



Republic of North Macedonia

**MINISTRY OF
ENVIRONMENT AND
PHYSICAL PLANNING**

CLIMATE CHANGE MITIGATION



**Projections of greenhouse gas emissions
and effects of policies and measures**

First Biennial Transparency Report



ENERGY



**INDUSTRIAL PROCESSES
AND PRODUCT USE**



AGRICULTURE



**FORESTRY AND
OTHER LAND USE**



WASTE



Skopje, 2026



This document was prepared within the framework of the project "Development of North Macedonia's First Biennial Transparency Report and the combined Second Biennial Transparency Report and Fifth National Communication on Climate Change under the UNFCCC (BTR1 and BTR2/NC5)". The document was prepared with financial support from the Global Environment Facility (GEF) and implemented by the United Nations Development Programme (UNDP).

UNFCCC National Focal Point
Teodora Obradović Grnčarovska, Ph.D

Project Manager
Jozhe Jovanovski, M.Sc., B.Sc. Eng. for environmental protection

Chief Technical Adviser
Prof. Konstantin Dimitrov, Ph.D

REPORT PREPARATION TEAM

Macedonian Academy of Sciences and Arts (MANU)
Acad. Ljupcho Kocarev
Aleksandar Dedinec, Ph.D, Senior Research Associate
Verica Taseska-Gjorgievska, Ph.D Senior Research Associate
Prof. Aleksandra Dedinec, Ph.D
Jana Prodanova, Ph.D
Tatjana Dzambazovska, M.Sc
Emilija Mihajloska Ivanoski, M.Sc
Viktor Andonov, M.Sc
Darko Janevski, LL.B
Dejan Dimitriev, B.Sc. El .Eng.
Onur Amet, B.Sc. Mash. Eng.

“Goce Delchev” University – Faculty of Natural and Technical Sciences
Prof. Dejan Mirakovski, Ph.D
Prof. Afrodita Zendelska, Ph.D
Prof. Sonja Lepitkova, Ph.D
Prof. Marija Hadzi-Nikolova, Ph.D

Ana Mihailovska, M.Sc

“Goce Delchev” University – Faculty of Agriculture
Prof. Ljupco Mihajlov, Ph.D

Prof. Dimitar Nakov, Ph.D

UKIM – Faculty of Forestry Sciences, Landscape Architecture and Eco-Engineering "Hans M."
Prof. Ljupco Nestorovski, Ph.D
prof. Nikola Nikolov, Ph.D

Foreword

The Climate Change Mitigation Report is a key document providing a comprehensive overview of greenhouse gas emission projections and the effects of existing and planned policies and measures. Its primary purpose is to provide a clear analytical basis for developing and strengthening national climate policies, in line with the country's international commitments, including the Paris Agreement and the European Union alignment process.

The report presents the results of the Without Measures and With Measures scenarios, together with a detailed sector-by-sector analysis of individual policies and measures, in order to assess their contribution to emission reductions. It provides a basis for informed decision-making and for defining priorities in the decarbonisation process.

In preparing this report, emphasis was placed on the consistent application of methodologies and the transparent presentation of results, providing a clear analytical basis for their interpretation and further use. The document is intended primarily to support the planning and evaluation of climate policies and to inform relevant institutions and stakeholders about the expected effects of mitigation measures and scenarios.

Acknowledgements

We express our sincere gratitude to all institutions and individuals who contributed in any way to the preparation, improvement and finalisation of the Climate Change Mitigation Report. Your commitment, expertise and timely support were essential to the successful fulfilment of this national obligation. We extend special thanks to all participants in the two workshops organised for the inventory, as well as to the institutions and experts involved in meetings, discussions and consultations aimed at improving data quality and methodology.

The workshops brought together active representatives from all key sectors: approximately 12 government ministries and agencies, 8 academic and research institutions, 8 international organisations, 6 energy companies and public utilities, 6 non-governmental and civil society organisations, 5 private companies and consulting firms, as well as representatives of local self-government and other specialised institutions. This broad participation enabled strong cross-sectoral cooperation and technical dialogue in support of greenhouse gas inventory activities.

Every effort made, every exchange of information and every professional discussion contributed to improving the quality, reliability and sustainability of the reporting system. Thank you for your cooperation, commitment and support for a document of particular importance to the country.

