercial buildings. • To adopt bylaws on energy performance of buildings, energy audits, and energy efficiency programmes and plans for municipalities • To develop and adopt a Plan for increasing the number of passive buildings with nearly zero energy consumption • Establishment of an Energy Efficiency Fund			
Indicators	Value in the last reporting year		Target value	
	2016-2018*		2030	
 Progress	Area under renovation (m ²)			
	Emission reduction (Gg CO ₂ -eq)		2030	
Other			16.6	
	Final energy savings (ktoe)		8.3	
	Primary energy savings (ktoe)		10.3	
 Finance	Budget		• 1140 million euros	
	Source of funding		• Private, donors through commercial EE loans, EE fund, financial support at the municipal level	
 Implementing entity	• Ministry of Energy, Mining and Mineral Resources • Ministry of Transport			

	- Donors and financial institutions - Investors (households)
 Monitoring entity	Ministry of Energy, Mining and Mineral Resources
 Contribution to achieving the Sustainable Development Goals	direct indirect    

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

PAM20DISPOSAL OF INCANDESCENT LIGHT BULBS

MAIN OBJECTIVE: Improving lighting efficiency following EU policies

DESCRIPTION: A number of governments around the world have taken steps to phase out incandescent light bulbs for general lighting in favor of other more energy-efficient lighting alternatives. The objective is not just to ban incandescent light bulbs but to improve energy efficiency. This includes replacing conventional incandescent light bulbs with compact fluorescent (CFL) and LEDs.

 Time frame	 Type	 Sector	 Gases	 Range
2026 – 2030	Regulatory, policy	Households and commercial sector	CO ₂ , CH ₄ , N ₂ O	National
 Relevant planning documents, legal and regulatory acts	- Energy Development Strategy of North Macedonia until 2040 - Law on Energy Efficiency - Commission Regulation (EC) No 244/2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to eco-design requirements for non-directional household lamps			
 Methodology	Bottom-up modelling and least-cost optimization using the MARKAL model. IPCC methodology			
 Assumptions	Since incandescent light bulbs have been banned in the EU since 2012 (and also in EC countries such as Montenegro), it is assumed that the new Decree on eco-design of energy-related products will include a ban on the sale of incandescent light bulbs (with a transition period of 2-3 years).			
Implementation status	In the implementation phase			
Steps taken	The price of LED light bulbs is decreasing.			
 Planned steps	- Adoption of a new Decree on eco-design of energy-related products that will transpose the latest EU implementing measures (technical regulations) related to non-directional, fluorescent and high-intensity discharge lamps and possibly ban the sale of incandescent light bulbs for a certain transitional period. - Information campaign aimed at lamp suppliers and consumers			
Indicators	Value in the last reporting year		Target value	
	2016-2018		2030	
 Progress	Number of light bulbs sold (LED, CFL)			
	Installed capacity (MW)			
	Electricity consumption (MWh)			
Emission reduction (Gg CO ₂ -eq)			2030	
			114.0	
Other	Final energy savings (ktoe)		36.3	
	Primary energy savings (ktoe)		49.2	

 Finance	Budget	• 770 million euros
	Source of funding	• Central government budget, private
 Implementing entity	• Government of the Republic of North Macedonia • Ministry of Energy, Mining and Mineral Resources • State Market Inspectorate • Lamp suppliers • End users	
 Monitoring entity	• Ministry of Energy, Mining and Mineral Resources	
 Contribution to achieving the Sustainable Development Goals	direct	
	indirect	  

PAM21 IMPROVEMENT OF STREET LIGHTING IN MUNICIPALITIES

MAIN OBJECTIVE: Reducing the costs and increasing the quality of street lighting

DESCRIPTION: The costs of street lighting, including electricity and maintenance, can have a huge impact on the budget of municipalities. In addition, new opportunities are opening up for municipalities, given the fact that a large number of manufacturers are working daily to improve lamps. It is necessary to replace inefficient lamps, purchasing new ones that will meet the highest energy efficiency criteria. (CFL and LED light bulbs).

 Time frame	 Type	 Sector	 Gases	 Range
2020 – 2030	Technical	Local government self-	CO ₂ , CH ₄ , N ₂ O	Local
 Relevant planning documents, legal and regulatory acts	• Energy Development Strategy of North Macedonia until 2040 • Law on Energy Efficiency			
 Methodology	• Replacement of mercury light bulbs with sodium and LED light bulbs. Bottom-up modelling and least cost optimization using the MARKAL model. IPCC methodology			
 Assumptions	• 100% improvement rate of street lighting by 2040.			
Implementation status	• In the implementation phase			
 Steps taken	• Street lighting replaced in some municipalities • Completed tenders and/or streetlight replacement underway in more than 10 municipalities • Promotional activities undertaken for the implementation of public-private partnership (PPP)			
Planned steps	• Adoption of a Decree on energy performance contracts • Continuation of promotional activities for the implementation of public-private partnership			
Indicators	Indicator value in the last reporting year		Indicator target value	
	2016-2018		2030	
 Progress	Number of light bulbs replaced (LED, CFL)			
	Installed capacity (MW)			
	Electricity consumption (MWh)			
Emission reduction (Gg CO ₂ -eq)				2030

Other	Final energy savings (ktoe)	37.9
	Primary energy savings (ktoe)	7.8
		14.2
 Finance	Budget	• 25.3 million euros, 8.56 million euros for a project in 54 municipalities
	Source of funding	• Central and local budget, ESCO
 Implementing entity	• Government of the Republic of North Macedonia • Energy Regulatory Commission • Ministry of Environment and Physical Planning • Ministry of Energy, Mining and Mineral Resources • Local self-government	
 Monitoring entity	• Ministry of Energy, Mining and Mineral Resources	
 Contribution to achieving the Sustainable Development Goals	direct	indirect
		 

PAM22"GREEN PROCUREMENT"

MAIN OBJECTIVE: Application of energy efficiency criteria ("greening") in public procurement procedures

DESCRIPTION: According to Article 6 of the Energy Efficiency Directive, central governments may only procure products, services and use buildings with high energy efficiency performance. Enhanced actions are needed to ensure legal and technical knowledge, as well as skills of public sector personnel at central level to include and evaluate energy efficiency requirements in public procurement procedures using the most economically advantageous tender criteria.

 Time frame	 Type	 Sector	 Gases	 Range
2026 – 2030	Regulatory	Public bodies	CO ₂ , CH ₄ , N ₂ O	National
 Relevant planning documents, legal and regulatory acts	• Energy Development Strategy of North Macedonia until 2040 • Law on Energy Efficiency			
 Methodology	• Implementation of energy efficiency criteria. Bottom-up modelling and least cost optimization using the MARKAL model. IPCC methodology			
 Assumptions	• Increased rate of advanced energy efficiency technology due to public procurement by 7%			
Implementation status	• In the implementation phase			
Steps taken	• The Law on Energy Efficiency has been adopted. • Law on Public Procurement			
 Planned steps	• Preparation and adoption of the following bylaws based on the Law on Energy Efficiency: • Decree on eco-design of energy-related products, • Rulebook on eco-labelling of energy-related products, • Rulebook on energy performance of buildings and • Rulebook on green procurement that will include a methodology for determining the level of energy efficiency of other products as provided for in Article 13 of the Law on Energy Efficiency • Organizing specialized training for contracting authorities on this topic • Developing model technical specifications for procurement of certain energy-related products for general use, which will include green and energy efficiency criteria, thus facilitating the procurement process			

Indicators		Indicator value in the last reporting year	Indicative trajectory		Indicator target value
		2016-2018	2020	2025	2030
	Progress	Number of devices purchased (A++, A+, A)			
	Emission reduction (Gg CO ₂ -eq)				2030
					2.9
	Other	Final energy savings (ktoe)			1.4
		Primary energy savings (ktoe)			2.0
	Finance	Budget	• 25.5 million euros		
		Source of funding	• Central and local budget		
	Implementing entity		• Ministry of Energy, Mining and Mineral Resources • Public Procurement Bureau • Local self-government		
		Monitoring entity		• Ministry of Energy, Mining and Mineral Resources	
Contribution to achieving the Sustainable Development Goals		direct	indirect		
					

PAM23 INCREASED USE OF CENTRAL HEATING SYSTEMS

MAIN OBJECTIVE: Reducing local air pollution, considering that household heating is one of the main sources of local pollution

DESCRIPTION: Increased use of existing district heating systems by implementing information campaigns to connect new consumers, including those who were previously disconnected from the system.

 Time frame	 Type	 Sector	 Gases	 Range
2030 – 2030	Technical information	Households and commercial buildings	CO ₂ , CH ₄ , N ₂ O	National
 Relevant planning documents, legal and regulatory acts	• Energy Development Strategy of North Macedonia until 2040 • Law on Energy Efficiency • Energy Law, Law on Urban Planning, Construction Law • Study to determine a techno-economically optimal and environmentally sustainable heating structure and implementation of district sanitary hot water supply in the City of Skopje.			
 Methodology	• Implementation of information campaigns. Bottom-up modelling and least cost optimization using the MARKAL model. IPCC methodology			
 Assumptions	• Information campaigns will contribute to maximum utilization of the existing network, as well as enabling the construction of a new network, which will increase heat consumption by at least 40%.			
Implementation status	• In the implementation phase			
 Steps taken	• Studies for analysis of the district heating system and implementation of district sanitary hot water supply developed for the City of Skopje • Information campaigns have been implemented to reconnect previously disconnected consumers and attract new consumers. • VAT reduced from 18% to 5%			

Planned steps		• Continuation of the implementation of information campaigns • Expansion of the heat distribution network in Skopje • Development of district heating in the municipality of Bitola • Preparation of a study for the introduction of small high-efficiency cogeneration plants in other cities (primarily Tetovo, Kumanovo and Gostivar according to the guidelines in the Annex)				
Indicators		Indicator value in the last reporting year	Indicative trajectory		Indicator target value	
		2016-2018	2020	2025	2030	
	Progress	Number of new customers				
	Emission reduction (Gg CO ₂ -eq)				2030	
					4.14	
	Other	Final energy savings (ktoe)				3.3
		Primary energy savings (ktoe)				4.8
	Finance	Budget				
	Source of funding				• 20 million euros • 4.28 million euros for a project for individual metering in 30 existing buildings	
		• Private energy efficiency fund, incentives from the central and local budgets				
	Implementing entity		• Ministry of Energy, Mining and Mineral Resources • ESM Snabduvanje • AD "Skopje Sever" • "Energetika" – Skopje, a subsidiary of AD Elektrani na Makedonija (ESM AD) • Private investors			
	Monitoring entity		• Energy Regulatory Commission • Ministry of Energy, Mining and Mineral Resources			
	Contribution to achieving the Sustainable Development Goals		direct		indirect	
				 		

Industry

PAM24ENERGY MANAGEMENT IN MANUFACTURING INDUSTRIES

MAIN OBJECTIVE: Efficient management of manufacturing processes in the industry in order to increase production, while using the same energy consumption.

DESCRIPTION: This measure envisages the implementation of mandatory energy audits of large companies and the implementation of the ISO 50001 standard, as well as advanced measurement and introduction of new IT technologies. This will enable the prevention of defects, better control of processes and faster action in production, using advanced data analysis and predictive technologies.

Time frame	Type	Sector	Gases	Range
2025 – 2040	Regulatory, technical	Industry	CO ₂ , CH ₄ , N ₂ O	National
Relevant planning documents, legal and regulatory acts	- Energy Development Strategy of the Republic of North Macedonia until 2040 - Law on Energy Efficiency			
Methodology	Implementation of information campaigns. Bottom-up modelling and least cost optimization using the MARKAL model. IPCC methodology.			

	Assumptions	Improving the efficiency of systems in manufacturing industries at an annual rate of 0.15%.	
	Implementation status	In the implementation phase	
	Steps taken	- Promotion of the ISO 50001 standard completed - Organized trainings on energy management in industry - Certificates issued for energy controllers - USAID Industrial Energy Management Project implemented in 17 companies - The UNIDO/GEF project, in which one of the activities is a Programme on energy management in industrial companies according to the ISO 50001 standard and the UNIDO methodology. Initial results have been achieved in 12 companies and an additional Programme on replication of energy management systems has been implemented in 5 companies.	
	Planned steps	- Continuation of the implementation of the ISO 50001 standard in a larger number of industrial companies (processing industries). - Preparation and adoption of a Rulebook on energy control of large retailers based on and in accordance with the content prescribed in Articles 15 and 16 of the Law on Energy Efficiency - Conducting mandatory energy audits.	
Indicators		Indicator value in the last reporting year	Target value of the indicator
		2016-2018	2030
	Progress		
Emission reduction (Gg CO ₂ -eq)			2030
			28.4
Other	Final energy savings (ktoe)		7.3
	Primary energy savings (ktoe)		9.6
	Budget	Negligible (ISO 500001 implementation is 0.15 million euros/large company*)	
	Source of funding	Private sector, donors through commercial energy efficiency loans	
	Implementing entity	- Ministry of Energy, Mining and Mineral Resources, Regulatory Commission for Energy, Water Services and Municipal Waste Management Services - Private companies	
	Monitoring entity	- Energy Regulatory Commission - Ministry of Energy, Mining and Mineral Resources	
Contribution to achieving the Sustainable Development Goals		direct	indirect
			 

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

PAM25INTRODUCTION OF EFFICIENT ELECTRIC MOTORS

MAIN OBJECTIVE: Increasing the competitiveness of industrial products by improving efficiency in the manufacturing process and reducing resource use.

DESCRIPTION: A large part of the total electricity consumption in industries comes from electric motors. This measure envisages the replacement of outdated motors currently in use with new, more efficient motors.

 Time frame	 Type	 Sector	 Gases	 Range
2025 – 2040	Technical	Industry	CO ₂ , CH ₄ , N ₂ O	National

	Relevant planning documents, legal and regulatory acts	- Energy Development Strategy of the Republic of North Macedonia until 2040 - Law on Energy Efficiency			
	Methodology	Implementation of information campaigns. Bottom-up modelling and least-cost optimization using the MARKAL model. IPCC methodology.			
	Assumptions	The share of efficient electric motors by 2040 is 60%.			
	Implementation status	In the implementation phase			
	Steps taken	New efficient electric motors installed in a large number of companies			
	Planned steps	Replacement of existing electric motors from production processes in industrial facilities in Macedonia with new, more efficient motors.			
	Indicators	Indicator value in the last reporting year	Indicative trajectory		Target value of the indicator
		2016-2018	2020	2025	2030
	Progress				
	Emission reduction (Gg CO ₂ -eq)				2030
					32.98
	Other				8.8
	Final energy savings (ktoe)				
	Primary energy savings (ktoe)				12.6
	Finance	120 million euros			
	Budget				
	Source of funding	Private sector, donors through commercial energy efficiency loans			
	Implementing entity	- Ministry of Energy, Mining and Mineral Resources, Regulatory Commission for Energy, Water Services and Municipal Waste Management Services - Private companies			
	Monitoring entity	- Regulatory Commission for Energy, Water and Municipal Waste Management Services - Ministry of Energy, Mining and Mineral Resources			
		direct indirect			
	Contribution to achieving the Sustainable Development Goals	  			

PAM26 INTRODUCTION OF MORE ADVANCED TECHNOLOGIES

MAIN OBJECTIVE: Introducing more advanced technologies into industrial processes, which will also enable greater use of environmentally friendly fuels.

DESCRIPTION: Advanced industrial technologies offer great opportunities to further reduce energy consumption with potentially lower costs, as well as environmental benefits. In addition, they can help to accelerate progress in various industry branches.

	Time frame	 Type	 Sector	 Gases	 Range
	2025 – 2040	Technical	Industry	CO ₂ , CH ₄ , N ₂ O	National
	Relevant planning documents, legal and regulatory acts	- Energy Development Strategy of the Republic of North Macedonia until 2040 - Law on Energy Efficiency			
	Methodology	Implementation of information campaigns. Bottom-up modelling and least-cost optimization using the MARKAL model. IPCC methodology.			

	Assumptions	The share of more advanced technologies by 2040 is 60% of all technologies.			
	Implementation status	In the implementation phase			
	Steps taken	- Construction of the gas pipeline network in North Macedonia - Klechove - station 5 (Shtip), completed in 2016 - Station 6 (Shtip) - Negotino, completed in 2019 - Negotino-Prilep-Bitola, completed in 2023 - Skopje-Tetovo-Gostivar, completed in 2024			
	Planned steps	- Completion of the construction of the gas pipeline network in North Macedonia - Gostivar-TPP Oslomej-Kichevo (project documentation) - Kichevo-Ohrid (tender documentation) - Ohrid – Bitola (tender documentation) - Station 5 (Shtip)-Radovish-Strumica - Sveti Nikole – Veles (project documentation) - Interconnector line Greece – Macedonia (Negotino) - Inventory of companies where fuel can be substituted for coal or natural gas - Developing a strategy for using hydrogen			
Indicators		Indicator value in the last reporting year	Indicative trajectory		Target value of the indicator
		2016-2018	2020	2025	2030
	Progress	Gas energy consumption			
	Emission reduction (Gg CO ₂ -eq)	2030			
		237.22			
	Other	Final energy savings (ktoe)			
		72.1			
		Primary energy savings (ktoe)			
		75.9			
	Finance	Budget			
		1060 million euros			
		Source of funding			
		Private sector, donors through commercial energy efficiency loans, energy efficiency fund			
	Implementing entity	- Government of the Republic of North Macedonia - Ministry of Environment and Physical Planning - Ministry of Energy, Mining and Mineral Resources, Regulatory Commission for Energy, Water Services and Municipal Waste Management Services - Private investors			
	Monitoring entity	Ministry of Energy, Mining and Mineral Resources, Regulatory Commission for Energy, Water Services and Municipal Waste Management Services			
Contribution to achieving the Sustainable Development Goals		direct	indirect		
					

- **Transportation**

PAM27/INCREASED USE OF RAILWAYS

MAIN OBJECTIVE: Increasing the share of rail transport of passengers and goods, in order to improve energy efficiency and reduce emissions in the Transport sector.

DESCRIPTION: The measure envisages the redirection of part of the passenger and freight traffic to rail transport, by improving the infrastructure and operational conditions. The measure includes:

- promotional and information campaigns to raise public awareness
- investing in stations and improving "access to stations"
- increasing network security and expanding network coverage

 Time frame	 Type	 Sector	 Gases	 Range
2025 – 2040	Technically, informative	Transport	CO ₂ , CH ₄ , N ₂ O	National
 Relevant planning documents, legal and regulatory acts	- National Transport Strategy (2018 – 2030) - Energy Development Strategy of the Republic of North Macedonia until 2040			
 Methodology	Energy modelling and IPCCMARKAL methodology.			
 Assumptions	By 2040, 3% of passenger kilometers by cars, 1% of passenger kilometers by buses and 6.6% of ton-kilometers by heavy goods vehicles will be carried out by rail transport.			
 Implementation status	Under implementation			
	Modernization and reconstruction of the railway infrastructure and removal of bottlenecks; gradual electrification of key corridors and renewal of the rolling stock fleet; improvement of the accessibility of stations; promotional activities to increase the use of railways in passenger and freight traffic.			
	Gradual electrification of key corridors and replacement of diesel locomotives with electric vehicles. Improvement of stations and intermodal connections, improving accessibility for all users, including persons with disabilities. Implementation of priority projects for the reconstruction and expansion of the railway network and renewal of the rolling stock fleet (coaches and locomotives). Implementation of information and promotional campaigns on the benefits of rail transport in order to increase its use in passenger and freight traffic.			
Indicators	Energy savings (ktoe/GWh)	Increase in passenger-km in rail transport (pkm)		Increase in tonne-km in rail transport (tkm)/ Reduction in emissions (Gg CO ₂ -eq)
	2016-2018			2030
 Progress	Increase in passenger kilometers in the rail transport (pkm)	The average value for the period 2016-2018		Target increase relative to the baseline value
	Increase in tonne km in rail transport (tkm)	The average value for the period 2016-2018		Target increase relative to the baseline value
 Emission reduction (Gg CO ₂ -eq)				2030
				91.7
				37.2
				29.8
 Finance	Budget	700 million euros		
	Source of funding	The central government budget		
 Implementing entity	- Government of the Republic of North Macedonia - Ministry of Transport - Ministry of Energy, Mining and Mineral Resources - AD Makedonski zheleznici - transport - Public institutions (end users)			

	Private companies
 Competent entity	Ministry of Energy, Mining and Mineral Resources
	direct and indirect
 Contribution to achieving the Sustainable Development Goals	    

PAM28RENEWAL OF THE NATIONAL FLEET OF PASSENGER CARS

MAIN OBJECTIVE: Gradual renewal of the state vehicle fleet with more efficient vehicles with low CO₂ emissions, in order to reduce energy consumption and emissions in road transport.

DESCRIPTION: The measure envisages the application of more advanced technologies to improve energy efficiency in the Transport sector, through a reduction in VAT from 18% to 5% for hybrid and electric vehicles, financial incentives, gradual equalization of excise duties for diesel and gasoline and obligations for public institutions for procurement of vehicles with low CO₂ emissions (up to 90 gCO₂/km by 2020 and 50 gCO₂

- Fiscal measures - Preparation and implementation of measures to reduce the VAT rate from 18% to 5% for hybrid and electric vehicles, as well as preparation of measures to gradually equalize excise duties on diesel and gasoline.
- Incentives - Design and implementation of a programme for financial incentives/subsidies for the purchase of vehicles with lower emissions
- Public procurement - Introduction and application of criteria for public procurement of low-emission vehicles in public institutions, with established limit values for CO₂ emissions ≤90 gCO₂/km and ≤50 gCO₂/km.

 Time frame	 Type	 Sector	 Gases	 Range
2025–2040	Regulatory, political, informative	Transport	CO ₂ , CH ₄ , N ₂ O	National
 Relevant documents, legal and regulatory acts	- National Transport Strategy - Energy Development Strategy of the Republic of North Macedonia until 2040 - Vehicle Law - Law on Vehicle Tax			
 Methodology	Energy modelling and IPCC/MARKAL methodology			
 Assumptions	- It is assumed that fiscal and financial instruments (reduced VAT rate, subsidies and excise tax revision) will be gradually introduced to encourage the purchase of low-emission vehicles. - Additionally, public institutions commit to progressively increasing the share of electric and other low-emission vehicles in new purchases, to a minimum of 20% by the end of 2027, and a minimum of 50% after 2028.			
Implementation status	Under implementation			
 Steps taken	- Adopted Vehicle Law (August 2019) - Law on Vehicle Tax Adopted - Adopted bylaws arising from the Law on Vehicle Tax			
Planned steps	- Financial incentives: implementing a subsidy programme for purchase of electric vehicles. - Fiscal measures: applying a reduced VAT and revising fuel excise duties in accordance with the environmental impact. - Public procurement: obligation for public institutions for the share of electric vehicles in new procurement: ≥20% by the end of 2027 and ≥50% after 2028. Increase in the EURO standard for car imports			
Indicators	Indicator value in		Target value	
	last reporting year		on the indicator	
	2016-2018		2030	

	Progress	Number of vehicles by type		
	Emission reduction (Gg CO ₂ -eq)			2030
	Other	Final energy savings (ktoe)		
Primary energy savings (ktoe)				18
	Finance	Budget	1625 million euros	
		Source of finance	Private sector, Energy Efficiency Fund, incentives from the central government budget	
	Implementing entity		- Government of the Republic of North Macedonia - Ministry of Transport - Ministry of Finance - Ministry of Energy, Mining and Mineral Resources - Ministry of Interior - Public institutions (end users)	
	Competent entity		- Ministry for Energy, Mining and Mineral Resources - Ministry of Interior	
	Contribution to achieving the Sustainable Development Goals		direct and	indirect
				  

PAM29 RENEWAL OF THE REST OF THE VEHICLE FLEET (HEAVY GOODS VEHICLES, BUSES)

MAIN OBJECTIVE: Reducing local air pollution from road traffic.

DESCRIPTION: The measure includes tightening the regulations and criteria for import and renewal of the vehicle fleet (light and heavy goods vehicles and buses), with the aim of gradually introducing vehicles with higher Euro standards.

 Time frame	 Type	 Sector	 Gases	 Range
2025 – 2040	Regulatory, political, informative	Transport	CO ₂ , CH ₄ , N ₂ O	National
 Relevant planning documents, legal and regulatory acts	- National Transport Strategy - Energy Development Strategy of the Republic of North Macedonia until 2040 - Vehicle Law - Law on Vehicle Tax			
 Methodology [for estimating emissions]	Energy modelling and IPCC/MARKAL methodology.			
 Assumptions	It is assumed that the conditions for import and renewal of the vehicle fleet will gradually tighten, with a focus on vehicles that meet current EU exhaust gas standards, especially for heavy vehicles and buses.			
Implementation status [idea, planning phase, in implementation phase]	Under implementation			
 Steps taken	- Adopted Vehicle Law (August 2019) - Adopted bylaws arising from the Law on Vehicle Tax			
Planned steps	Gradual harmonization and improvement of the conditions for import and registration of vehicles in accordance with EURO emission standards, including for heavy goods vehicles and buses; establishing minimum EURO requirements by category for passenger vehicles; and encouraging the replacement of outdated vehicles with vehicles that meet higher EURO emission standards.			
 Indicators	Value of the indicator in the last one reporting year		Target value on the indicator	
	2016-2018		2030	
	Progress	Number of vehicles by type		
	Emission reduction (Gg CO ₂ -eq)		2030	
			98.2	
	Other	Final energy savings (ktoe)	80	
		Primary energy savings (ktoe)	80	
 Finance	Budget	3,960 million euros (2025 – 2040)		
	Source of finance	Private sector		
 Implementing entity	- Government of the Republic of North Macedonia - Ministry of Transport - Ministry of Energy, Mining and Mineral Resources - Association of Road Transport Operators - Private companies			
 Competent entity	- Ministry of Transport - Ministry of Energy, Mining and Mineral Resources			
	direct and indirect			



Contribution to achieving the Sustainable Development Goals



PAM30. ADVANCED MOBILITY

MAIN OBJECTIVE: Reduction of local air pollution from road traffic

DESCRIPTION: The measure provides for the introduction and support of bicycle and electric scooter rental systems, encouraging walking and optimizing parking, with the aim of redirecting short car trips towards active and micromobility modes of transport.

 Time frame	 Type	 Sector	 Gases	 Range
2025 – 2030	Political, informative, financial	Transport	CO ₂ , CH ₄ , N ₂ O	National
 Relevant planning documents, legal and regulatory acts	- National Transport Strategy - Energy Development Strategy of the Republic of North Macedonia until 2040 - Decisions adopted by municipalities to subsidize the purchase of new bicycles			
 Methodology	- Energy modelling and IPCC methodology - MARKAL			
 Assumptions	By 2030, 5% of short-distance passenger kilometers will be replaced by walking, cycling or electric scooters			
Implementation status	Under implementation			
 Steps taken	Campaigns and subsidies for the purchase of bicycles and electric scooters have been implemented; bicycle rental systems have been established; bicycle paths and parking lots have been built in several locations; and parking management measures are being implemented. In the period 2016–2019, around 17,500 bicycles and around 300 electric scooters have been subsidized, with an annual subsidy amount of around 230,000 euros. In the period 2020-2024, where applicable, activities are continued and expanded through local initiatives to promote active mobility and micromobility, develop/improve rental systems and expand bicycle infrastructure.			
Planned steps	- To continue implementing campaigns and subsidies for purchasing new bicycles and renting bicycles - To continue the construction of new bicycle paths			
 Indicators	Value of the indicator in the last one report year		Target value on the indicator	
	2016-2018		2030	
	 Progress	Number of bicycles/ electric scooters	12660	
Other	Emission reduction (Gg CO ₂ -eq)		2030	
			3.0	
	Final energy savings (ktoe)		1	
	Primary energy savings (ktoe)		1	
 Finance	Budget		12 million denars	
	Source of finance		Private sector, EE fund, incentives from the central and local government budget, donors	
 Implementing entity	Ministry of Energy, Mining and Mineral Resources			

	- Local self-government units - End users
 Competent entity	- Ministry of Energy, Mining and Mineral Resources, - Local self-government units
 Contribution to achieving the Sustainable Development Goals	direct and indirect    

*Only those who applied for subsidies

PAM31 CONSTRUCTION OF THE RAILWAY TO THE REPUBLIC OF BULGARIA

MAIN OBJECTIVE: Improving regional connectivity and increasing freight and passenger transport by rail through the construction of the railway line to the Republic of Bulgaria.

DESCRIPTION: Construction of the railway line to the Republic of Bulgaria (Corridor VIII).

 Time frame	 Type	 Sector	 Gases	 Range
2020 – 2030	Investment, technical, strategic	Transport	CO ₂ , CH ₄ , N ₂ O	National
 Relevant planning documents, legal and regulatory acts	National Transport Strategy			
 Methodology [for estimating emissions]	Energy modelling and IPCC/MARKAL methodology.			
 Assumptions	By 2040, up to 5% of tonne kilometers (to the Republic of Bulgaria) of freight traffic will be replaced by rail transport.			
 Implementation status [idea, planning phase, in implementation phase]	- Under implementation (Phase I Kumanovo–Beljakovce has been completed and put into operation; - Phase II Beljakovce–Kriva Palanka is under construction; - Phase III Kriva Palanka–Deve Bair is in preparation with secured financing; an agreement for the cross-border tunnel has been signed with the Republic of Bulgaria). - Phase IV: In November 2025, an agreement was signed for the preparation, construction and operation of a cross-border railway tunnel with the Republic of Bulgaria.			
Steps taken	The modernization and opening to traffic of the Kumanovo–Beljakovce section has been completed; construction of the Beljakovce–Kriva Palanka section continues; project preparation for the sections towards Deve Bair has been provided; and an agreement has been signed for the cross-border railway tunnel with the Republic of Bulgaria.			
Planned steps	Completion of the construction of the Beljakovce–Kriva Palanka section; realization of the Kriva Palanka–Deve Bair section; and implementation of the agreed activities for the cross-border railway tunnel.			
 Indicators	Value of			
	the indicator			
	in the last one	Indicative trajectory		Target value of
	report			the indicator
	year			
	2016-2018	2020	2025	2030
Progress	Increase in tonne-km in rail transport (tkm)			
Emission reduction (Gg CO ₂ -eq)				2030

Other	Final energy savings (ktoe)	24.6
	Primary energy savings (ktoe)	10.2
		8.2
Finance	Budget	• 720 million euros (infrastructure + rolling stock)
	Source of finance	• Central government budget
Implementing entity	- Government of the Republic of North Macedonia - Ministry of Transport	
Competent entity	Ministry of Transport	
Contribution to achieving the Sustainable Development Goals	direct and	indirect
	   	

PAM32ELECTRIFICATION OF TRANSPORT

MAIN OBJECTIVE: Accelerating the electrification of road transport and reducing greenhouse gas emissions and local pollutants through support for electric vehicles and development of charging infrastructure.

DESCRIPTION: The measure includes the introduction and promotion of financial incentives for the purchase of electric vehicles, as well as the planning, construction and expansion of public charging infrastructure in urban areas and on major road routes, in order to ensure a reliable and accessible charging network and encourage wider use of electric vehicles.

Time frame	Type	Sector	Gases	Range
2025 – 2030	Regulatory, strategic, informative	Transport	CO ₂ , CH ₄ , N ₂ O	National
Relevant planning documents, legal and regulatory acts	- National Transport Strategy - Energy Development Strategy of the Republic of North Macedonia until 2040 - Vehicle Law - Law on Vehicle Tax			
Methodology	- Energy modelling and IPCC MARKAL methodology.			
Assumptions	By 2030, electric and hybrid electric vehicles reach a share of 55% in passenger traffic, in parallel with the expansion of the charging network.			
Implementation status	Under implementation			
Steps taken	Chargers have been installed at certain locations in the City of Skopje and in other cities. Amendments have been adopted to the Vehicle Law (2019), as well as the Law on Vehicle Tax with relevant bylaws (2019). Benefits for electric vehicles have been introduced and reserved parking spaces for electric vehicles in public parking lots have been provided. The calculation of the import tax is based on CO₂ emissions.			
Planned steps	Changes in tax policy to encourage the purchase of hybrid and electric vehicles (including VAT, where applicable) will be prepared and considered. An expert analysis will be prepared for priority locations and the charging infrastructure will be expanded, with budgetary funds provided for the continuation and expansion of the subsidy programme. In addition, strategic documents for electrification of the Transport sector and the use of hydrogen in transport will be prepared and adopted.			
Indicators	Indicator value in last reporting year		Target value of the indicator	

		2018	2030
Progress	Increase in tonne km in the railway transport (tkm)		
	Emission reduction (Gg CO ₂ -eq)		2030
			97.8
Other	Final energy savings (ktoe)		48.5
	Primary energy savings (ktoe)		32.6
	Budget	• 324M EUR	
	Source of finance	• Donor funds and private investments central government budget • Budgets of local self-government units	
	Implementing entity	• Government of the Republic of North Macedonia • Ministry of Transport • Ministry of Energy, Mining and Mineral Resources	
	Competent entity	• Ministry of Energy, Mining and Mineral Resources • Ministry of Interior	
	Contribution to achieving the Sustainable Development Goals	direct and	indirect
		    	

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

• Industrial Processes and Product Use (IPPU)

PAM33IMPLEMENTATION OF THE KIGALI AMENDMENT ON THE PHASE-OUT OF HFCs

MAIN OBJECTIVE: Phase out the use of hydrofluorocarbon (HFC) greenhouse gases

DESCRIPTION: The Kigali Amendment is an amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer. The amendment adds the potent greenhouse gases hydrofluorocarbons (HFCs) to the list of substances controlled under the Protocol that are to be phased out. The Republic of North Macedonia has become the 94th country to ratify the Kigali Amendment to phase out HFC refrigerants. North Macedonia follows the schedule of the Kigali Amendment to the Montreal Protocol for Annex 5 countries, starting with a phase-out of HFCs in 2024 and ending with a permanent 80% reduction in 2045.