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Abbreviations and Acronyms

GDP	Gross Domestic Product
CTA	Chief Technical Adviser
SSO	State Statistical Office of the Republic of North Macedonia
EC	European Commission
ESM	Power Plants of North Macedonia AD
AI	Agricultural Institute
AFOLU	Agriculture, Forestry and Other Land Use
IPPU	Industrial Processes and Product Use
RCESD	Research Centre for Energy and Sustainable Development
ME	Ministry of Economy
MAKStat	Database of the State Statistical Office of the Republic of North Macedonia
MASA	Macedonian Academy of Sciences and Arts
MoEPP	Ministry of Environment and Physical Planning
MAFWE	Ministry of Agriculture, Forestry and Water Economy
M-NAV	Macedonian Air Navigation
UN	United Nations
USA	United States of America
CS	Country-Specific factor
MCC	Macedonian Chambers of Commerce
DF	Default Factor
CHP	Combined Heat and Power Plant
LPG	Liquefied Petroleum Gas
UKIM	Ss. Cyril and Methodius University in Skopje
FASF	Faculty of Agricultural Sciences and Food
CMC	Crisis Management Centre
FF	Faculty of Forestry
LULUCF	Land Use, Land-Use Change and Forestry
AR5	Assessment Report
BUR	Biennial Update Report
BUR1	First Biennial Update Report
BUR2	Second Biennial Update Report
BUR3	Third Biennial Update Report
BTR	Biennial Transparency Report
CLC	CORINE Land Cover
CORINE	Coordination of Information on the Environment
COPERT	Computer Programme to Calculate Emissions from Road Transport
CORINAIR	Core Inventory of Air Emissions
CRT	Common Reporting Tables
DOC	Degradable Organic Carbon
EEA	European Environment Agency
EFDB	IPCC Emission Factor Database
EMEP	European Monitoring and Evaluation Programme
Eurostat	Statistical Office of the European Union
FAOStat	Food and Agriculture Organisation of the United Nations Statistical Database
FOD	First Order Decay
ETF	Enhanced Transparency Framework

F-gases	Fluorinated gases
GEF	Global Environment Facility
GSP	Global Support Programme
GIS	Geographic Information System
GWP	Global Warming Potential
GHGI	Greenhouse Gas Inventory
IE	Included Elsewhere
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
LU	Land Use
LUC	Land-Use Change
MMR	Monitoring Mechanism Regulation
MMU	Minimum Mapping Unit
MRV	Monitoring, Reporting and Verification
NA	Not Applicable
NACE	Nomenclature of Economic Activities
NC1	First National Communication
NC2	Second National Communication
NC3	Third National Communication
NCV	Net Calorific Value
NE	Not Estimated
NIR	National Inventory Report
NID	National Inventory Document
NO	Not Occurring
ODS	Ozone-Depleting Substances
QA	Quality Assurance
QC	Quality Control
SAR	IPCC Second Assessment Report
SWDS	Solid Waste Disposal Sites
T1	Tier 1
T2	Tier 2
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change)

Chemical Symbols

CaCO ₃	Limestone
CaMgCO ₃	Dolomite
CH ₄	Methane
CO(NH ₂) ₂	Urea
CO	Carbon monoxide
CO ₂	Carbon dioxide
CO ₂ -eq	Carbon dioxide equivalents
HCO ₃ ⁻	Bicarbonate
HFCs	Hydrofluorocarbons
N	Nitrogen
N ₂ O	Nitrous oxide
Na ₂ CO ₃	Sodium carbonate
NH ₃	Ammonia
NH ₄ ⁺²	Ammonium
NMVOC	Non-methane volatile organic compounds
NO ₃ ⁻	Nitrate
NO _x	Nitrogen oxides
OH ⁻	Hydroxide ion
PFCs	Perfluorocarbons
SF ₆	Sulfur hexafluoride
SO ₂	Sulfur dioxide
SO _x	Sulfur oxides

Units and Metric Symbols

Unit	Name	Unit of	Metric symbols	Prefix	Factor
<i>g</i>	gram	mass	P	peta	10 ¹⁵
<i>W</i>	watt	power	T	tera	10 ¹²
<i>J</i>	joule	energy	G	giga	10 ⁹
<i>m</i>	metre	length	M	mega	10 ⁶
<i>Wh</i>	watt-hour	energy	k	kilo	10 ³
<i>toe</i>	tonnes of oil equivalent	energy	h	hecto	10 ²
			da	deca	10 ¹
			d	deci	10 ⁻¹
<i>1g</i>			c	centi	10 ⁻²
<i>1kg</i>	= 1 000 g		m	milli	10 ⁻³
<i>1t</i>	= 1 000 kg	= 1 Mg	μ	micro	10 ⁻⁶
<i>1kt</i>	= 1 000 t	= 1 Gg	n	nano	10 ⁻⁹
<i>1Mt</i>	= 1 000 000 t	= 1 Tg	p	pico	10 ⁻¹²

EXECUTIVE SUMMARY

Climate change represents one of the most complex and dynamic challenges facing modern society, with profound impacts on the economy, energy and social development. In this context, this report is a key analytical document supporting the national framework for planning and implementing climate change mitigation policies, in accordance with the obligations under the UNFCCC and the Paris Agreement. In addition, the report forms part of the First Biennial Transparency Report (BTR1), meaning that it is structured in line with the latest requirements for data transparency, consistency and comparability. In this way, the document provides both a national analysis and a means of positioning the country within the international climate reporting system.