 Time frame	 Type	 Sector	 Gases	 Range
2025 – 2040	Technical, regulatory	IPPU	HFC	National
 Relevant planning documents, legal and regulatory acts	• Order on the prohibition of the production and trade of substances that deplete the ozone layer as well as the production and trade of products containing substances that deplete the ozone layer ("Official Gazette of the Republic of North Macedonia" No. 92/10) • Order on restricting the import of substances that deplete the ozone layer ("Official Gazette of the Republic of North Macedonia" No. 111/2021) • Order on the prohibition of the trade in hydrochlorofluorocarbons (HCFCs) ("Official Gazette" No. 111/2021, applicable from 01.01.2028) • Order on the prohibition of trade in 1,1-dichloro-1-fluoroethane (HCFC 141b) and mixtures containing 1,1-dichloro-1-fluoroethane (HCFC 141b) ("Official Gazette of the Republic of North Macedonia" No. 111/21) • Law on Ratification of the Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer ("Official Gazette of the Republic of North Macedonia" No. 34/2020)			

 Methodology	• IPPU model developed in Excel										
 Assumptions	• HFC phase-down schedule for North Macedonia under the Kigali Amendment: • Basic formula – average consumption for 2020-2022 + 65% of the baseline value of chlorofluorocarbons (HCFCs) ○ 2024 - freezing ○ 2029 - -10% ○ 2035 - -30% ○ 2040 - -50% ○ 2045 - -80% • The addition of 65% HCFC to the baseline is optional and is not recommended to be considered if HCFC consumption is reduced to zero. Given the legal acts in force in North Macedonia, the consumption (i.e. import) of HCFC is minimal and equal to 0 already in 2017, and therefore this addition is not taken into account in this measure.										
Implementation status	• In the implementation phase										
 Steps taken	• Ratification of the Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer • Ongoing UNIDO project for implementation of the Kigali Amendment to the Montreal Protocol, given the current situation in the country regarding current HFC consumption. Legislative documents, stakeholder engagement and awareness-raising events are underway, leading to the ratification of the Kigali Amendment in February 2020 (https://open.unido.org/projects/MK/projects/200289)										
Planned steps	• Implementation of the HFC phase-out schedule, with the help of projects supported by the Montreal Protocol Fund										
Indicators  Progress HFC [tons] Emission reduction (Gg CO₂-eq)	<table> <tr> <th>Value in the last reporting year</th><th>Target value</th></tr> <tr> <td>2022</td><td>2030</td></tr> <tr> <td>403</td><td>0</td></tr> <tr> <td></td><td>2030</td></tr> <tr> <td></td><td>225.6</td></tr> </table>	Value in the last reporting year	Target value	2022	2030	403	0		2030		225.6
Value in the last reporting year	Target value										
2022	2030										
403	0										
	2030										
	225.6										
 Finance Budget	• N/A										
 Finance Source of funding	• Montreal Protocol Fund, private sector										
 Implementing entity	• Ministry of Environment and Physical Planning										
 Monitoring entity	• Ministry of Environment and Physical Planning										
 Contribution to achieving the Sustainable Development Goals	<table> <tr> <th>direct</th><th>indirect</th></tr> <tr> <td>  </td><td>   </td></tr> </table>	direct	indirect		 						
direct	indirect										
	 										

- **Agriculture, forestry and other land use**
 - Livestock farming

PAM34 REDUCING CH₄ EMISSIONS FROM ENTERIC FERMENTATION IN DAIRY COWS BY 20%

MAIN OBJECTIVE: Reducing the level of CH₄ emissions resulting from enteric fermentation of high-yielding dairy cows.

DESCRIPTION: By modifying the nutritional practices and diet of dairy cows, CH₄ emissions from enteric fermentation can be reduced by 20%. It is estimated that the number of dairy cows under intensive livestock farming systems will increase from the current 1% to 25-30% in 2040. As a result of the high-yielding cows, CH₄ emissions will also increase. However, by modifying the diet (adding carbohydrates, high-quality forages and tannins) in the feed, CH₄ emissions will be reduced by 20%. This mitigation measure can be implemented by changing the diet on dairy farms. There is no need for additional subsidies and financial incentives for this measure, since the advantage of using high-quality forage feeds in the diet of high-yielding heads is seen in higher productivity (the profitability of high-yielding heads is achieved only if high-quality forage feeds are used in the diet and nutritional management techniques are introduced). Practical training and demonstrations would be sufficient for farmers.

 Time frame	 Type	 Sector	 Gases	 Range	
2025 – 2040	Technical support, education	AFOLU – Livestock farming	CH ₄	National	
 Relevant planning documents, legal and regulatory acts	• IPARD Programme 2021-2027; • Agro-ecological measures in the National Programme for the Development of Agriculture and Rural Development for the Period 2023-2027 (“Official Gazette of the Republic of North Macedonia”, 7/23); • National Strategy for the Development of Agriculture and Rural Development for the Period 2021-2027 (MAFWE, 2021);				
 Methodology	• Regression model, IPCC methodology • Changed feed composition and nutritional management in 25-30% of dairy cows.				
 Assumptions	• Increasing the number of highly productive cows in an intensive production system; • Introduction of modified TMR (Total Mixt Ration) and nutritional management; • Envisaged modification of dairy cow breeding systems and consolidation of herds into farms with more than 50 dairy cows;				
Implementation status	• In the implementation phase				
Steps taken	• TMR with partially modified feed composition is already being applied on several intensive farms containing about 1% of the total dairy cow population				
 Planned steps	• Development of an advisory package for feed modification and nutritional management in intensive dairy farms with over 50 dairy cows; • Support for expanding the advisory package to target farmers; • Monitoring the effects of feed modification and nutritional management and further improvements.				
Indicators	Indicator value in the last reporting year	Indicative trajectory	Indicator target value		
	2022		2040		
 Progress	Number of farms (dairy cows as a percentage of total population) and application of modified diet and nutritional management on a biennial basis		1%		25% of all dairy cows will be subject to modified diet and nutritional management by 2040.
Emission reduction (Gg CO ₂ -eq)			2030		
			35		
 Finance	Budget	• 0.25 million US dollars			
	Source of funding	• Private sector, IPARD Programme			

 Implementing entity	• MAFWE
 Monitoring entity	• MAFWE
 Contribution to achieving the Sustainable Development Goals	direct
	indirect
	 

PAM35 REDUCTION OF N₂O EMISSIONS BY UP TO 20% DURING MANURE MANAGEMENT ON DAIRY FARMS WITH MORE THAN 50 HEADS

MAIN OBJECTIVE: Reducing the level of N₂O emissions resulting from manure management on farms with high-yielding dairy cows. This measure aims to improve environmental sustainability and reduce greenhouse gas emissions from the agricultural sector, especially from large livestock farms practicing intensive dairy farming systems. This measure also aims to reduce greenhouse gas emissions and environmental pollution from large dairy farms in North Macedonia by improving manure management, promoting the use of organic fertilizers and converting organic waste into renewable energy through biogas production.

DESCRIPTION: This measure stimulates green investments in infrastructure and technology, such as biogas systems and composting plants. In addition, the measure encourages stakeholder cooperation between farms, municipalities and waste suppliers to optimize resource efficiency and integration of circular economy. As a result of modified manure management from dairy cows, N₂O emissions can be reduced by 20%. It is estimated that the number of dairy cows in intensive farming conditions on farms with more than 50 cows will increase from 1% to 25-30% by 2040. All farms will need to implement improved manure management in order to reduce nitrogen losses from feces and urine through increased N₂O, NO_x emissions. Therefore, it is necessary to change and modify the manure management system on farms. This mitigation measure takes into account adaptations in existing farms and moderate investments in new farms (if adaptation or construction of new farms is carried out), in accordance with existing environmental protection legislation, improved farm management techniques will be mandatory. There is a need for adaptation subsidies and incentives in the design and construction of new dairy farms.

 Time frame	 Type	 Sector	 Gases	 Range
2025 – 2040	Technical support, education	AFOLU – Livestock farming	N ₂ O, CH ₄	National
 Relevant planning documents, legal and regulatory acts	• Law on Nature Protection; • IPARD Programme 2021-2027; • Agro-ecological measures in the National Programme for the Development of Agriculture and Rural Development for the Period 2023-2027 ("Official Gazette of the Republic of North Macedonia", 7/23); • National Strategy for the Development of Agriculture and Rural Development for the Period 2021-2027 (MAFWE, 2021)			
 Methodology	• Regression model, IPCC methodology • Modified manure management of 25-30% of dairy cows.			
 Assumptions	• The target group is farms with more than 50 dairy cows. The manure management practice is expected to change from solid fraction (N 40 loss factor) to liquid manure (N 28 loss factor). • The measure is expected to result in 10% of the manure generated by the dairy cow population, or manure generated on 15% of farms, being used for biogas production by 2030. • The percentage of high-milk cows is expected to be 25% in 2040. Under such conditions, the reduction of N₂O emissions from manure management in dairy cows will reach 25% by 2040. • Increasing the number of highly productive dairy cows under an intensive farming system. • Modifying manure management on farms.			
Implementation status	• In the planning phase			
 Steps taken	• On existing larger dairy farms, the planning process for modified manure management has begun; • No concrete steps taken			
Planned steps	• Adaptation of manure management in intensive farms for more than 50 dairy cows; • Design and construction of farms for intensive farming with more than 50 dairy cows;			

		Monitoring the effects of modified manure management in intensive farms with more than 50 cows.			
Indicators		Indicator value in the last reporting year	Indicative trajectory		Indicator target value
		2022	2025	2030	2035
 Progress - Total funds paid to farms through IPARD, subsidies or energy incentives; - Farms (dairy cows as a percentage of total population) using modified manure management on a 2-5 year basis; - Number of farms equipped with improved systems for manure storage and composting or biogas production;		0			
Emission reduction (Gg CO ₂ -eq)					2030
					2.1
 Finance Budget		1.5 million US dollars			
 Finance Source of funding		Private sector, IPARD Programme			
 Implementing entity		Agency for Financial Support of Agriculture and Rural Development			
 Monitoring entity		MAFWE			
Contribution to achieving the Sustainable Development Goals		direct	indirect		
					

PAM36 REDUCTION OF N₂O EMISSIONS BY 13% FROM MANURE MANAGEMENT ON PIG FARMS

MAIN OBJECTIVE: Reducing the level of N₂O emissions resulting from manure management on farms for intensive breeding of high-yielding pigs. This measure aims to improve environmental sustainability and reduce greenhouse gas emissions from the agricultural sector, especially from smaller livestock farms practicing intensive pig breeding systems. This measure also aims to reduce greenhouse gas emissions and environmental pollution from large-scale pig farms in North Macedonia by improving manure management, promoting the use of organic fertilizers and converting organic waste into renewable energy through biogas production.

DESCRIPTION: This measure stimulates green investments in infrastructure and technology, such as biogas systems and composting plants. In addition, the measure encourages stakeholder cooperation between farms, municipalities and waste suppliers to optimize resource efficiency and integration of circular economy. Poor manure management is a key source of N₂O emissions and nitrogen leaking into water resources, contributing to air and water pollution. The measure is expected to result in improved manure management systems by 5% of small farms with intensive pig farming systems. By modifying manure management in pig farms, N₂O emissions can be reduced by 50%. It is estimated that the number of finishers and finishers produced per sow will increase, while the total number of sows will remain stable. The number of pig farms with more than 1000 finishers and/or 350 sows will also increase. Therefore, there will be a need to implement improved manure management systems in order to reduce nitrogen losses through N₂O emissions. In 2040, it is expected that 90% of finishers will be produced on large intensive farms, which will account for 75% of the sows in the country. The mitigation measure takes into account adaptations in existing farms and moderate investments in new farms. There is a need for adaptation subsidies and incentives in the design and construction of new farms. Modification of techniques for direct application of liquid manure to arable land is envisaged.

 Time frame	 Type	 Sector	 Gases	 Range
2025 – 2040	Technical support, education	AFOLU – Livestock farming	N ₂ O, CH ₄	National
 Relevant planning documents, legal and regulatory acts	- Law on Nature Protection; - Harmonization of national policies with EU standards for waste, energy and agriculture;			

	• Providing financial support and incentives through the IPARD Programme 2021-2027; • Agro-ecological measures in the National Programme for the Development of Agriculture and Rural Development for the Period 2023-2027 ("Official Gazette of the Republic of North Macedonia", 7/23); • National Strategy for the Development of Agriculture and Rural Development for the Period 2021-2027 (MAFWE, 2021);			
 Methodology	• Regression model, IPCC methodology • Modified manure management in pig farms with a capacity of over 1000 finishers and/or 350 sows			
 Assumptions	• An improvement in the pig breeding system is expected, which will contribute to the modernization of pig farms. A change in manure management practice from solid to liquid manure (a practice already applied on large pig farms) is also expected. In this case, the loss of nitrogenous substances will be reduced by 50%; • Implementation of the change will be gradual over the years in the categories of finishers and sows (for example, a rate in finishers from 55% in 2025 to 75% in 2040; a rate in sows from 70% in 2025 to 92% in 2040); • Increasing the number of farms for breeding highly productive heads with a capacity of more than 1000 finishers and/or 350 sows; • Modified manure management in pig farms			
Implementation status	• In the implementation phase			
Steps taken	• 0% farms practicing modified manure management; • On existing larger pig farms, the process for modified manure management has begun, as a result of the implementation of environmental impact assessment studies (A permit for compliance with the operational plan).			
 Planned steps	• Adaptation of manure management in intensive pig farms with more than 1000 finishers and/or 350 sows; • 5% of pig farms with more than 1000 finishers and/or 350 sows will be subject to modified manure management by 2030; • Design and construction of intensive farms with more than 1000 finishers and/or 350 sows; • Monitoring the effects of modified manure management in intensive farms with more than 1000 finishers and/or 350 sows			
Indicators	Indicator value in the last reporting year	Indicative trajectory		Indicator target value
	2022	2025	2030	2035
 Progress	• Total funds paid to farms through IPARD, subsidies or energy incentives; • Farms for breeding finishers and sows (percentage of total population) using modified manure management on a multi-year basis (2-5 years); • Number of farms equipped with improved systems for manure storage and composting or biogas production;	0		
Emission reduction (Gg CO ₂ -eq)			2030	
			0.4	
 Finance	Budget	• 1 million US dollars		
	Source of funding	• Private sector, IPARD Programme		
 Implementing entity	• Agency for Financial Support of Agriculture and Rural Development			

 Monitoring entity	• MAFWE	
 Contribution to achieving the Sustainable Development Goals	direct	indirect
		

PAM37 REDUCTION OF N₂O EMISSIONS BY 20% FROM MANURE MANAGEMENT IN DAIRY COWS ON FARMS WITH A CAPACITY OF LESS THAN 50 HEADS

MAIN OBJECTIVE: Reducing the level of N₂O emissions resulting from manure management on farms with high-yielding dairy cows with a capacity of less than 50 heads. This measure aims to improve environmental sustainability and reduce greenhouse gas emissions from the agricultural sector, especially from smaller livestock farms.

DESCRIPTION: Poor manure management is a key source of N₂O emissions and nitrogen leaking into water resources, contributing to air and water pollution. The measure is expected to result in improved manure management systems on 5% of small dairy farms. With modified manure management on dairy farms, N₂O emissions could be reduced by 30%. According to the report of the study under the project "Fourth National Climate Change Plan and Third Biennial Report on Climate Change under the UNFCCC", the most common system is dry manure management, where feces and urine, together with bedding (mostly wheat or barley straw) are removed from the barn daily or weekly and the manure is composted in a pile near the farm. Farmers do not use manure covers or tanks to collect liquid waste (slurry) from the manure pile. In the process of manure fermentation, the pile is usually stirred to aerate the lower layers, which have anaerobic conditions, and the surface environment is aerobic. Fermented manure is most often used as fertilizer for arable land for a period of 2-3 months (depending on the storage space on the farm and the possibility of using the field). Depending on the fermentation of the manure, the loss of nitrogen can be up to 60%. The loss of nitrogen and the reduction of N₂O emissions can be achieved by extending the fermentation (maturation) period to 6 months and covering the manure pile. Therefore, the measure concerns the support of farmers on farms with a capacity of less than 50 dairy cows in order to ensure adequate storage of manure for a longer period of time.

 Time frame	 Type	 Sector	 Gases	 Range
2030 – 2030	Technical support, education	AFOLU – Livestock farming	N ₂ O, CH ₄	National
 Relevant planning documents, legal and regulatory acts	• Law on Nature Protection; • IPARD Programme 2021-2027; • Agro-ecological measures in the National Programme for the Development of Agriculture and Rural Development for the Period 2023-2027 ("Official Gazette of the Republic of North Macedonia", 7/23); • National Strategy for the Development of Agriculture and Rural Development for the Period 2021-2027 (MAFWE, 2021)			
 Methodology	• Regression model, IPCC methodology • Modified manure management on farms that breed about 25-30% of dairy cows.			
 Assumptions	• Replacing low-productive with high-productive dairy cows; • Modifying manure management on farms with 10-50 cows; • Dairy cows produce manure (feces and urine) of about 7% of their body weight per day. Dairy cows have an average body mass of 500 - 650 kg, depending on the breed and breeding technology. Heifers aged 1-2 years, calves aged 3-12 months and young calves aged 0-3 months are aged to an adult cow with a coefficient of 2, 4 and 10 respectively. For a simplified presentation, animal units (conditional head) should be used as a basis (1 conditional head = 500 kg). Based on the usual feed consumption, bedding material (annual average use of wheat/barley straw of 8%), what can be expected is about 0.04 m³ manure/conditional head/day; • The feces contain about 40% moisture and during storage they reduce their volume by 40%. • A total volume of 5 m³ per conditional head should be expected for a period of 6 months. For composting a pile, a trench with clay or concrete floor with a slope of 4% is required. The pile should be protected from rainfall (with a roof or covered with plastic film). Aeration occurs when fresh manure is added, making sure that the old and already fermented manure is always on top. By extending the manure storage and the covering period, a reduction of N₂O emissions by 30% is expected.			
 Implementation status	• In the planning phase			
 Steps taken	• None			

Planned steps		• Support for the construction of a storage facility for fermented manure; • Training for farmers on manure management; • Monitoring the effects of modified manure management.			
Indicators		Indicator value in the last reporting year	Indicative trajectory		Indicator target value
		2022	2025	2030	2035
	Progress	• Farms (dairy cows as a percentage of total population) using modified manure management on a 5-year basis; • Number of farms (dairy cows as a percentage of the total population) adopting good agricultural practices for manure management / Number of farms using modification of techniques for direct application of liquid manure to arable land with the aim of reduced greenhouse gas emissions.			
Emission reduction (Gg CO ₂ -eq)					2030
					0.7
	Finance	Budget			
		Source of funding			
	Implementing entity	• 1 million US dollars			
	Monitoring entity	• Private sector, IPARD Programme			
		• Agency for Financial Support of Agriculture and Rural Development			
		• MAFWE			
		direct		indirect	
					

○ **Agriculture**

Of the 11 proposed measures in the AFOLU sector, 5 measures in the field of crop agricultural production are listed, which are also contained in the previous report, and 3 new measures are proposed, which are contained in this report. The content of the measures proposed in the previous reports has been minimally supplemented and amended in certain sections, in order to more clearly describe the main objective and information about the already proposed measures.

PAM38 ENCOURAGING AND INTENSIFYING THE APPLICATION OF "GREEN MANURE" (SIDERATION)

MAIN OBJECTIVE: Replacing or reducing the use of synthetic mineral fertilizers in plant production, which will largely contribute to reducing CO₂ emissions and increasing sinks.

DESCRIPTION: Siderates enrich humus, improve soil structure, aeration and water retention. Mineral fertilizers do not affect the physical and structural properties of the soil. Organic matter from siderates increases the activity of soil microorganisms and earthworms. Mineral fertilizers can reduce activity at high doses. Legume siderates fix atmospheric nitrogen and, through symbiotic nitrogen fixation with certain strains of bacteria, they enrich the soil with forms of nitrogen available to plants. Mineral nitrogen fertilizers are a quick source of available nitrogen, but are easily leached downward. The dense cover of siderates overcomes weeds; some have an allelopathic effect. Mineral fertilizers do not prevent the development of weeds. The root system of siderates prevents erosion and leaching of nutrients. Mineral fertilizers do not provide such protection. Organic plant mass incorporated into the soil creates permanent reserves of nutrients. Mineral fertilizers have a short-term effect.

Sideration reduces the need for mineral fertilizers. Sideration affects the reduction of pollution and greenhouse gas emissions. Siderates have a positive impact on increasing biodiversity.

 Time frame	 Type	 Sector	 Gases	 Range				
2030 – 2030	Research, Educational, Technical	AFOLU – Plant production	CO ₂ , N ₂ O, NH ₃	National				
 Relevant planning documents, legal and regulatory acts	• Law on Agriculture and Rural Development • Law on Organic Production • Law on the Quality and Safety of Fertilizers, Biostimulants and Soil Improvers • Rulebook on Good Practices in Agriculture • National Strategy for Agriculture and Rural Development (2021–2027) and national programming documents • Agro-environmental measures and policies of the Financial Support Agency (direct payments / rural development measures) • IPARD / Rural Development Programme (measures: Agro-ecology, Climate and Organic)							
 Methodology	• Regression model, IPCC methodology							
 Assumptions	• Reduction of soil erosion processes in the upper layer, and improvements in the water-air regime of the soil, reduction of the loss of soil organic matter (SOM), when the classical method of plant cultivation system with the application of synthetic mineral fertilizers is replaced by sideration, with a dynamic of 15,000 hectares per year of areas for plant agricultural production.							
Implementation status	• In the planning phase							
Steps taken	• In 2025, the Programme for Financial Support in Agriculture included a sub-measure "1.14 Direct payments for areas intended for green manure or fallow in crop rotation" • There is a possibility of receiving support from IPARD 3 funds.							
Planned steps	• To promote green manuring as a measure to mitigate greenhouse gas emissions • Guidelines and training (MAFWE, advisory services), issuing application guides (how to practice sideration) • To increase financial support from national programmes for the application of sideration • The measure should be intensified into an agro-ecological scheme							
Indicators	<table><tr><th>Indicator value in the last reporting year</th><th>Indicator target value</th></tr><tr><td>2025</td><td>2030</td></tr></table>				Indicator value in the last reporting year	Indicator target value	2025	2030
Indicator value in the last reporting year	Indicator target value							
2025	2030							
Progress								
Emission reduction (Gg CO ₂ -eq)	<table><tr><td></td><td>2030</td></tr><tr><td></td><td>93.6</td></tr></table>					2030		93.6
	2030							
	93.6							
 Finance	<table><tr><td>Budget</td><td>• \$108.0 million</td></tr><tr><td>Source of funding</td><td>• Private sector, IPARD Programme</td></tr></table>				Budget	• \$108.0 million	Source of funding	• Private sector, IPARD Programme
Budget	• \$108.0 million							
Source of funding	• Private sector, IPARD Programme							
 Implementing entity	• MAFWE							
 Monitoring entity	• MAFWE							
Contribution to achieving the Sustainable Development Goals	<table><tr><td>direct</td><td>indirect</td></tr></table> 				direct	indirect		
direct	indirect							

PAM39 ENCOURAGING AND INTENSIFYING THE APPLICATION OF REDUCED TILLAGE AND ORGANIC CROP PRODUCTION

MAIN OBJECTIVE: Reducing greenhouse gas emissions – due to lower fuel consumption, synthetically produced fertilizers and pesticides, as well as greater retention of organic carbon in the soil

DESCRIPTION: There are a number of advantages to reduced/conservation tillage, but in the context of these recommendations, the most significant are reduced greenhouse gas emissions – due to lower fuel consumption and greater retention of organic carbon in the soil. In terms of reducing greenhouse gas emissions, the advantage of the organic crop production method lies in the reduced dependence on industrial mineral fertilizers and synthetically produced pesticides (which require a lot of energy to produce). The greater number of hectares certified for organic crop production contributes to an increase in the amount of carbon stored in the soil, as well as to an increase in the level of biodiversity, both below and above ground.

 Time frame	 Type	 Sector	 Gases	 Range
2030 – 2030	Research, Educational, Technical	AFOLU – Plant production	CO ₂ , N ₂ O, NH ₃	National
 Relevant planning documents, legal and regulatory acts	• Law on Agriculture and Rural Development • Law on Organic Production • Law on Soil Protection • Rulebook on Good Practices in Agriculture • National Strategy for Agriculture and Rural Development (2021–2027) and national programming documents • Rulebook on Cross-Compliance for the Implementation of Specific Minimum Conditions for Good Agricultural Practice • IPARD 3			
 Methodology	• Regression model, IPCC methodology			
 Assumptions	• Preservation of microbiological activity - combined cultivation of crops to naturally reduce the risks of diseases, pests and weeds, i.e. changing crops by place and time (crop rotation). • Growing cover crops • Application of certification methodologies – monitoring of standards and annual controls • Protection against erosion and enrichment of the soil with organic matter, i.e. reduction of soil organic matter (SOM) loss, and improvements to the water-air regime of the soil • Greater biological activity and emergence of beneficial organisms • Reduced "carbon footprint" (CO₂ emission), lower mineralization of organic matter, when the classical way of cultivation system using reduced tillage methods and establishment of organic crop production systems would be implemented on at least 15,000 hectares of annual crop production areas			
Implementation status	• In the implementation phase			
Steps taken	• In 2025, the Government adopted a "Programme for Financial Support in Organic Agricultural Production" with funds provided for: • Organic crop producers receive higher subsidies, up to 30% higher for fodder crops, 50% for cereals, 70% for fruit and viticulture, and a 100% increase for horticultural crops. • Part of the costs for certification of organic production and for analyses (pedological, agrochemical, analyses for pesticides and their residues) are covered by funds provided for in this programme. • Possibility of receiving support from IPARD 3 funds.			
Planned steps	• To promote reduced tillage and organic production as measures to mitigate greenhouse gas emissions • Guidelines and training (MAFWE, advisory services, how to practice reduced tillage and organic production), issuing application guides. • To increase financial support from national programmes for the implementation of reduced tillage and organic crop production • The measure should be intensified into an agro-ecological scheme			
 Indicators	Indicator value in the last reporting year		Indicator target value	
	2025	2030	2040	2030
Progress				

Emission reduction (Gg CO ₂ -eq)		2030
		60.6
 Finance	Budget	• \$100.0 million
	Source of funding	• Private sector, IPARD Programme
 Implementing entity	• MAFWE	
 Monitoring entity	• MAFWE	
 Contribution to achieving the Sustainable Development Goals	direct	indirect
		

PAM40 ENCOURAGING AND INTENSIFYING THE METHOD OF ALTERNATING WETTING AND DRYING OF SURFACES IN RICE CULTIVATION.

MAIN OBJECTIVE: Optimal water use, reduction of methane emissions (by 30–70%), improvement of root system aeration. Reduction of irrigation costs. This measure can contribute to maintaining or even increasing the average rice yield achieved in rice fields in the RNM.

DESCRIPTION: Rice fields have been routinely and currently irrigated by flooding the entire surface area through so-called drainage/irrigation systems. Under these anaerobic (oxygen-free) conditions, organic matter in the soil and from plant residues decomposes through microbial methanogenesis, a process that releases methane (CH₄). When rice fields are continuously flooded, high levels of methane emissions occur. The “Alternate Wetting and Drying (AWD)” method is a modern, efficient and sustainable technique for irrigating rice fields, developed by IRRI (International Rice Research Institute). It is applied in flooded rice cultivation systems. If implemented, it encourages and intensifies the method of rice cultivation through alternating wetting and drying of the surfaces, and can contribute to the reduction of methane emissions from rice fields. According to several scientific and expert literature sources, rice cultivation according to this method, due to the occasional creation of aerobic conditions in the rice fields, can contribute to the reduction of CH₄ emissions by 30–70%.

 Time frame	 Type	 Sector	 Gases	 Range
2030 – 2030	Research, Educational, Technical	AFOLU – Plant production	CH ₄	National
 Relevant planning documents, legal and regulatory acts	• Water Law - Rules/tariffs for charging water, • Rulebook on Good Practices in Agriculture • National Strategy for Agriculture and Rural Development (2021–2027) and national programming documents • Law on Environment and water protection regulations / (Environmental Assessment) • IPARD 3 - EU financial documentation / public grant programmes - requirements for financial support (technical standards, indicators)			
 Methodology	• Regression model, IPCC methodology			
 Assumptions	• Reducing methane emissions from rice fields (by 30–70%) • Reducing water consumption and irrigation costs • Maintaining or even increasing the average rice grain yield • Improving aeration of the root system and reducing the risk of plant diseases			
Implementation status	• Idea			
 Steps taken	• There are ongoing projects and programmes in the North Macedonia that are relevant to irrigation and water system modernization (e.g., the FAO-funded Irrigation Programme North Macedonia (IPNM) for land consolidation and rice production improvement). They create a technical and institutional “base” on which AWD could be introduced, but the project documents do not mention specific AWD pilot projects.			
Planned steps	• To promote this method of rice cultivation as a measure to mitigate greenhouse gas emissions • Guidelines and training (MAFWE, advisory services, how to practice this method of cultivation – rice irrigation), issuing application guides.			

		- To increase financial support from national programmes for the application of the method of alternating wetting and drying of rice fields and to introduce this method on at least 100 to 200 hectares of rice annually. - The measure should be intensified into an agro-ecological scheme			
Indicators		Indicator value in the last reporting year	Indicative trajectory		Indicator target value
		2025	2030	2040	2030
	Progress	Area (ha) of rice where this cultivation method is practiced annually;			
Emission reduction (Gg CO ₂ -eq)					2030
					1.0
	Finance	Budget			
		Source of funding			
		\$1.0 million			
	Implementing entity	MAFWE			
	Monitoring entity	MAFWE			
Contribution to achieving the Sustainable Development Goals		direct		indirect	
					

Forestry

Climate change mitigation measures in the Forestry sector relate to reducing CO₂ emissions from forestry (forest fires) and increasing CO₂ sequestration through afforestation of new areas (increasing forest area).

In the period from 2020 to 2022, the measure Establishing Integrated Forest Fire Management has been partially implemented. 5 of the planned 25 special vehicles for initial attack have been purchased. The legal regulation for establishing integrated forest fire management has not been adopted. The planned 3000 ha of average burned area per year has not been achieved, but on the contrary, in the period 2020 - 2021 the average annual burned area is 5168 ha.

PAM41 ESTABLISHING INTEGRATED FOREST FIRE MANAGEMENT

MAIN OBJECTIVE: Reducing the average annual burned area by 6000 ha

DESCRIPTION: Forest fires are a very serious problem with forest loss and a source of greenhouse gas emissions. In the period from 1999 to 2019, the average annual number of forest fires was 229, the average annual burned area was 10,985 ha and the average annual damage was 6.9 million euros. The total burned area under forest in the same period is about 219,163 ha with a total damage of about 138 million euros. This measure covers the protection of the forest area by extinguishing forest fires and the damage caused by forest fires.

 Time frame	 Type	 Sector	 Gases	 Range
2030 – 2030	Reducing forest fires	AFOLU – Forestry	CO ₂	National
 Relevant planning documents, legal and regulatory acts	- Forest Law, - Rulebook on Forest Fire Protection, - Strategy for the development of protection against forest fires, diseases and insects with an Action Plan for the implementation of projects and procurement for the needs of PE "Nacionalni Shumi"			
 Methodology	Efficient and fast initial action with well-trained and equipped teams			
 Assumptions	On average, up to 3,000 ha will be burned annually.			

	Implementation status	• In the implementation phase		
	Steps taken	• The location for construction and establishment of a forest fire training center within the framework of the PE "Nacionalni Shumi" has already been selected, a plan has been prepared and 8 vehicles have been purchased.		
	Planned steps	• Phase I - Procurement of initial attack vehicles, tools and personal protective equipment (PPE) Duration: one year Vehicle Procurement: 25 specialized vehicles for initial attack 25 vehicles x €40,000 = €1,000,000 50 sets of hand tools and PPE for 50 crew members of five firefighters (two per vehicle) 1 set of hand tools and PPE = €4,000 50 sets x €5,000 = €250,000 • Phase II - Specialized training for firefighters (six days) 50 groups x 5 people = 250 firefighters 250 firefighters x €800 = €200,000		
	Indicators	Indicator value in the last reporting year		Indicator target value
		2022		2030
	Progress	Forest area (ha)		
	Emission reduction (Gg CO ₂ -eq)			2030
	Finance	Budget		
		Source of funding		
	Implementing entity	• MAFWE through PE "Nacionalni Shumi"		
	Monitoring entity	• MAFWE through PE "Nacionalni Shumi"		
	Contribution to achieving the Sustainable Development Goals	direct		indirect
				

PAM42AFFORESTATION

MAIN OBJECTIVE: Afforestation of 5000 ha of barren land with oak (Quercus spp.)

DESCRIPTION: Afforestation and restoration of degraded forests can change the land and can affect the provision of land-related goods and services. The provision of goods and services (to people and societies) and the establishment of traditional cultures, as well as the ecology of the land should also be taken into account. According to many strategic documents, there are about 1,500,000 ha of barren land for afforestation or restoration.

 Time frame	 Type	 Sector	 Gases	 Range
2025 – 2040	Afforestation of barren land	AFOLU - Forestry	CO ₂	National
 Relevant planning documents, legal and regulatory acts	Forest Law			
 Methodology	Empirical modelling, based on scientific work			

Assumptions	• Oak is resistant to high air temperature and low rainfall-dry conditions (conditions expected in accordance with the official national climate change scenarios for N. Macedonia) and is less sensitive to forest fires. In addition, the economic and technical value of the timber is high. Afforestation can be carried out in one location (total 5,000 ha) or distributed, but not more than five locations. • At least 80% of seedlings should survive after the third year of afforestation and be maintained in good health and morphological condition.															
Implementation status Steps taken	• In the implementation phase • There are nurseries producing more than 8,000,000 seedlings per year. It is necessary to select an area for afforestation, about 7.5 million oak seedlings need to be produced, afforestation should be done with proper care over the next 5 years															
Planned steps	• Phase I - seedling production ◦ Duration: 3 years ◦ Amount of seedlings: 2,500 seedlings / ha x 5,000 ha = 12,500,000 seedlings ◦ Costs for producing seedlings: 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 Progress Forest area (ha) Emission reduction (Gg CO₂-eq)	<table><tr><th>Indicator</th><th>value in the last reporting year</th><th>Indicator target value</th></tr><tr><td></td><td>2022</td><td>2030</td></tr><tr><td></td><td></td><td></td></tr><tr><td></td><td></td><td>2030</td></tr><tr><td></td><td></td><td></td></tr></table>	Indicator	value in the last reporting year	Indicator target value		2022	2030						2030			
Indicator	value in the last reporting year	Indicator target value														
	2022	2030														
		2030														
Finance Budget Source of funding	• Budget: €7.8 million • PE "Nacionalni Shumi", other forestry enterprises															
Implementing entity	• MAFWE															
Monitoring entity	• MAFWE															
Contribution to achieving the Sustainable Development Goals	<table><tr><th>direct</th><th>indirect</th></tr><tr><td> 15 LIFE ON LAND </td><td> 13 CLIMATE ACTION </td></tr></table>	direct	indirect	15 LIFE ON LAND	13 CLIMATE ACTION											
direct	indirect															
15 LIFE ON LAND	13 CLIMATE ACTION															

- **Other land use**

PAM43 CONVERSION OF ARABLE LAND WITH A SLOPE GREATER THAN 15% INTO PERMANENT MEADOWS AND PASTURES

MAIN OBJECTIVE: Conversion of arable land with a slope greater than 15% into permanent meadows and pastures

DESCRIPTION: Crop production on sloping land causes intensive processes of soil erosion and mineralization of soil organic matter. These processes lead to intensive decomposition of soil organic matter and emissions of carbon from the soil into the atmosphere. The conversion of these areas into permanent pastures (pastures, meadows) will significantly reduce the intensity of soil organic matter depletion and soil carbon emissions and will lead to carbon sinks. In areas with a slope greater than 15%, a document published by MANU in 2020 (Climate Change) recommends that those sloping areas where cereal crops are grown be converted into meadows and pastures. This land use conversion and change in the production system may affect the net annual income of primary producers. Therefore, implementation should be supported by incentives, especially in the first years of conversion in order to bridge the possible loss of income in agricultural holdings.