The report was prepared amid significant global and regional changes, including the energy crisis, increased volatility in energy markets and the need to accelerate the energy transition. These factors affect key analytical inputs, such as energy prices, demand and technological development, resulting in projections that differ from those in previous documents. Nevertheless, despite short-term adjustments, the long-term direction remains clearly defined: gradual decarbonisation of the economy through a higher share of renewable energy sources, electrification and improved energy efficiency. This dual approach, combining short-term security with long-term sustainability, is essential for understanding the scenario results.

Scenarios have been developed within the report to enable a clear assessment of the effects of policies and measures on greenhouse gas emissions. Importantly, the analysis is not limited to the Energy sector, but applies an integrated approach across all relevant sectors, including Industrial Processes and Product Use, Agriculture, Forestry and Other Land Use, and Waste. This multisectoral approach provides a better understanding of systemic interactions and synergies between measures, which are a fundamental element of modern climate policy. At the same time, the report includes additional analyses in the annexes, going significantly beyond the conventional reporting approach and introducing innovative methods for analysing public perception and policies.

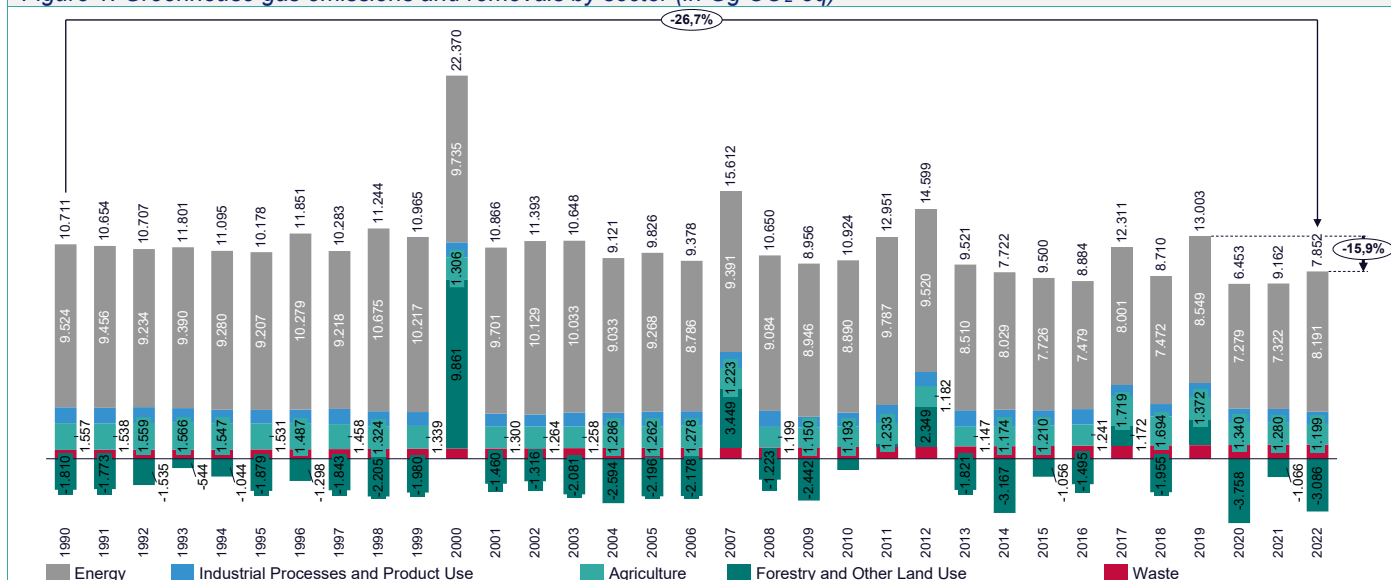
In terms of structure, the report provides a clear and logical framework that begins with an analysis of national circumstances, continues with the definition of the reference Without Measures scenario and a detailed elaboration of policies and measures, and concludes with an analysis of the mitigation scenarios and their comparison with the National Energy and Climate Plan (both the adopted plan and the new plan currently undergoing adoption). This approach allows the narrative to be built progressively, guiding the reader from the context to the results and their interpretation. In addition, the chapters on co-benefits and the annexes provide a broader perspective and increase the document's practical value for decision-makers. In this way, the report goes beyond a conventional technical document and becomes a strategic tool for planning low-carbon development.