 Time frame	 Type	 Sector	 Gases	 Range
2025 – 2040	Educational, Technical	AFOLU – Plant production	CO ₂	National
 Relevant planning documents, legal and regulatory acts	• Law on Agricultural Land • Pasture Law • Law on Environmental Protection. • National Strategy for Agriculture and Rural Development (2021–2027) • Rulebooks (MAFWE) on procedures for conversion/use of agricultural land • Rulebook on Good Practices in Agriculture • Rulebook on Cross-Compliance for the Implementation of Specific Minimum Conditions for Good Agricultural Practice			
 Methodology	• Regression model, IPCC methodology			
 Assumptions	• The total area of almost 3000 hectares is intensively cultivated, which leads to a decrease in soil organic matter (SOM), as a result of its intensive decomposition and intensive soil erosion processes. If these areas are converted to meadows and pastures, the estimated increase in organic matter (SOM) will be more than 2%. • The land use change should: • Stop the intensive process of erosion of the upper soil layer, leading to the loss of organic matter in the soil and its intensive mineralization. • Stop the mineralization of organic matter in the soil due to intensive processing processes, • Intensify carbon absorption through the accumulation of organic matter in the soil			
Implementation status	• In the implementation phase			
 Steps taken	• The effects of converting arable land to grassland are being monitored in two experimental fields. • A land parcel identification system has been established, which will serve as a tool for controlling the land use conversion process.			
Planned steps	• Establishing a system for systematic control of land use and land use change at the national level, • Institutional support for primary producers by subsidizing the process of converting fields into grasslands			
 Indicators	Indicator value in the last reporting year		Indicator target value	
	2025		2030	
 Progress	Area converted on an annual basis (ha/year)			
Emission reduction (Gg CO ₂ -eq)			2030	
			3.7	
 Finance	Budget	• \$1.75 million		
	Source of funding	• Private sector, IPARD Programme		
 Implementing entity	• MAFWE			
 Monitoring entity	• MAFWE			

 Contribution to achieving the Sustainable Development Goals	direct	indirect
		

The categories of agricultural land on sloping terrain (5-15% and above 15%), which is cultivated, were calculated based on the total areas using the existing pan-European CORINE land graphical representations and data, and the DTM for the country. Several areas have been identified that will be covered by the mitigation measures.

PAM44 CONTOUR CULTIVATION OF ARABLE AGRICULTURAL LAND ON SLOPING TERRAIN (5-15% SLOPE)

MAIN OBJECTIVE: Reducing topsoil erosion and preserving soil organic matter

DESCRIPTION: Regular tillage in agricultural crop production involves massive disturbance of the topsoil, which causes intensive mineralization of soil organic matter (SOM) and CO₂ emissions. Continuous tillage of arable land on sloping terrain usually causes intensive soil erosion processes. Field experiments have shown that the amount of eroded soil sediment during tillage in the direction of the terrain slope is many times greater than in contour tillage (in the direction of the isohypses) and crop cultivation. This eroded sediment is rich in organic matter (SOM), which is rapidly mineralized under such circumstances, resulting in the release of a significant amount of soil carbon into the atmosphere.

Contour cultivation means that all agrotechnical activities should be transverse to the slope of the terrain, i.e. in the direction of the isohypses. This measure is easy to implement, as it does not require special technical capacities and knowledge. In practice, farmers are usually not aware of its importance and impact on the overall fertility of the soil. With a systematic campaign to increase awareness among farmers, this measure can be widely adopted.

 Time frame	 Type	 Sector	 Gases	 Range
2025 – 2040	Educational, Technical	AFOLU – Plant production	CO ₂	National
 Relevant planning documents, legal and regulatory acts	• Law on Agricultural Land • Law on Soil Protection (and/or draft/active bylaws) • Water Law • Law on Environmental Protection • Rulebooks and technical instructions from the MAFWE (and paying agency/IPARD) • Agro-environment measures / payments (Agro-environment schemes) — financial subsidies for farmers who practice contour tillage. • Rulebook on Good Practices in Agriculture • Rulebook on Cross-Compliance for the Implementation of Specific Minimum Conditions for Good Agricultural Practice			
 Methodology	• Regression model, IPCC methodology			
 Assumptions	• 14,000 hectares (30%) of the total 47,090 hectares of land on sloping terrain (over 5%), which is not covered by hydro-ameliorative irrigation systems, are planned for this measure. • Reducing topsoil erosion processes and loss of soil organic matter (SOM), by contour plowing on sloping arable land, • Increasing soil carbon by preserving soil organic matter (SOM) in the topsoil			
Implementation status	• In the implementation phase			
Steps taken	• Contour cultivation tested in practice at two experimental locations, • Contour cultivation promoted among farmers within the framework of several national and international projects			
 Planned steps	• Inclusion of contour cultivation as an agro-ecological measure in strategic documents, • Promotion of contour cultivation among farmers, • Institutional support for primary producers by subsidizing the process of adopting the contour cultivation system • Technical guidelines and training (MAFWE, advisory services), issuing guidelines on agrotechnics on slopes (how to practice contour plowing, minimum tillage, protection of areas 5–15%) and training programmes			

Indicators		Indicator value in the last reporting year	Indicator target value
		2025	2030
	Progress	Area converted from standard to contour tillage, on an annual basis (ha/year)	
			2030
			28
	Finance	Budget	
		\$1.15 million	
		Source of funding	
		Private sector, IPARD Programme	
	Implementing entity	MAFWE	
	Monitoring entity	MAFWE	
		direct	indirect
	Contribution to achieving the Sustainable Development Goals		

PAM45 CULTIVATION OF ORCHARDS AND VINEYARDS, ON SLOPING TERRAIN (SLOPE OF 5-15%), WITH SOWING OF PERENNIAL HERBACEOUS CROPS OR MIXTURES OF HERBACEOUS CROPS BETWEEN THE ROWS

MAIN OBJECTIVE: Reducing soil erosion and increasing soil organic matter in vineyards and orchards on sloping terrain (5-15% slope)

DESCRIPTION: In vineyards and orchards in locations where rows run along the slope, intensive classical cropping systems cause soil erosion and depletion of its organic matter, which in turn leads to increased carbon emissions from the soil. Changing the cropping system and planting perennial herbaceous species or mixtures of herbaceous crops between the rows can significantly mitigate soil organic matter losses and carbon emissions. This measure can be implemented without major efforts and with low initial costs.

 Time frame	 Type	 Sector	 Gases	 Range
2025 – 2040	Educational, Technical	AFOLU – Plant production	CO ₂	National
 Relevant planning documents, legal and regulatory acts	- Law on Agricultural Land - Agro-environment measures / payments (Agro-environment schemes) — financial subsidies for farmers who practice growing orchards and vineyards on sloping terrain (slope of 5-15%), with sowing of perennial herbaceous crops or mixtures of herbaceous crops between the rows - Rulebook on Good Practices in Agriculture - Rulebook on Cross-Compliance for the Implementation of Specific Minimum Conditions for Good Agricultural Practice			
 Methodology	Regression model, IPCC methodology			
 Assumptions	- Reduction of soil erosion processes in the topsoil layer and loss of soil organic matter (SOM), when the classical cropping system is replaced by sowing perennial herbaceous species or mixtures of herbaceous species between the rows and applying a no-tillage cropping system between the rows. - Increase in soil carbon by accumulation of soil organic matter (SOM), in the topsoil due to mulching of translocated biomass and accumulation of biomaterial in the root zone of perennial herbaceous species.			
Implementation status	In the implementation phase			

Steps taken Planned steps	- This method of cultivation is being tested in practice in two regions, where perennial herbaceous species are grown as cover crops in vineyards and orchards. - The cultivation of perennial herbaceous species in vineyards and orchards, as an agro-ecological measure, is promoted among farmers within the framework of several national and international projects.		
	- To foresee cover crops in perennial plantations (vineyards and orchards) as an agro-ecological measure in strategic documents, - To promote the effects of cover crops among winegrowers and fruit growers, - Institutional support for primary producers by subsidizing the process of implementing the measure, - Incorporation of contour processing as a condition for granting certain subsidies (in the rules of the Paying Agency / MAFWE / IPARD calls)		
Indicators Progress Emission reduction (Gg CO₂-eq)	Indicator value in the last reporting year		Indicator target value
	2025		2030
	Area converted on an annual basis (ha/year)		
			2030
Finance Budget Source of funding	1.2 million dollars		
	Private sector, IPARD Programme		
Implementing entity	MAFWE		
Monitoring entity	MAFWE		
Contribution to achieving the Sustainable Development Goals	direct		indirect
			

PAM46 USING BIOCHAR TO INCREASE THE CARBON SINK IN AGRICULTURAL LAND

MAIN OBJECTIVE: Reducing soil erosion and increasing carbon sinks (absorption and sequestration) and binding of organic matter in the soil.

DESCRIPTION: Agricultural soils in the country are characterized as having relatively low carbon content and average to low fertility. The application of biochar can improve soil water retention capacity, soil nutrient storage and increase yield. Biochar can absorb up to 3 times more CO₂ than its weight, due to its high carbon concentration. Biochar was included for the first time as a promising negative emission technology in a new IPCC special report:

"IPCC Special Report on the Impact of Global Warming of 1.5 °C Above Pre-Industrial Levels and Associated Global Greenhouse Gas Emission Pathways, in Relation to Strengthening the Global Response to the Threat of Climate Change, Sustainable Development and Poverty Eradication Efforts" published in 2018. The process of applying biochar should go through several steps:

i) research, ii) development of appropriate technology for different soil and crop combinations, iii) experimental/demonstration sites, iv) development of a support measure from national agricultural support programmes, v) promotion of the measure. This is a new measure and research is needed.

Time frame	Type	Sector	Gases	Range
2030 – 2040	Research, Educational, Technical	AFOLU – Plant production	CO ₂	National
Relevant planning documents, legal and regulatory acts		The Republic of North Macedonia's ENDC (Enhanced Nationally Determined Contribution) financing strategy document directly mentions a "biochar-related carbon removal measure" as an example of a win-win measure that improves soil and can generate revenue from carbon markets.		

		Ministry of Environment — information pages/materials — official climate change info pages in the RNM mention that the application of biochar can improve the water retention capacity of the soil and improve the structure/properties of the soil.						
	Methodology	Regression model, IPCC methodology						
	Assumptions	- Reducing the amount of 330.3 Gg-eq CO₂-eq and removing that amount from the atmosphere - Increasing soil carbon content by adding biochar as a permanent carbon source. Most of the biochar will remain in the topsoil due to the available application technology incorporating biochar with a plow at plowing depth. - Positive effects on soil fertility and health - Local production of biochar using residual biomass.						
	Implementation status	Idea						
	Steps taken	- Initiatives / partners (e.g. MoU with Carbonaires) There are public announcements (MoU/initiatives) for collaboration with private/international actors for the development of VCM/carbon removal projects — and in those announcements biochar is mentioned as an option/potential. This also indicates interest from the public and private sectors for practical application/financing. - Biochar is included in the Climate Framework Plan (ENDC) and is being considered as a potential measure - meaning there is political/strategic space for funding and pilot projects.						
	Planned steps	- To conduct experimental research and determine optimal biochar application rates for different soil/crop combinations - To envisage the application of biochar on arable land as an agro-ecological measure in strategic documents, - To promote the effects of biochar on soil health, yield and the environment, - Institutional support for primary producers by subsidizing the process of implementing the measure						
	Indicators	<table><tr><th>Indicator value in the last reporting year</th><th>Indicator target value</th></tr><tr><td>2025</td><td>2030</td></tr></table>	Indicator value in the last reporting year	Indicator target value	2025	2030		
Indicator value in the last reporting year	Indicator target value							
2025	2030							
	Progress	<table><tr><td colspan="2">Area (ha) of arable land enriched with biochar. Amount of carbon sinks per hectare and total.</td></tr><tr><td></td><td></td></tr></table>	Area (ha) of arable land enriched with biochar. Amount of carbon sinks per hectare and total.					
Area (ha) of arable land enriched with biochar. Amount of carbon sinks per hectare and total.								
	Emission reduction (Gg CO ₂ -eq)	<table><tr><td></td><td></td><td>2030</td></tr><tr><td></td><td></td><td>110</td></tr></table>			2030			110
		2030						
		110						
	Finance	<table><tr><td>Budget</td><td> 35 million dollars </td></tr><tr><td>Source of funding</td><td> - Private sector, IPARD Programme </td></tr></table>	Budget	35 million dollars	Source of funding	Private sector, IPARD Programme		
Budget	35 million dollars							
Source of funding	Private sector, IPARD Programme							
	Implementing entity	MAFWE						
	Monitoring entity	MAFWE						
	Contribution to achieving the Sustainable Development Goals	<table><tr><td>direct</td><td>indirect</td></tr><tr><td></td><td></td></tr></table>	direct	indirect				
direct	indirect							
								

PAM47 INSTALLATION OF PHOTOVOLTAIC IRRIGATION SYSTEMS

MAIN OBJECTIVE: Mitigation by replacing non-renewable energy sources for pumping water with renewable ones, thus reducing CO₂ emissions.

DESCRIPTION: Installation of a photovoltaic irrigation system with an installed capacity of 2.4 kW, capable of operating with a 3-phase 1.1 kW pump. Both cases are considered as mitigation practices, replacement of the petrol pump with a consumption of 0.3 liters of petrol per hour, with

a 3-phase AC pump and the addition of a photovoltaic one and replacement of the 1.1 kW electric pump with a 3-phase AC pump and the addition of a photovoltaic one. The measure is suitable for already established irrigation systems on the farm, but also for the new establishment of irrigation systems with a water source on the farm. The measure is compatible with the IPARD 3 measure "Production of energy from renewable sources for own consumption, through the processing of plant and animal products from primary and secondary biomass (except biomass from fishery products) for the production of biogas and/or biofuels, use of solar energy, wind turbines, geothermal energy.

 Time frame	 Type	 Sector	 Gases	 Range
2025 – 2040	Research, Educational, Technical	AFOLU – Plant production	CO ₂	National
 Relevant planning documents, legal and regulatory acts	• Law on Agriculture and Rural Development • Energy Law • Regulations / decisions of the Regulatory Commission (ERC) and connection rules (MEPSO/DSO procedures) • Water Law • Law on Nature Protection / Protected Areas • Law on Physical and Urban Planning / Municipal CUP/DUP • National Strategy for Agriculture and Rural Development • IPARD 3			
 Methodology	• Regression model, IPCC methodology			
 Assumptions	• Around 1000 installations per year over a period of 20 years, reaching around 20,000 ha irrigated with photovoltaics as an energy source.			
Implementation status	• In the planning phase			
 Steps taken	• There is a possibility of receiving support from IPARD 3 funds. The measure provides up to 65% co-financing and promotion of photovoltaic irrigation if the framework of this measure is feasible.			
Planned steps	• To promote photovoltaic irrigation as a mitigation measure • The measure should be included in an agro-ecological scheme • To explore opportunities for diversifying farm incomes by distributing excess electricity generated in the grid			
 Indicators	Indicator value in the last reporting year		Indicator target value	
	2025		2030	
 Progress	Increase in the installed power (MW); Area (ha) of arable land on which photovoltaic systems are installed and can be irrigated by obtaining electricity from them			
Emission reduction (Gg CO ₂ -eq)			2030	
			93.3	
 Finance	Budget			
	Source of funding			
 Implementing entity	• MAFWE			
 Monitoring entity	• Ministry of Energy, Mining and Mineral Resources			
	direct		indirect	



Contribution to achieving the Sustainable Development Goals



• **Waste**

PAM48 ESTABLISHMENT OF REGIONAL CENTRES FOR INTEGRATED WASTE MANAGEMENT

MAIN OBJECTIVE: Reducing greenhouse gas emissions and pollutants through the establishment of regional centres for integrated waste management with controlled treatment technologies and safe waste handling.

DESCRIPTION: The measure covers the establishment and commissioning of five regional centres for integrated waste management that will include controlled collection and treatment of landfill gas by flaring, composting of biodegradable waste and modern systems for the treatment of separate waste streams. The implementation of the measure eliminates the practice of open burning of waste, reduces emissions of CH₄ and other pollutants from landfills, and the treatment of medical waste will be carried out through sterilizers instead of incineration, thus ensuring a significant improvement in the protection of the environment and public health.

Time frame	Type	Sector	Gases	Range
2026 – 2040	Technical	Waste – Solid waste disposal	CO ₂ , CH ₄ , N ₂ O	Regional
Relevant planning documents, legal and regulatory acts	- National Waste Management Plan 2021-2031 - National Waste Management Strategy 2024-2036 - Regional waste management plans (Northeast, East, Southeast, Southwest, Pelagonija, Polog, Vardar and Skopje regions) – final and draft version			
Methodology [for estimating emissions]	IPCC methodology			
Assumptions	- Opening of regional waste management centres in the following order: - Skopje – 2027 - East and Northeast – 2028 - Polog – 2029 - Southeast and Vardar – 2030 - Pelagonija and Southwest – 2030 - It is assumed that landfill gas flaring, biodegradable waste composting, and medical waste sterilization will be performed.			
Implementation status [idea, planning phase, in implementation phase]	In the implementation phase			
Steps taken	- Regional waste management plans developed and implemented - EU funds have been provided for the construction of a regional landfill for the Eastern and Northeastern planning regions, the construction of six transfer stations and the closure of all substandard landfills.			
Planned steps	- Obtaining funds for other regions - Construction of regional waste management centres begins			
Indicators	Indicator value in the last reporting year		Indicator target value	
	2022		2030	
	Progress	Amount of compost (kt)	0	
	Emission reduction (Gg CO ₂ -eq)		2030	
			270	
Finance	Budget		60 million euros	
	Source of funding		Local self-government through public utility companies, public-private partnership, EU funds	

 Implementing entity	- Ministry of Environment and Physical Planning - Municipalities / Public utility companies for waste management - Regional waste management companies / Inter-municipal waste management board
 Monitoring entity	- Ministry of Environment and Physical Planning - State Environmental Inspectorate - Authorized environmental inspectors (municipalities)
 Contribution to achieving the Sustainable Development Goals	direct indirect   

PAM49 CLOSURE AND REHABILITATION OF EXISTING SUBSTANDARD LANDFILLS

MAIN OBJECTIVE: Elimination of substandard landfills and reduction of greenhouse gas emissions and local pollution through their closure and rehabilitation

DESCRIPTION: The measure covers the systematic closure, rehabilitation and reclamation of existing substandard landfills and illegal landfills, with the aim of stopping uncontrolled landfilling, open burning of waste and continuous emissions of pollutants and greenhouse gases. The implementation of this measure is inextricably linked to the establishment and commissioning of regional centres for integrated waste management, which provide alternative, safe and environmentally acceptable capacity for waste treatment and disposal. Only with the parallel implementation of both measures, the permanent closure of substandard landfills, reduction of CH₄ emissions, protection of soil and water, as well as improvement of the health and quality of life of the population will be ensured.