National circumstances define the basis on which climate policies and mitigation scenarios are developed by clearly linking economic, energy and emissions trends. The analysis shows that economic growth in the Republic of North Macedonia is accompanied by a moderate increase in energy demand, while a gradual decoupling of growth from energy consumption is also evident, indicating improvements in energy efficiency and structural changes in the economy. The energy system remains dominated by fossil fuels, but there is a clear trend towards a growing share of renewable energy and gradual diversification of generation. At the same time, dependence on energy imports remains a significant factor, with implications for energy security and price stability. These characteristics define the starting point for assessing the effects of policies and measures.

Regarding greenhouse gas emissions, the energy sector accounts for the dominant share, while transport stands out as the fastest-growing source of emissions, indicating the need for additional intervention in this sector. The Forestry and Other Land Use sector has a specific role as a carbon sink (Figure 1), although with substantial variations, while the Agriculture and Waste sectors contribute non-CO₂ gases. These sectoral differences highlight the need for differentiated policies tailored to the specific characteristics of each sector. In addition, the structure of emissions and energy consumption indicates that the greatest reduction potential is concentrated in the energy sector, but that an integrated approach is essential to achieve long-term objectives. This chapter establishes a clear analytical basis for understanding the scenarios and policy effects presented in the following sections.

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Figure 1. Greenhouse gas emissions and removals by sector (in Gg CO₂-eq)



Source: IPCC software, team analysis

The emissions analysis is based on the development of three scenarios: a Without Measures scenario (WOM), a With Existing Measures scenario (WEM) and a With Additional Measures scenario (WAM). The key focus is on the difference between WOM and WAM in order to clearly demonstrate the effect of climate policies. WOM is used as the reference baseline for assessing the effects of policies and measures and represents the emissions pathway in the absence of additional interventions. The results show that without additional intervention, emissions would follow a stable or increasing pathway, particularly in the energy sector, whereas implementation of the measures enables a significant reduction in emissions and a change in the trend after 2030.

Under the WAM scenario, 69 policies and measures covering all relevant sectors were analysed: 32 measures in the energy sector, 1 measure in Industrial Processes and Product Use (IPPU), 4 in Agriculture, 2 in Forestry, 5 in Land Use and 9 in Waste. In addition, 16 horizontal enabling measures are included to strengthen institutional, regulatory and financial capacities. This portfolio represents a significant expansion and improvement compared with previous national documents, particularly in relation to technological solutions (battery systems and hydrogen), regulatory interventions and emissions management in non-energy sectors.

In the With Additional Measures scenario, net emissions amount to approximately 2,800 kt CO₂-eq in 2030, declining further to 2,621 kt CO₂-eq in 2035 and 2,400 kt CO₂-eq in 2040 (Figure 2). This represents a reduction of approximately 74% compared with 1990, demonstrating a high level of ambition that is very close to the National Energy and Climate Plan adopted in 2023 and to the targets defined by the Energy Community.