 Time frame	 Type	 Sector	 Gases	 Range
2026 – 2040	Technical	Waste – Solid waste disposal	CO ₂ , CH ₄	Regional
 Relevant planning documents, legal and regulatory acts	- National Waste Management Plan 2021-2031 - National Waste Management Strategy 2024-2036 - Regional waste management plans (Northeast, East, Southeast, Southwest, Pelagonija, Polog, Vardar and Skopje regions) – final and draft version			
 Methodology	IPCC methodology			
 Assumptions	- Closure of existing and opening of new landfills by waste management region in the following order: - Skopje – 2027 - East and Northeast – 2028 - Polog – 2029 - Southeast and Vardar – 2030 - Pelagonija and Southwest – 2030			
Implementation status	In the implementation phase			
Steps taken	- A completed project worth approximately €4.56 million has been implemented for the closure and rehabilitation of old illegal landfills and garbage dumps in the eastern and northeastern regions. - Local actions to remove illegal landfills (for example in Skopje, Ohrid). - The Ministry of Environment and Physical Planning and the State Environmental Inspectorate have sent recommendations to municipalities to identify, map and prepare plans for the removal of all illegal landfills, by forming teams for field inspection and geolocation mapping.			
Planned steps	- Preparation and implementation of closure and rehabilitation projects, including waste removal or stabilization, capping, reclamation, and prevention of further pollution in all regions - Establishing a post-closure control and monitoring system, with regular inspections to prevent the reactivation of landfills and the emergence of new illegal landfills. - Harmonizing the dynamics of closing substandard landfills with the commissioning of regional centres for integrated waste management, in order to provide an appropriate alternative for waste disposal and treatment.			

		Strengthening local capacities and public awareness, through clearly defined responsibilities of municipalities, utility companies and inspection services, with parallel application of sanctions and preventive measures.			
Indicators		Indicator value in the last reporting year		Indicator target value	
		2018		2030	
	Progress	Number of closed substandard landfills			
	Emission reduction (Gg CO ₂ -eq)				2030
				Together with PAM 48	
	Finance	Budget		10.5 million euros	
		Source of funding		Local self-government through public utility companies, public-private partnerships, EU funds, international financial institutions	
	Implementing entity		- Ministry of Environment and Physical Planning - Municipalities / Public utility companies for waste management - Regional waste management companies / Inter-municipal waste management board		
	Monitoring entity		- Ministry of Environment and Physical Planning - State Environmental Inspectorate - Authorized environmental inspectors (municipalities)		
Contribution to achieving the Sustainable Development Goals		direct		indirect	
					
					

PAM50WASTE SELECTION AND RECYCLING

MAIN OBJECTIVE: Reducing the quantities of waste going to landfill and greenhouse gas emissions through the introduction and expansion of waste selection systems

DESCRIPTION: The measure covers the establishment and improvement of waste selection systems, including separate collection of paper, plastic, metal, glass and biodegradable waste, with the aim of increasing recycling rates and reducing the organic fraction sent to landfills, which directly contributes to reducing CH₄ emissions from the Waste sector and improving overall waste management. This measure will help achieve the municipal solid waste recycling targets of 45% in 2035 and 65% in 2045, as defined in the National Waste Management Plan 2021-2031, while the measure also takes into account extended producer responsibility schemes, including the targets set in the Law on Packaging and Packaging Waste Management, thus enabling and supporting the achievement of the objectives of the circular economy.

Time frame	Type	Sector	Gases	Range
2026 – 2030	Technical, regulation	Waste – Solid waste disposal	CO ₂ , CH ₄ , N ₂ O	National
Relevant planning documents, legal and regulatory acts	- National Waste Management Plan 2021-2031 - National Waste Management Strategy 2024-2036 - Law on Extended Producer Responsibility (EPR) - Law on Waste Management and bylaws - Law on Packaging and Packaging Waste Management - Regional waste management plans (Northeast, East, Southeast, Southwest, Pelagonija, Polog, Vardar and Skopje regions)			
Methodology [for estimating emissions]	IPCC methodology			
Assumptions	- Gradually, compared to WOM of - Paper recycling to increase by 72% in 2030 - Textile recycling to increase by 42% in 2030			

		- Recycling of plastic and other inert waste to increase by 70% in 2030 - A reduction in the percentage of biodegradable components in generated municipal waste is also assumed, at a rate as defined in Table 8 of the National Waste Management Plan 2021-2031.						
	Implementation status [idea, planning phase, in implementation phase]	In the implementation phase						
	Steps taken	- Strategic and planning documents for waste management have been adopted, including the National Waste Management Plan 2021–2031, with defined goals for increasing selection and recycling rates. - Extended Producer Responsibility (EPR) schemes have been established and are operating, especially for packaging and packaging waste, in accordance with the Law on Packaging and Packaging Waste Management. - In several municipalities, systems for separate collection of selected fractions (paper, plastic, metal and glass) have been introduced, including the installation of containers and selection points.						
	Planned steps	- Expanding waste selection systems and separate collection infrastructure, by increasing population coverage at the national level. - Strengthening and promoting extended producer responsibility schemes and investing in selection and recycling capacities. - Encouraging the reduction of paper use and promoting the digitalization of processes and information through the application of information and communication technologies.						
	Indicators	<table><tr><td>Indicator value in the last reporting year</td><td>Indicator target value</td></tr><tr><td>2022</td><td>2030</td></tr></table>	Indicator value in the last reporting year	Indicator target value	2022	2030		
Indicator value in the last reporting year	Indicator target value							
2022	2030							
	Progress	<table><tr><td>Quantity of selected municipal waste (kt)</td><td></td></tr></table>	Quantity of selected municipal waste (kt)					
Quantity of selected municipal waste (kt)								
	Emission reduction (Gg CO ₂ -eq)	<table><tr><td></td><td></td><td>2030</td></tr><tr><td></td><td></td><td>53.2</td></tr></table>			2030			53.2
		2030						
		53.2						
	Budget	2 million euros						
	Finance	Local self-government through public utility companies, public-private partnership, EU funds						
	Source of funding							
	Implementing entity	- Ministry of Environment and Physical Planning - Public utility companies for waste management - Municipalities - Inter-municipal waste management board						
	Monitoring entity	Ministry of Environment and Physical Planning						
	Contribution to achieving the Sustainable Development Goals	<table><tr><td>direct</td><td>indirect</td></tr><tr><td></td><td></td></tr></table>	direct	indirect	 			
direct	indirect							
 								

PAM51 WASTE GENERATION PREVENTION

MAIN OBJECTIVE: Long-term prevention and reduction of municipal waste generation per inhabitant through changing consumption patterns and systematic introduction of waste prevention measures

DESCRIPTION: The measure includes a package of preventive interventions aimed at reducing waste generation "at source", through changes in consumer habits, replacement of single-use products with reusable alternatives, promotion of reuse and repair, reduction of food waste, eco-design and optimization of packaging, as well as economic and regulatory instruments at local and national level (campaigns, educational programmes). The measure directly contributes to reducing the quantities ending up in landfills and indirectly to reducing CH₄ emissions from landfilling, through a long-term reduction in the total quantities of waste generated.

 Time frame	 Type	 Sector	 Gases	 Range
2026 – 2030	Technical	Waste – Solid waste disposal	CO ₂ , CH ₄ , N ₂ O	National
 Relevant planning documents, legal and regulatory acts	- National Waste Management Plan 2021-2031 - Plan for Waste Generation Prevention 2022-2028 - National Waste Management Strategy 2024-2036 - Law on Waste Management - Law on Extended Producer Responsibility for the Management of Special Waste Streams - Law on Packaging and Packaging Waste Management			
 Methodology [for estimating emissions]	IPCC methodology			
 Assumptions	Gradual reduction of waste generated per inhabitant in the period from 2026 to 2030, reaching in 2030 it to be 10% lower than the projected waste per inhabitant of the EU average in 2030 (520 kg/inhabitant), i.e. reaching 469 kg/ inhabitant in 2030.			
Implementation status [idea, planning phase, in implementation phase]	In the implementation phase			
Steps taken	- Adopted/updated national planning documents that include prevention (Plan for Waste Generation Prevention 2022-2028). - Established legal basis for waste management and extended producer responsibility, as a prerequisite for preventive measures (especially through packaging and separate flows).			
Planned steps	- Introducing/expanding economic instruments for prevention (e.g. differentiated tariffs, reuse subsidies and return/deposit systems where applicable) and incorporating them into local plans. - Monitoring the amount of waste per inhabitant by municipality/region and setting annual targets per region to achieve the target of 469 kg/inhabitant in 2030. - Food waste prevention programmes and reuse/repair measures (reuse centres, "repair" initiatives)			
 Indicators	Indicator value in the last reporting year	Indicative trajectory		Indicator target value
	2022	2030	2040	2030
	Progress	Amount of waste per inhabitant (kg/inhabitant)		
		121	231	319
Emission reduction (Gg CO ₂ -eq)				
Budget	n.a			
 Finance	Source of funding			
	Local self-government through public utility companies, public-private partnership, EU funds			
 Implementing entity	- Ministry of Environment and Physical Planning - Public utility companies for waste management - Municipalities			

	• Inter-municipal waste management board
 Monitoring entity	• Ministry of Environment and Physical Planning
 Contribution to achieving the Sustainable Development Goals	direct
	indirect
	  

PAM52 CONSTRUCTION OF NEW TREATMENT PLANTS

MAIN OBJECTIVE: Reducing greenhouse gas emissions from wastewater treatment through the construction and commissioning of new treatment plants.

DESCRIPTION: The measure covers the construction and commissioning of new wastewater treatment plants with the aim of replacing uncontrolled wastewater discharge with organized and efficient treatment, resulting in a reduction of CH₄ and N₂O emissions from the Waste sector, improvement of water quality and compliance with national and European legislation. Within the framework of this measure, it is assumed that in the next five years a total of 10 new wastewater treatment plants will be built and commissioned, in the following municipalities: Veles, Kavadarci, Shtip, Delchevo, Debar, Vevchani, Bitola, Tetovo, Gostivar and Skopje.

 Time frame	 Type	 Sector	 Gases	 Range
2026 – 2030	Technical	Waste – wastewater	CH ₄	National
 Relevant planning documents, legal and regulatory acts	- National Sludge Management Strategy (2024-2034) - Waste Management Strategy in the Republic of North Macedonia - Law on Waste Management and bylaws - Regional waste management plans (Northeast, East, Southeast, Southwest, Pelagonija, Polog, Vardar and Skopje regions)			
 Methodology [for estimating emissions]	IPCC methodology			
 Assumptions	In the next five years (until 2030), 10 new wastewater treatment plants will be opened, with a capacity of: Veles – 50,000 p.e., Kavadarci – 44,032 p.e., Shtip – 53,000 p.e., Delchevo – 14,985 p.e., Debar – 17,998 p.e., Vevchani – 1,500 p.e., Bitola – 112,474 p.e., Tetovo – 100,000 p.e., Gostivar – 102,658 p.e., Skopje – 625,000 p.e.			
Implementation status [idea, planning phase, in implementation phase]	In the planning phase and implementation phase (Skopje, Bitola)			
 Steps taken	- Skopje: The project for a central wastewater treatment plant is active and in an advanced phase - Bitola: The design and construction of a wastewater treatment plant is an officially launched project with initial activities completed - Other locations: generally pre-project activities and planning have been carried out			
Planned steps	- Skopje: Completion of construction and technical commissioning by 2027, including equipment and testing. - Bitola: Next phases of construction according to the project dynamics (construction and equipment). - Other cities: Completion of project documentation, securing financing, public procurement and commencement of construction in the planned period until 2030.			
Indicators	Indicator value in the last reporting year			
	Indicative trajectory			
	2022	2030	2040	Indicator target value
Progress	Total installed capacity of newly built wastewater treatment plants (p.e.)			
	0	1,121,674	1,121,674	1,121,674
 Emission reduction (Gg CO ₂ -eq)				2030
				25

 Finance	Budget	• Total estimate for all stations 550-600 million EUR. • Skopje alone – 204.8 million EUR
	Source of funding	• Ministry of Environment and Physical Planning, • European Bank for Reconstruction and Development (EBRD), European Investment Bank (EIB), Western Balkans Investment Framework (WBIF) and other funds
 Implementing entity		• Ministry of Environment and Physical Planning • Municipalities / City of Skopje • Public utility companies for water supply and sewage • Ministry of Finance
 Monitoring entity		• Ministry of Environment and Physical Planning
 Contribution to achieving the Sustainable Development Goals	direct	 
	indirect	

PAM53 IMPROVED TREATMENT OF INDUSTRIAL WASTEWATER

MAIN OBJECTIVE: Increasing the treatment rate of industrial wastewater, through sludge reduction

DESCRIPTION: This measure assumes industrial sludge treatment processes, which include mechanisms and processes used to treat waters that are in some way contaminated by anthropogenic industrial or commercial activities before their discharge into the environment or their reuse. This measure, i.e. the treatment of industrial wastewater, is also part of the integrated environmental permits of industrial facilities.

 Time frame	 Type	 Sector	 Gases	 Range	
2026 – 2030	Regulation, Technical	Waste – Industrial wastewater	CH ₄	National	
 Relevant planning documents, legal and regulatory acts	- National Waste Management Plan 2021-2031 - Waste Management Strategy in the Republic of North Macedonia - Law on Waste Management and bylaws - Law on Packaging and Packaging Waste Management - Law on Extended Producer Responsibility for Waste Management - Finance Law and Bylaws - Regional waste management plans (Northeast, East, Southeast, Southwest, Pelagonija, Polog, Vardar and Skopje regions)				
 Methodology [for estimating emissions]	Regression model, IPCC methodology				
 Assumptions	Emissions from industrial wastewater will be reduced by 50% in 2030 compared to emissions from this category in 2030 in the WOM scenario.				
Implementation status [idea, planning phase, in implementation phase]	In the planning phase				
 Steps taken	/				
Planned steps	- Amended and issued environmental permits - Regular annual monitoring of implementation - Regular annual reporting by IPPC operators				
Indicators	Indicator value in the last reporting year		Indicative trajectory		Indicator target value
	2018	2030	2040	2030	
 Progress	Sludge removed in each industrial sector (kg COD/year)	0	51,531,106	141,338,206	385,499,107
 Emission reduction (Gg CO ₂ -eq)				2030	
				62.4	
 Finance	Budget	not available			
	Source of funding	- Ministry of Environment and Physical Planning, - Industrial capacities, EU funds			
 Implementing entity	- Ministry of Environment and Physical Planning - Public municipal waste management enterprises - State Environmental Inspectorate - Inter-municipal waste management board - Authorized environmental inspectors (municipalities)				
 Monitoring entity	Ministry of Environment and Physical Planning				
	direct	indirect			



Contribution to achieving the Sustainable Development Goals



- **Additional measures**

PAM54 INTRODUCTION OF MRVA SYSTEM AND NATIONAL CARBON PRICING MECHANISM

MAIN OBJECTIVE: To establish a functional national carbon pricing mechanism supported by a MRVA system and alignment with the EU ETS by 2030.

DESCRIPTION: The measure envisages the development and phased implementation of a carbon pricing mechanism in the period 2025–2029, in preparation for integration into the EU ETS. It includes the establishment of a MRVA system, a digital registry, an institutional framework and training of all relevant stakeholders.

 Time frame	 Type	 Sector	 Gases	 Range
2025 – 2030	Regulatory, institutional, capacity building	Energy	CO ₂	National level
 Relevant planning documents, legal and regulatory acts	• Energy Development Strategy in the Republic of North Macedonia until 2040 • Energy Law and related legal regulations • Law on Climate Action (not yet adopted) • Bylaws on renewable energy sources • Law on Climate Change • Reform Agenda			
 Methodology [for estimating emissions]	• Bottom-up modelling, economic optimization through the MARKAL model and IPCC methodology			
 Assumptions	• Phased introduction of the CO₂ emissions tax (WAM scenario from NECP 2023) based on projected prices from WEO 2017.			
Implementation status [idea, planning phase, in implementation phase]	• In the implementation phase			
 Steps taken	• Draft version of Law on Climate Change prepared • Preparation of a legal framework • Initial MRVA activities			
Planned steps	• Adoption of the Law on Climate Change • Pilot implementation • Registry development • Trainings			
 Indicators • Number of installations • Number of reports • Reduced emissions	Indicator value in the last reporting year		Target value of the indicator	
	2018		2030	
Progress				
 Emission reduction (Gg CO ₂ -eq)			2030	
			Law adopted and system implemented	
 Finance	Budget	0.5 million euros		
	Source of funding			
 Responsible body for implementation	• Government of the Republic of North Macedonia • Ministry of Environment and Physical Planning • Ministry of Energy, Mining and Mineral Resources • Ministry of Finance			
 Monitoring entity	• Ministry of Environment and Physical Planning			

 Contribution to achieving the Sustainable Development Goals	direct	indirect
		 

PAM55. JUST TRANSITION PROGRAMME

MAIN OBJECTIVE: Development of a programme for a socially responsible and just transition

DESCRIPTION: The measure covers the establishment of institutional structures, the development of regional strategies, the retraining of workers and the development of energy storage capacities. It supports the gradual abandonment of coal and economic transformation.