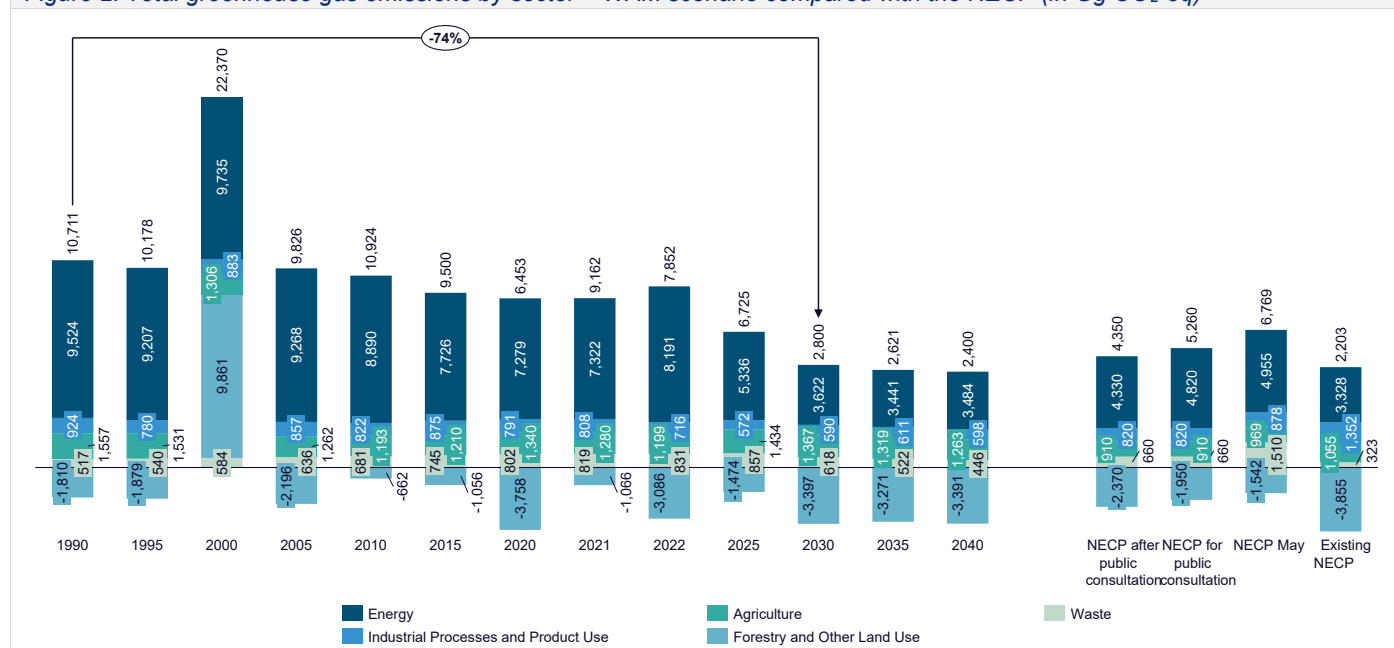
This report also compares its results with the National Energy and Climate Plan (the plan adopted in 2023 and the new plan currently awaiting adoption) in order to clarify whether the proposed policies and measures lead to the achievement of national climate targets and whether the two strategic documents are consistent. Although the documents were developed in parallel and substantial efforts were made to align them, some differences are unavoidable because of the different methodological approaches. For the BTR, an integrated optimisation model of the entire energy system (MARKAL) is used, while the National Energy and Climate Plan uses the LEAP model and applies optimisation only to the electricity system. This means that the BTR results represent the economically optimal solution. Nevertheless, aligning key assumptions, such as the operation of REK Bitola until 2040, has significantly reduced the differences and improved comparability. **Consequently, the comparison is not intended to determine which document is "correct", but to understand the range of possible results and their robustness.**

The results show a high level of alignment between the With Additional Measures scenario (WAM) and the NECP, with net emissions of approximately 2,800 kt CO₂-eq in 2030. Compared with the various NECP versions, the WAM value is significantly lower than the "May NECP" (6,769 kt CO₂-eq), the "NECP for public consultation" (5,260 kt CO₂-eq) and the "NECP after public consultation" (4,350 kt CO₂-eq), while it is close to the "existing NECP" (2,203 kt CO₂-eq). The main differences originate in the energy sector and the Forestry and Other Land Use sector, where the BTR uses updated data from the national greenhouse gas inventory (including removals from perennial plantations) and an optimisation approach, whereas the NECP assumes higher electricity generation and exports (more than 13,000 GWh

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in 2040 compared with around 10,000 GWh in the BTR). This results in higher emissions in the NECP, because increased generation also entails greater use of energy capacities, including fossil-fuel capacity. **Nevertheless, despite these differences, the two documents are largely consistent: they show the same trends, strong growth in renewable energy sources, reduced use of fossil fuels and a clear direction towards decarbonisation. The remaining differences are relatively small and mainly arise from the different treatment of certain technologies, the timing of investments and system optimisation in the BTR.**

Figure 2. Total greenhouse gas emissions by sector – WAM scenario compared with the NECP (in Gg CO₂-eq)



Analysis of the With Additional Measures scenario (WAM) 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 3), representing an almost threefold increase and a clear indicator of the intensity of investment and policy implementation. In the initial period, jobs related to energy efficiency predominate (2,351 in 2025), but over time renewable energy sources take the leading role, reaching 5,410 jobs in 2040 compared with 5,074 in energy efficiency. In addition, the structure of renewable energy employment shows that long-term activities such as maintenance and indirect services become increasingly important (1,519 and 1,296 jobs respectively in 2030) (Figure 4), indicating stable and sustainable sector development. In parallel, the air quality analysis shows a substantial reduction in PM_{2.5} emissions under WAM, from around 8.1 kt in 2020 to 3.2 kt in 2040, while under WEM they reach around 6.0 kt and under WOM they increase to 7.7 kt. This clearly highlights the importance of additional measures for public health (Figure 5).