 Time frame	 Type	 Sector	 Gases	 Range
2025 - 2030	Regulation	Energy	CO ₂ , CH ₄ , N ₂ O	National level
 Relevant planning documents, legal and regulatory acts	• Energy Development Strategy in the Republic of North Macedonia until 2040 • Energy Law and related legal regulations • Bylaws on renewable energy sources • Reports, documents and conclusions from expert bodies that deal with this matter • Just Transition Roadmap			
 Methodology [for estimating emissions]	• To be established			
 Assumptions	• The Bitola thermal power plant should cease operation by the end of 2029.			
Implementation status [idea, planning phase, in implementation phase]	• In the implementation phase			
 Steps taken	• EBRD-financed project for just transition in the Oslomej mine region • NGO projects for just transition in the Oslomej mine region • NGO projects for just transition in the Bitola and Novaci region • 100 MW Photovoltaic (Solar PV) power plant on the land of the Oslomej mine • 20 MW Photovoltaic (Solar PV) power plant on the land of the Oslomej mine • 20 MW Photovoltaic (Solar PV) power plant on land near Bitola			
Planned steps				
Indicators • Number of strategies • Number of trained workers • Financing	Indicator value in the last reporting year		Target value of the indicator	
	2018		2030	
Progress				
 Emission reduction (Gg CO ₂ -eq)			2030	
 Finance	Budget			
	• 8.5 million euros			
	Source of funding			
	• ESM budget, state budget and donations			
 Responsible body for implementation	• Government of the Republic of North Macedonia • Ministry of Energy, Mining and Mineral Resources • Public Enterprise Elektrani na Severna Makedonija (ESM) • Ministry of Labor and Social Policy			
 Monitoring entity	• Ministry of Energy, Mining and Mineral Resources			

Contribution to achieving the Sustainable Development Goals	direct	indirect
		 

PAM56 IDENTIFICATION OF SUITABLE LOCATIONS FOR CONSTRUCTION OF PHOTOVOLTAIC AND WIND POWER PLANTS

MAIN OBJECTIVE: Increasing the share of renewable energy sources in the Electricity sector and in the heating and cooling sectors; reducing energy dependence; improving the security and resilience of the energy system; increasing the grid's ability to integrate RES.

DESCRIPTION: In accordance with Recommendation 2024/1-MC-EnC on accelerating the implementation of renewable energy sources and the application of the "energy efficiency first" principle, this measure provides for the establishment of a legal and institutional framework for the identification and mapping of suitable locations for the development of RES, as well as the provision of the necessary grid and storage infrastructure. In this regard, in 2023, MANU and Eko Svest, with the support of the Natural Conservancy, prepared a study on the utilization of mines and other degraded (brownfield) locations for the construction of solar and wind power plants. The study is the basis for development of a national methodology that will enable the identification of suitable areas without significant impact on the environment and local communities. The methodology will take into account spatial, ecological, technical and economic criteria, as well as the availability of infrastructure and anthropogenic activities. Additionally, renewables acceleration areas will be defined, in accordance with Directive (EU) 2023/2413, applying the "do no harm" principle. In parallel, the measure includes the implementation of pilot projects (photovoltaic, wind, hydro and storage systems), public campaigns and the integration of lessons learned into national plans. Projects such as photovoltaic power plants in Oslomej and Bitola, the Bogdanci wind farm, rehabilitation of hydropower plants and solar central heating in Bitola are already being implemented. Around 26 million euros in investments have been provided for these activities, as well as technical support for the preparation of project documentation.

 Time frame	 Type	 Sector	 Gases	 Range
2025 - 2030	Technical	Energy	CO ₂ , CH ₄ , N ₂ O	National level
 Relevant planning documents, legal and regulatory acts	• Energy Development Strategy in the Republic of North Macedonia until 2040 • Energy Law and related legal regulations • Law on Environmental Protection • Reports, documents and conclusions from expert bodies that deal with this matter • Recommendation 2024/1-MC-EnC			
 Methodology [for estimating emissions]	• GIS and spatial modelling,			
 Assumptions	• The Bitola thermal power plant should cease operation by the end of 2029. • Development and adoption of methodology • Availability of brownfield locations • Financial support • Institutional coordination			
Implementation status [idea, planning phase, in implementation phase]	• In the implementation phase			
 Steps taken	• 100 MW Photovoltaic (Solar PV) power plant on the land of the Oslomej mine • 20 MW Photovoltaic (Solar PV) power plant on the land of the Oslomej mine • 20 MW Photovoltaic (Solar PV) power plant on land near Bitola • A study has been prepared for brownfield locations. • Pilot projects launched (PV, wind, hydro) • Secured investments (~26 million EUR)			
Planned steps	• Adoption of methodology • Law implementation • Defining acceleration areas • Public campaigns • Integration into national plans			
Indicators	Indicator value in the last reporting year	Indicative trajectory		Target value of the indicator
	2018			2030

	Progress	Methodology adopted	Methodology adopted		
		Installed capacity (MW)			
		Emission reduction (Gg CO ₂ -eq)	2030		
	Finance	Budget	30 million euros		
		Source of funding	State budget, EBRD, KfW, EIB		
	Responsible body for implementation		- Government of the Republic of North Macedonia - Ministry of Energy, Mining and Mineral Resources - Public Enterprise Elektrani na Republika Severna Makedonija (ESM) - Ministry of Labor and Social Policy - Donors		
	Monitoring entity		Ministry of Energy, Mining and Mineral Resources		
	Contribution to achieving the Sustainable Development Goals		direct	indirect	
					

PAM 57SMART COMMUNITIES

MAIN OBJECTIVE: Increasing the share of renewable sources in the Electricity sector; transition to less carbon-intensive fuels; increasing consumer participation in energy markets; improving security of supply.

DESCRIPTION: Macedonia has significant potential for development of small-scale photovoltaic systems, especially on rooftops and degraded areas. One of the key mechanisms for increasing these capacities is the development of energy communities (civic and renewable energy communities), which enable joint investment, production and use of energy. In 2023, the Law on Cooperatives was adopted, which allows for the establishment of cooperatives in the Energy sector, while energy legislation applies to aspects that are not regulated. The measure aims to create favourable conditions for the development of energy communities by removing administrative and regulatory barriers, as well as by raising public awareness. Additionally, the measure is complementary to the simplification of permit procedures (one-stop-shop), the introduction of long-term renewable energy contracts (PPAs), as well as energy efficiency measures (especially in residential buildings). It also contributes to reducing import dependence, increasing domestic production and developing the internal energy market.

	Time frame		Type		Sector		Gases		Range
	2025 - 2030		Educational and technical		Education and energy		CO ₂ , CH ₄ , N ₂ O		National level
	Relevant planning documents, legal and regulatory acts		- Energy Development Strategy until 2040 - Energy Law - Law on Renewable Energy Sources (in preparation) - Bylaws on RES - Law on Cooperatives						
	Methodology [for estimating emissions]		Not yet defined						
	Assumptions		- Adoption and implementation of the legal framework - Financial support (grants, loans) - Increased public awareness - Interest from citizens and local communities						
	Implementation status [idea, planning phase, in implementation phase]		In the planning phase						
	Steps taken		- Law on Cooperatives adopted - Legal basis for energy communities established						

Planned steps		• Finalizing the legal framework for RES • Pilot projects • Awareness campaigns • Establishing financial mechanisms • Trainings	
Indicators	Number of energy cooperatives	Indicator value in the last reporting year	Target value of the indicator
		2018	2030
Progress			
	Emission reduction (Gg CO ₂ -eq)		2030
	Budget	• Depending on the type of smart community	
	Source of funding	• Donations • Horizon 2020 Programme and other programmes to support scientific research	
	Responsible body for implementation	• Universities (or secondary schools) • Non-governmental organisations	
	Monitoring entity	• Ministry of Education and Science • Ministry of Energy, Mining and Mineral Resources	
Contribution to achieving the Sustainable Development Goals		direct	indirect
			 

PAM58 CONSTRUCTION OF A 400 kV CROSS-BORDER TRANSMISSION LINE BETWEEN THE REPUBLIC OF NORTH MACEDONIA AND THE REPUBLIC OF ALBANIA

MAIN OBJECTIVE: Strengthening the electricity transmission network for the integration of renewable sources and increasing cross-border connectivity.

DESCRIPTION: The measure covers the construction and modernization of the transmission network in North Macedonia, including new interconnections (in particular with Albania and Greece), reconstruction of the 110 kV network and introduction of new system management technologies. The objective is to enable secure integration of renewable energy sources, improve system stability and increase regional connectivity. Activities include the construction of new transmission lines and substations, digitalization of the network, introduction of dynamic load management (DLR) systems, as well as improvement of reactive power through shunt reactors.

 Time frame	 Type	 Sector	 Gases	 Range
2020 - 2028	Technical	Energy	CO ₂ , CH ₄ , N ₂ O	National level
 Relevant planning documents, legal and regulatory acts	• List of projects of interest to the European Energy Community (PECI list) • Plan for the Development of the Electricity Transmission System in the Republic of North Macedonia for 2025 – 2035, MEPSO • Energy Development Strategy in the Republic of North Macedonia until 2040			
 Methodology [for estimating emissions]	• Calculation of the degree of cross-border connectivity using the MARKAL software, additionally analysing the results of the Energy Development Strategy until 2040, and estimates and projections made by ENTSO-E.			
 Assumptions	• The degree of cross-border connectivity will increase by 7%. • Increased participation of RES • Need for new interconnections • Financial support from the EU and banks			

		• Demand growth				
Implementation status [idea, planning phase, in implementation phase]		• In the implementation phase				
	Steps taken	• Construction contract signed • Interconnection projects with Albania launched • Modernization of the 110 kV network				
	Planned steps	• Construction of new 400 kV transmission lines • Reconstruction of the existing network • Digitization and AMS system • Integration with the regional market				
Indicators	Length of new transmission lines (km)	Indicator value in the last reporting year		Indicative trajectory		Target value of the indicator
	New interconnections					
	Network capacity (MW)	2018	2030	2040	2030	
Progress						
	Emission reduction (Gg CO ₂ -eq)					2030
	Budget	• 100 million euros				
	Finance	• EBRD (17.2 million euros) • Western Balkans Investment Fund (16.9 million euros), EBRD, EIB, MEPSO				
	Responsible body for implementation	• MEPSO • Ministry of Energy, Mining and Mineral Resources				
	Monitoring entity	• Ministry of Energy, Mining and Mineral Resources				
	Contribution to achieving the Sustainable Development Goals	direct		indirect		
		7 7 AFFORDABLE AND CLEAN ENERGY	13 13 CLIMATE ACTION	12 12 RESPONSIBLE CONSUMPTION AND PRODUCTION		

PAM59 DEVELOPMENT OF CROSS-BORDER NATURAL GAS TRANSMISSION INFRASTRUCTURE

MAIN OBJECTIVE: Diversification of natural gas supply, increasing market competitiveness and reducing energy prices.

DESCRIPTION: On 10.07.2015, the Republic of North Macedonia became a signatory to the Memorandum of Understanding on a Common Approach to Addressing Natural Gas Diversification and Security of Supply Challenges, within the framework of the Central and South-Eastern Europe Gas Connectivity Initiative (CESEC). ESM AD Skopje has started implementing the obligations arising from this initiative, which are aimed at promoting the diversification of natural gas supply and ensuring security of supply in the region. This should happen through the improvement of regional infrastructure and integration of natural gas markets through the joint engagement of all EU Member States and Energy Community Contracting Parties. This initiative should ensure the supply of the necessary quantities of natural gas to all consumers in the Central and South-Eastern Europe region, including the Republic of North Macedonia. In addition, there is an initiative to build a gas pipeline with the Republic of Serbia. The gas pipeline to Serbia could provide an additional - alternative source and transit opportunity. Both initiatives can increase the system utilization rate, which has the potential to reduce tariffs and aid gasification efforts in the Republic of North Macedonia.

Time frame	Type	Sector	Gases	Range
2020 - 2025	Technical, regulatory	Energy	CO ₂ , CH ₄ , N ₂ O	National level
Relevant planning documents, legal and regulatory acts	- List of Projects of Common Interest (PECI) - List of projects of interest to the Energy Community - Energy Development Strategy in the Republic of North Macedonia until 2040			

	Methodology [for estimating emissions]	Energy modelling (MARKAL/TIMES), scenario analysis, IPCC methodology (indirect effects through fuel substitution).		
	Assumptions	- Availability of financial resources - Regional cooperation - Increased demand for gas - Integration into the European market		
Implementation status [idea, planning phase, in implementation phase]		In the implementation phase		
	Steps taken	- Construction of interconnector with Greece begins - Preparation of studies for other interconnectors		
	Planned steps	- Completion of interconnectors - Integration into the regional market - Development of additional infrastructure		
Indicators	Gas pipeline length (km)	Indicator value in the last reporting year		Target value of the indicator
	Interconnection capacity	2018		2030
	Progress			Interconnector with Greece built
	Emission reduction (Gg CO ₂ -eq)	2030	2040	2030
	Budget	€161.7 million		
	Source of funding	Grants and state budget, EBRD, EIB, WBIF		
	Responsible body for implementation	NOMAGAS AD Skopje		
	Monitoring entity	Ministry of Energy, Mining and Mineral Resources		
	Contribution to achieving the Sustainable Development Goals	direct	indirect	
				

PAM60 DEVELOPMENT OF A GAS PIPELINE NETWORK

MAIN OBJECTIVE: Improving the natural gas transmission infrastructure in the Republic of North Macedonia

DESCRIPTION: North Macedonia has an ambitious gasification plan, a detailed list of planned infrastructure projects, with their implementation timeframes. The increased level of access to the natural gas transmission network is particularly targeted at industrial consumers (who are, in fact, the most affected by the measures in the green scenario). This is particularly important because natural gas as a fuel is particularly significant for the implementation of measures aimed at decarbonizing the Industry sector. In addition, with the implementation of this measure, air quality will significantly improve.

 Time frame	 Type	 Sector	 Gases	 Range
2020 - 2030	Technical	Energy	CO ₂ , CH ₄ , N ₂ O	National level
 Relevant planning documents, legal and regulatory acts	Gasification Plan for Macedonia			
 Methodology [for estimating emissions]	Economic optimization and bottom-up approach in modelling with the MARKAL model.			
 Assumptions				
Implementation status [idea, planning phase, in implementation phase]	In the implementation phase			
Steps taken	- Klechovce - station 5 (Shtip), completed in 2016 - Station 6 (Shtip) - Negotino, completed in 2019 - Negotino-Prilep-Bitola, completed in 2023 - Skopje-Tetovo-Gostivar, completed in 2024			
Planned steps	- Gostivar-TPP Oslomej-Kichevo (project documentation) - Kichevo-Ohrid (tender documentation) - Ohrid – Bitola (tender documentation) - Station 5 (Shtip)-Radovish-Strumica - Sveti Nikole – Veles (project documentation) - Interconnector line Greece – Macedonia (Negotino) - station 5 (Shtip) – Radovish – Strumica with a length of 60 km			
Indicators	Indicator value in the last reporting year	Indicative trajectory		Target value of the indicator
	2018	2030	2040	2030
Progress				
 Emission reduction (Gg CO ₂ -eq)	2030	2040	2030	
 Finance	Budget	200 million euros		
	Source of funding	State budget		
 Responsible body for implementation	NOMAGAS AD Skopje			
 Monitoring entity	Ministry of Energy, Mining and Mineral Resources			
 Contribution to achieving the Sustainable Development Goals	direct	indirect		
				

PAM61 DEVELOPMENT AND CONSTRUCTION OF A NATURAL GAS DISTRIBUTION NETWORK

MAIN OBJECTIVE: Diversification of energy resources in Macedonia

DESCRIPTION: North Macedonia has an ambitious gasification plan, and natural gas is one of the resources that can significantly contribute to the realization of the goals of achieving the energy transition by 2040. At the same time, with the implementation of this measure, the air quality on the territory of the country will significantly improve.

 Time frame	 Type	 Sector	 Gases	 Range
2020 - 2030	Technical	Energy	CO ₂ , CH ₄ , N ₂ O	National level
 Relevant planning documents, legal and regulatory acts	- Gasification Plan for Macedonia - Revised feasibility study for gasification (revision carried out in 2020)			
 Methodology [for estimating emissions]	Economic optimization and bottom-up approach in modelling with the MARKAL model.			
 Assumptions	Development of a cost-benefit analysis – for every city in the country			
Implementation status [idea, planning phase, in implementation phase]	In the implementation phase			
 Steps taken	- Public tender announced - EBRD support for procurement and installation of household equipment (worth 50 million euros) - Tender for technical and legal assistance for the preparation and implementation of a public procurement procedure - published by the EBRD in June 2020			
Planned steps				
Indicators	Indicator value in the last reporting year	Indicative trajectory		Target value of the indicator
	2018	2030	2040	2030
Progress				
 Emission reduction (Gg CO ₂ -eq)	2030	2040	2030	
 Finance	200 million euros			
Budget				
Source of funding	State budget, grants, local self-government budget			
 Responsible body for implementation	- Ministry of Energy, Mining and Mineral Resources - NOMAGAS AD Skopje - Local self-governments			
 Monitoring entity	Ministry of Energy, Mining and Mineral Resources			
 Contribution to achieving the Sustainable Development Goals	direct	indirect		
				

PAM62 REGIONAL INTEGRATION OF ELECTRICITY MARKETS

MAIN OBJECTIVE: Increasing the competitiveness of electricity markets

DESCRIPTION: The interconnection and integration of the wholesale (day-ahead) electricity market within the Energy Community, and the development of a free electricity market, have an important role for the Macedonian Energy sector. The development of domestic energy capacities is planned in the context of an integrated regional and European electricity market. The integration will enable all market participants

to access the single European market through implicit allocation of transmission capacities, thereby increasing competition, liquidity and market efficiency. This will lead to better allocation of resources, cost reduction and increased security of supply. Within the framework of the measure, a day-ahead market has already been established (from 2023), and the next step is joining the European SDAC and SIDC mechanism through market coupling with neighbouring countries (Greece, Albania and Kosovo). This process requires the definition of a Capacity Calculation Region (CCR), coordination with TSOs and NEMOs, as well as approval by ACER.

 Time frame	 Type	 Sector	 Gases	 Range
2025 - 2030	Regulatory	Energy	CO ₂ , CH ₄ , N ₂ O	National level
 Relevant planning documents, legal and regulatory acts	• Energy Law and relevant bylaws • Market Integration Plan (TSO and NEMO) • Energy Community Regulations			
 Methodology [for estimating emissions]	• Market modelling, scenario analysis, MARKAL/TIMES models (indirect effects through production optimization).			
 Assumptions	• Harmonization with EU regulations • Coordination with regional operators • Market participants' readiness • IT systems development			
Implementation status [idea, planning phase, in implementation phase]	• In the implementation phase			
 Steps taken	• Compliance with EU regulations • Coordination with regional operators • Market participants' readiness • IT systems development			
Planned steps	• Complete package transposition • Joining SDAC and SIDC • Defining CCR • Market coupling with the EU			
Indicators	Indicator value in the last reporting year		Target value of the indicator	
	2018		2030	
Progress			Market realized coupling	
 Emission reduction (Gg CO ₂ -eq)			2030	
 Finance	Budget		€15 million	
	Source of funding		• National Electricity Market Operator (NEMO), EU funds	
 Responsible body for implementation	• National Electricity Market Operator (NEMO)			
 Monitoring entity	• Energy Regulatory Commission			
 Contribution to achieving the Sustainable Development Goals	direct		indirect	
			 	

PAM63 VARIABLE ELECTRICITY DEMAND DEPENDING ON THE PRICE OF ELECTRICITY

MAIN OBJECTIVE: Introducing price signals for users that will stimulate electricity consumption during periods when the price of electricity is lower.

DESCRIPTION: The measure envisages the introduction of price signals in the Electricity sector in order to enable an active role for consumers in demand management (demand response – DR). This approach allows consumers to adjust their consumption depending on electricity prices, i.e. to reduce consumption during periods of high prices and increase it when prices are lower. The introduction of DR will contribute to better balancing of the system, increasing energy efficiency and reducing the need for additional production capacities. The measure includes the development of dynamic tariff models (time-of-use, real-time pricing), the implementation of smart meters, the creation of financial incentives for consumers and the development of digital platforms for automated consumption management. The Energy Regulatory Commission will play a key role in the implementation, providing an appropriate regulatory framework, while operators and suppliers will be responsible for technical implementation. This measure is expected to improve system stability, reduce costs and facilitate the integration of renewable energy sources.

 Time frame	 Type	 Sector	 Gases	 Range
2025 - 2030	Regulatory	Energy	CO ₂ , CH ₄ , N ₂ O	National level
 Relevant planning documents, legal and regulatory acts	• Energy Law and relevant bylaws • MEPSO study on automated variable electricity consumption depending on the price of electricity.			
 Methodology [for estimating emissions]				
 Assumptions	This will reduce the number of hours during the year when electricity consumption is highest and will allow for a better distribution of electricity consumption. • Introduction of dynamic tariffs • Installation of smart meters • Active consumer participation • Development of digital platforms			
Implementation status [idea, planning phase, in implementation phase]	• In the implementation phase			
 Steps taken	• Prepared analyses for DR • Regulatory activities underway			
Planned steps	• Introduction of time-of-use tariffs • Installation of smart meters • Introduction of financial incentives • Development of DR platforms			
Indicators	Indicator value in the last reporting year			Target value of the indicator
	2018			2030
Progress				Number of suppliers with price signals
Emission reduction (Gg CO ₂ -eq)				Participants in DR programmes
	2030	2040	2030	
Budget	n.a			
 Finance				
	Source of funding			
 Responsible body for implementation	• Distribution operator • Electricity suppliers			
	• Participants in the electricity market • Ministry of Energy, Mining and Mineral Resources			
 Monitoring entity	• Energy Regulatory Commission			
	direct	indirect		



Contribution to achieving the Sustainable Development Goals



PAM64 REDUCING ENERGY POVERTY AND PROTECTING VULNERABLE CONSUMERS

MAIN OBJECTIVE: Protection of vulnerable consumers and reduction of energy poverty in conditions of market liberalization.

DESCRIPTION: The measure aims to ensure fair energy access for all citizens, especially vulnerable categories, in conditions of gradual liberalization of the energy market and expected price increases. In accordance with the Energy Law, a methodology for measuring energy poverty has been developed, according to which a significant proportion of households are exposed to risk. The measure envisages a combination of financial and structural measures, including subsidies, social tariffs and energy efficiency programmes, to reduce energy costs for vulnerable households. In addition, programmes for home renovation, replacement of inefficient appliances and introduction of renewable energy sources at the household level will be developed. The measure envisages the establishment of a national registry for energy poverty, the definition of targets for its reduction and the introduction of mechanisms for protection against price shocks. At the same time, coordination between institutions and integration with existing social programmes will be ensured. The measure also envisages the development of one-stop-shop centres and engagement of local energy advisors to support citizens.

Time frame	Type	Sector	Gases	Range
2025 - 2030	Regulatory	Energy	CO ₂ , CH ₄ , N ₂ O	National level
Relevant planning documents, legal and regulatory acts	• Energy Law and relevant bylaws • Special acts and rules for electricity, natural gas and electricity supply • Programme for Protection of Vulnerable Categories of Citizens			
Methodology [for estimating emissions]				
Assumptions	• Availability of financial support • Coordination between institutions • Implementation of energy efficiency measures • Active participation of households			
Implementation status [idea, planning phase, in implementation phase]				
Steps taken	• Developed methodology for energy poverty • Energy Law adopted			
Planned steps	• Defining goals and indicators • Establishing a registry • Introduction of social tariffs and subsidies • Energy efficiency programmes • Development of one-stop-shop centres			
Indicators	Indicator value in the last reporting year		Target value of the indicator	
	2018		2030	
Progress			Developed methodology	
			Annual programme adopted	
Emission reduction (Gg CO ₂ -eq)			2030	
Finance	Budget			
	Source of funding			
Responsible body for implementation				

- Energy Law and relevant bylaws
- Special acts and rules for electricity, natural gas and electricity supply
- Programme for Protection of Vulnerable Categories of Citizens

- Availability of financial support
- Coordination between institutions
- Implementation of energy efficiency measures
- Active participation of households

- Developed methodology for energy poverty
- Energy Law adopted

- Defining goals and indicators
- Establishing a registry
- Introduction of social tariffs and subsidies
- Energy efficiency programmes
- Development of one-stop-shop centres

Indicator value in the last reporting year	Target value of the indicator
2018	2030

Developed methodology
Annual programme adopted

2030

- A different budget every year
- State budget and potential donors

- Ministry of Energy, Mining and Mineral Resources
- Suppliers of electricity, natural gas and heat

 Monitoring entity	Energy Regulatory Commission	
 Contribution to achieving the Sustainable Development Goals	direct	indirect
		 

PAM65 DEVELOPMENT OF TECHNOLOGIES AND RESEARCH CAPACITIES FOR ENERGY TRANSITION

MAIN OBJECTIVE: Accelerate the research, development and application of advanced technologies to support the energy transition and decarbonisation of the economy.

DESCRIPTION: The measure aims to systematically strengthen the national research and innovation ecosystem in order to support the energy transition, through the development and application of innovative technologies in energy. In this context, it is envisaged to deepen cooperation between the academia, research institutions, industry and policymakers, in order to create an integrated approach to the development of new technological solutions. Special focus is placed on identifying and supporting priority areas such as renewable energy sources, energy storage, hydrogen technologies, digitalization of energy systems and energy efficiency. The measure envisages the development of funding programmes for research and innovation projects, as well as support for technology transfer and their commercialization. Additionally, mechanisms will be established to better connect the education system with the needs of the labour market, through the development of new curricula, training and specialized skills in the field of clean energy. This will enable the creation of a qualified workforce that can actively participate in the energy transition process. The measure also envisages active involvement in European and international research and innovation programmes (such as Horizon Europe), with the aim of attracting additional funding and integration into European innovation networks.

 Time frame	 Type	 Sector	 Gases	 Range
2025 - 2030	Research	Energy, Education and Economy	CO ₂ , CH ₄ , N ₂ O	National level
 Relevant planning documents, legal and regulatory acts	• Innovation Strategy for the Period 2012 - 2020 • Innovation Law • Annual programmes of the Fund for Innovations and Technological Development			
 Methodology [for estimating emissions]	• Scenario analysis, technological modelling (MARKAL/TIMES), indicator approach for R&D and IPCC methodology (indirect effects).			
 Assumptions	• Increased funding for research and development • Collaboration between academia and industry • Access to European funds • Human capital development			
Implementation status [idea, planning phase, in implementation phase]				
 Steps taken	• Establishment of INOVA – Agency for Innovation Activity, Scientific and Technological Development and Entrepreneurship			
 Planned steps	• Development of new programmes for clean technologies • Strengthening technology transfer • Inclusion in Horizon Europe and other programmes • Development of educational and training programmes			
Indicators	Indicator value in the last reporting year			Target value of the indicator
	2018			2030
Progress				
 Number of innovations			2030	
Number of researchers				
Finance Budget	on			

 Source of funding	• Innovation and Technological Development Fund • Horizon Europe • Chamber of Commerce of the Republic of North Macedonia
 Responsible body for implementation	• Ministry of Education and Science • Fund for Innovation and Technological Development • Chamber of Commerce of the Republic of North Macedonia
 Monitoring entity	• Ministry of Education and Science
 Contribution to achieving the Sustainable Development Goals	direct indirect   

PAM66 "GREEN" EDUCATION AND TRAINING FOR ENERGY EFFICIENCY AND TRANSITION

MAIN OBJECTIVE: Integration of energy efficiency, renewable energy and energy transition topics into the education system and development of a qualified workforce for a green economy.

DESCRIPTION: The measure aims to transform the education system by integrating content related to the energy transition into all levels of education, from primary to higher education. This includes revising and modernizing curricula to include topics such as renewable energy sources, energy efficiency, climate change and sustainable development. Special emphasis is placed on developing practical skills and competencies through vocational training, laboratory work and cooperation with industry. The measure also envisages strengthening the link between education, research and the labour market, in order to provide a workforce that meets the needs of the energy transition. Additionally, participation in European research and education programmes (e.g. Horizon Europe, Erasmus+) will be encouraged, which will enable access to knowledge, finance and international partnerships. An important segment of the measure is also the support of scientific research work in the field of energy and sustainable development.

 Time frame	 Type	 Sector	 Gases	 Range
2025 - 2030	Research	Energy, Education and Economy	CO ₂ , CH ₄ , N ₂ O	National level
 Relevant planning documents, legal and regulatory acts	• Law on Primary Education • Law on Secondary Education • Law on Higher Education			
 Methodology [for estimating emissions]	• Indirect assessment through indicators of education, skills and technology implementation			
 Assumptions	• Support from educational institutions • Availability of financial resources • Cooperation with the private sector • Harmonization with EU education policies			
Implementation status [idea, planning phase, in implementation phase]				
 Steps taken	• Partially included sustainable development topics in curricula • Participation in European educational programmes			
Planned steps	• Curriculum revision • Introducing new green curricula • Development of training programmes and certifications • Strengthening research capacities			
Indicators	Indicator value in the last reporting year		Target value of the indicator	
	2018		2030	
 Progress				

Number of trained staff				2030
Participation in R&D projects				
 Finance	Budget	n.a		
	Source of funding	• State budget, donations, European funds		
 Responsible body for implementation	• Universities, secondary and primary schools			
 Monitoring entity	• Ministry of Education and Science			
 Contribution to achieving the Sustainable Development Goals	direct	indirect		
				

PAM67CROSS-SECTORAL AND GEOGRAPHICAL MOBILITY OF RESEARCHERS

MAIN OBJECTIVE: To encourage cross-sectoral and geographical mobility of researchers

DESCRIPTION: The transfer of knowledge and experience between researchers from industry and academia is extremely important for building sustainable domestic human resources capacities. Cross-border mobility and exchange of personnel between countries are also of particular importance for this. An example of a concrete measure could be – doctoral students at universities could be supported and stimulated to do their doctoral research within private companies that will cooperate with their home universities.

 Time frame	 Type	 Sector	 Gases	 Range
2025 - 2030	Research, regulation	Energy, Education and Economy	CO ₂ , CH ₄ , N ₂ O	National level
 Relevant planning documents, legal and regulatory acts	• Law on Primary Education • Law on Secondary Education • Law on Higher Education			
 Methodology [for estimating emissions]				
 Assumptions				
 Implementation status [idea, planning phase, in implementation phase]	• The Faculty of Electrical Engineering and Information Technologies, at the University of Saints Cyril and Methodius in Skopje, has established a body (INNOFEIT) within which experiences, information, cooperation and the transfer of technologies and innovations can be exchanged between the academic community, industry and students. The main goal of INNOFEIT is to improve, strengthen and stimulate the transfer of knowledge.			
	Steps taken			
	Planned steps			
Indicators	Indicator value in the last reporting year		Target value of the indicator	
	2018		2030	
Progress				
 Emission reduction (Gg CO ₂ -eq)			2030	
Finance	Budget			

 Source of funding	• Industry • Donations • State budget
 Responsible body for implementation	• Universities and industry
 Monitoring entity	• Ministry of Education and Science • Ministry of Energy, Mining and Mineral Resources
 Contribution to achieving the Sustainable Development Goals	direct indirect   

PAM68 ALIGNING THE S3 AND SME STRATEGY WITH THE PRIORITIES OF THE ENERGY UNION

MAIN OBJECTIVE: Integrate the Energy Union priorities into the Smart Specialization Strategy (S3) and the Small and Medium-sized Enterprises (SME) Strategy.

DESCRIPTION: The measure aims to ensure the systematic inclusion of the Energy Union priorities in the national strategies for smart specialization (S3) and the development of small and medium-sized enterprises. Although priority areas and objectives are defined in the existing strategies, clean energy technologies are not explicitly covered, which makes it difficult to monitor and support them within the existing monitoring system. In this regard, national targets for financing and developing clean energy technologies will be defined, as well as indicators for monitoring research, innovation and competitiveness. This will enable better targeting of research and development funds, monitoring of scientific production and industrial participation, as well as improving the country's position in terms of technological development. To implement the measure, a working group with representatives from relevant institutions will be established, which will coordinate the harmonization of strategies. An analysis of the current state of clean energy technologies, their market potential and export opportunities will be conducted. Based on this, specific sub-goals will be defined, such as investments in research and development, number of scientific publications, patents and mobility of researchers. The results of this measure will be used to update national strategies and to better integrate energy priorities into economic and innovation development.

 Time frame	 Type	 Sector	 Gases	 Range
2025 - 2030	Research, technical and volunteer	Energy, Economics	CO ₂ , CH ₄ , N ₂ O	National level
 Relevant planning documents, legal and regulatory acts	• Smart Specialization Strategy (S3) 2024–2027			
 Methodology [for estimating emissions]	• Policy analysis, indicator approach, monitoring of R&D and innovation performance.			
 Assumptions	• Institutional coordination • Availability of R&D data • Support from the scientific and business community • Financial support for innovations			
Implementation status [idea, planning phase, in implementation phase]				
 Steps taken	• Defined priorities in the S3 strategy			
 Planned steps	• Formation of a working group • Analysis of technologies • Defining indicators and goals • Updating strategies			
Indicators	Indicator value in the last reporting year		Target value of the indicator	
	2018		2030	
 Progress				

Number of patents/number of publications			2030
Budget			
 Finance Source of funding	- Grants - Donations - Private investments		
 Responsible body for implementation	- Small and medium-sized enterprises - Ministry of Education and Science		
 Monitoring entity	Ministry of Energy, Mining and Mineral Resources		
 Contribution to achieving the Sustainable Development Goals	direct	indirect	
			

PAM69 DEVELOPMENT OF CAPACITIES FOR PRODUCTION, TRANSPORT, STORAGE AND USE OF HYDROGEN

MAIN OBJECTIVE: Enabling the use of hydrogen as an energy carrier in the energy system.

DESCRIPTION: The measure aims to establish prerequisites for the development of the hydrogen economy in Macedonia through the development of an appropriate legal framework, institutional capacities and technical standards. The introduction of hydrogen as an energy carrier will contribute to the decarbonisation of the industry and the energy sector, as well as to increasing the flexibility of the system. The measure envisages activities to strengthen institutional capacities (Ministry of Energy, Regulatory Commission, NOMAGAS), as well as the implementation of pilot projects for the production, storage and use of hydrogen. These pilot activities will provide practical experiences for the definition of technical standards and licensing procedures. In addition, technical guidelines and specifications for hydrogen infrastructure will be developed, and the gas network will be prepared for the gradual integration of hydrogen. The measure is linked to the development of green hydrogen for industrial applications and to research and innovation strategies. It also builds on regional initiatives and studies financed by international funds.

 Time frame	 Type	 Sector	 Gases	 Range
2025 - 2030	Research, regulatory	Energy, Economics	CO ₂ , CH ₄ , N ₂ O	National level
 Relevant planning documents, legal and regulatory acts	Fourth National Climate Change Plan			
 Methodology [for estimating emissions]	- Policy analysis, indicator approach, monitoring of R&D and innovation performance. - Scenario analysis, MARKAL/TIMES models, IPCC methodology (indirect effects through fossil fuel substitution).			
 Assumptions	- Development of a regulatory framework - Availability of technologies - Financial support - Regional cooperation			
Implementation status [idea, planning phase, in implementation phase]				
 Steps taken	Initial analyses and studies prepared			
 Planned steps	- Adoption of a hydrogen strategy - Development of a regulatory framework - Implementing pilot projects - Development of technical standards - Training and capacity building			
Indicators	Indicator value in the last reporting year		Target value of the indicator	
	2018		2030	

Progress				
	Number of pilot projects			2030
	Adopted strategy			
Budget		n.a		
	Finance	• Grants • Donations • Private investments		
	Source of funding			
	Responsible body for implementation	• Ministry of Energy, Mining and Mineral Resources • NOMAGAS		
	Monitoring entity	• Ministry of Energy, Mining and Mineral Resources		
 Contribution to achieving the Sustainable Development Goals		direct	indirect	
				