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Figure 3. Total new jobs in the WAM scenario

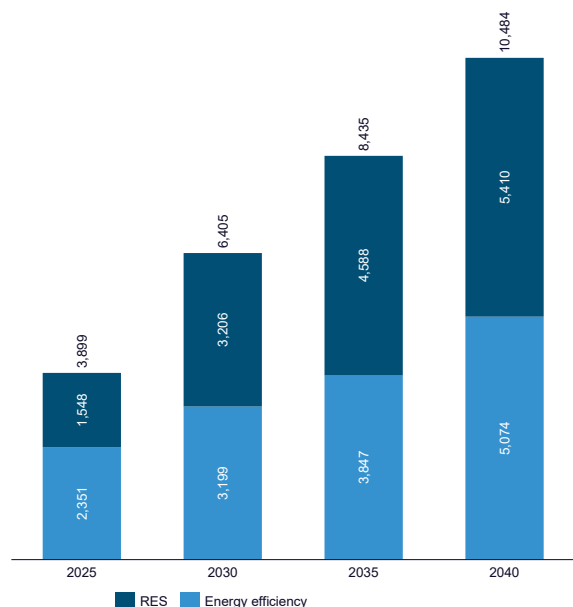


Figure 4. Breakdown of renewable energy jobs in the WAM scenario

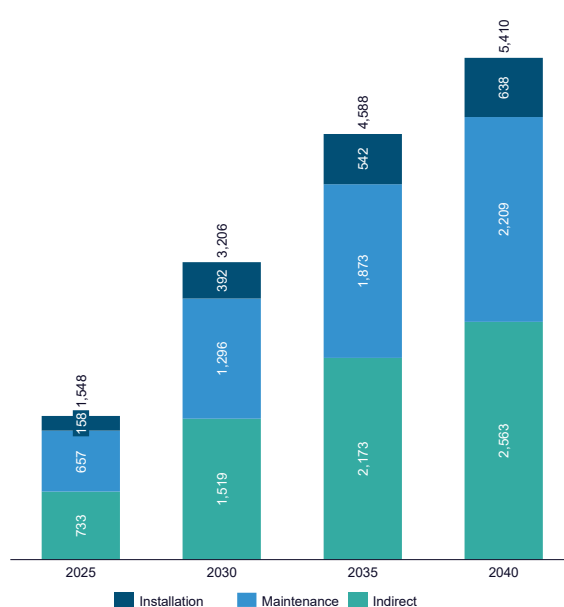
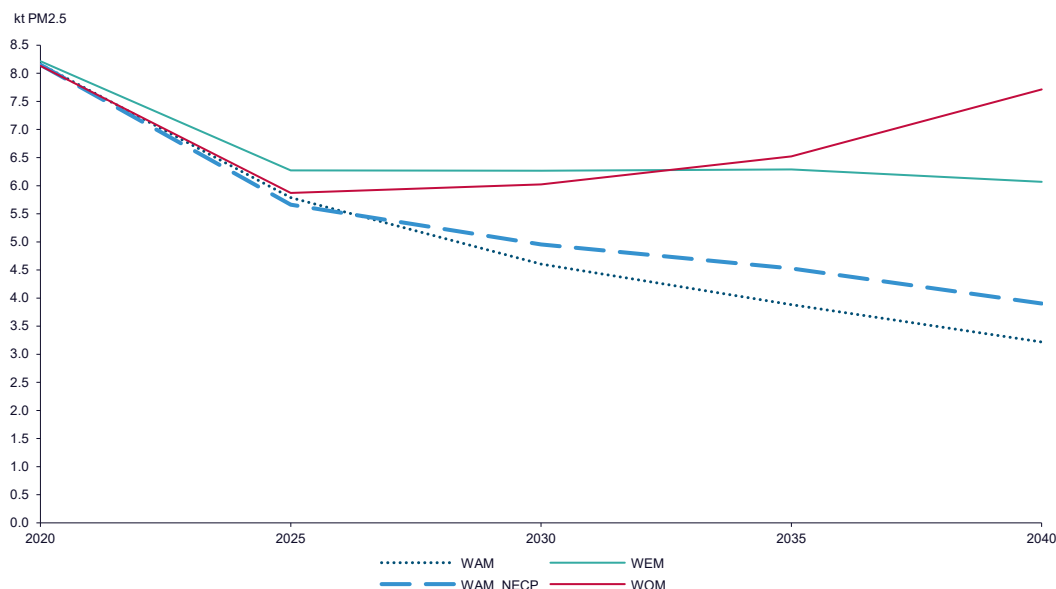


Figure 5. PM2.5 emissions (kt PM2.5)



From an economic perspective, the WAM scenario requires substantial investment of around EUR 22 billion, of which 88% is directed to the energy sector, with the remainder allocated to Waste (3%), Forestry (1%) and additional measures (around 3%), confirming the central role of the energy transition. On an annual basis, these investments amount to around EUR 792 million, or approximately 9% of GDP, a level that can be mobilised through a combination of public and private sources (Figure 6). Despite the higher initial costs, the analysis shows that WAM results in lower total system costs, which are approximately 9% lower in 2040 than under the Without Measures scenario, mainly because of reduced dependence on fossil-fuel imports and improved energy efficiency (Figure 7). This indicates that the transition to a low-carbon economy is not only a cost, but also a major economic opportunity offering long-term benefits, including greater energy security, price stability and sustainable economic growth.

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Figure 6. Investments for WAM implementation

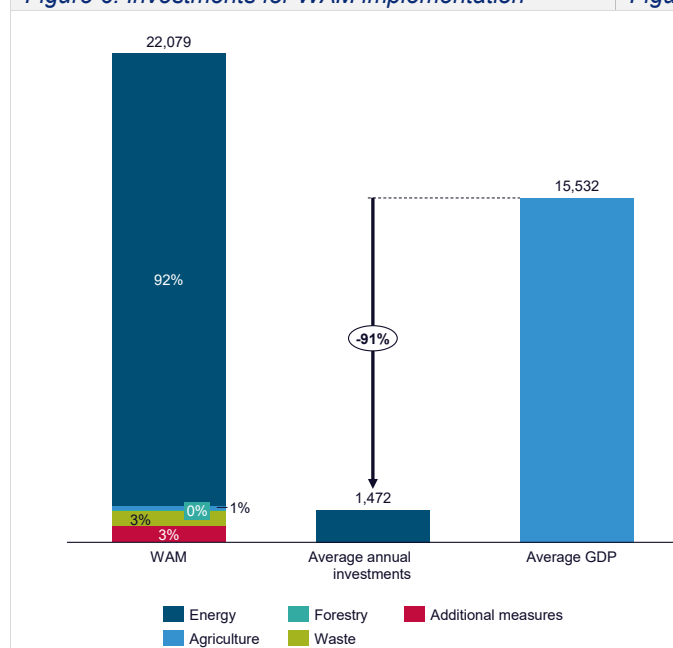
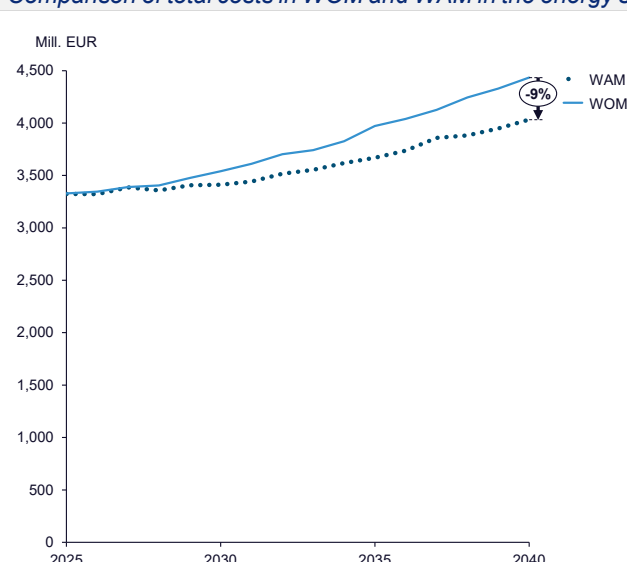


Figure 7. Comparison of total costs in WOM and WAM in the energy sector



The additional analyses presented in the annexes provide an innovative perspective on the role of public perception in policy design and implementation, particularly in the Waste sector. Using advanced methods such as sentiment analysis and topic modelling on more than 13,000 social media posts and around 9,500 media items, the results show that negative sentiment regarding waste management predominates in North Macedonia, especially in relation to landfills, institutional effectiveness and the lack of recycling infrastructure. At the same time, the media analysis indicates a gradual increase in positive coverage of renewable energy topics, highlighting the potential role of the media in driving public support. Comparison with European Union countries such as Spain shows that higher levels of trust in institutions are associated with significantly more positive public sentiment (76% positive reactions, compared with approximately 83% negative reactions in North Macedonia). **These results indicate that successful policy implementation depends not only on technical solutions, but also on their social acceptability, highlighting the need to integrate public perception into the process of designing and implementing climate policies.**

1 Introduction

Climate change represents one of the most significant global challenges facing modern society, with substantial economic, environmental, 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 strengthening its national policies for climate change mitigation and adaptation, while ensuring transparent reporting on progress. The preparation of the First Biennial Transparency Report (BTR1) constitutes a key step in fulfilling these international commitments, while also providing a systematic, transparent, and consistent framework for monitoring greenhouse gas emissions and assessing the effects of climate policies and measures.

This report builds upon the country's previous national climate policy documents while providing an enhanced methodological framework aligned with the latest IPCC guidelines and the requirements of the Enhanced Transparency Framework established under the Paris Agreement. It is particularly significant that this document is being prepared during a period of considerable global and regional energy and economic uncertainty, where climate objectives must be balanced with the need to ensure energy security and economic stability. Nevertheless, the Republic of North Macedonia remains firmly committed to the transition towards a low-carbon and sustainable development pathway through the gradual reduction of its dependence on fossil fuels, the promotion of renewable energy sources, the strengthening of energy efficiency, and the improved management of natural resources.

BTR1 is not only a technical document, but also a strategic tool for planning, policymaking and supporting the integration process in the European Union. By providing a transparent presentation of data and results, the report facilitates informed decision-making, strengthens public institutions, enhances coordination among stakeholders, and promotes the active participation of the academic community, the private sector, and civil society. In this way, the national climate policy system is developed on the principles of science-based, accountability and long-term sustainability.

At the same time, the BTR1 provides a foundation for the further enhancement of the national system for data collection and processing, the development of analytical capacities, and the strengthening of institutional cooperation. This establishes a robust framework for future reporting cycles and enables a more accurate assessment of progress towards achieving national and international climate objectives. This report, with its scope and methodological precision, highlights the continued commitment of the Republic of North Macedonia to contribute to global efforts to combat climate change in a transparent, structured and accountable manner.

2 National circumstances

2.1 Macroeconomic context

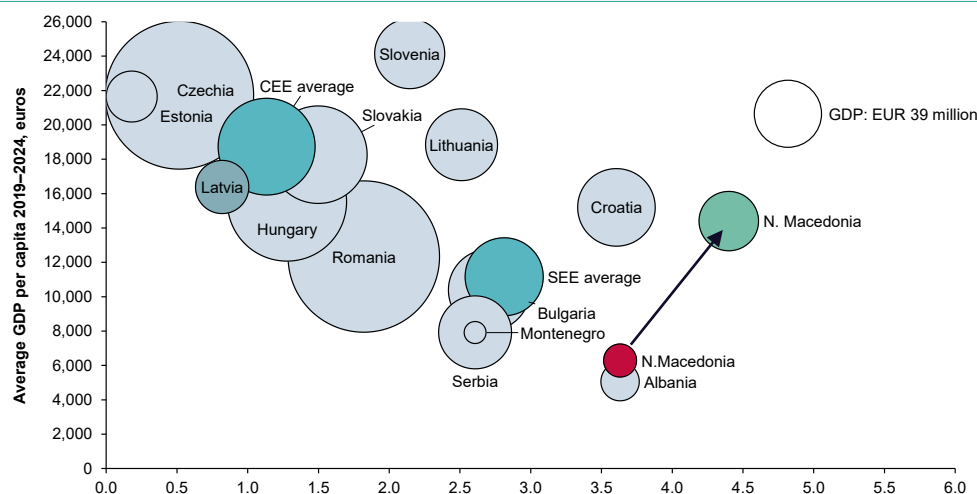
2.1.1 Introduction

The Republic of North Macedonia, as a Contracting Party to the Energy Community and a candidate country for European Union membership, is committed to following the European energy policy and is obliged to transpose and implement the EU's energy and climate directives and regulations. North Macedonia has held the status of an EU candidate country, with formal accession negotiations having commenced in 2022. The accession process involves aligning national climate and energy policies with the EU acquis, serving as a significant driver of decarbonisation and the implementation of climate change mitigation measures.

2.1.2 Economic Growth, Labour Market and Business Environment

Long-term economic growth projections indicate that by 2030, the Republic of North Macedonia will gradually approach the economic performance of the countries in the Central and Eastern Europe (CEE) region. Gross Domestic Product (GDP), as a key indicator of the level and dynamics of economic activity, shows that, based on its current level of economic development, North Macedonia lags behind the average of the Southeast European (SEE) economies, as well as those of the CEE region. According to the available macroeconomic projections prepared within the National Development Strategy, North Macedonia's real GDP is expected to grow at an average annual rate of approximately 4.4%. This growth trajectory is characteristic of developing economies and, if sustained, could lead to gradual real convergence toward the current GDP per capita levels observed in the more advanced CEE countries (Figure 8). The projected economic growth will have direct implications for future energy demand, the structure of production and consumption, and the long-term trends in greenhouse gas emissions.

Figure 8. GDP Trends in CEE and SEE



Note: SEE includes Albania, Bulgaria, Croatia, North Macedonia, Montenegro, Serbia, Slovenia, and Romania; CEE includes Hungary, Latvia, Lithuania, Czechia, Estonia, and Slovakia. The GDP growth projections for North Macedonia assume an annual growth rate of 4.4%. Data on GDP per capita for Albania are not available for 2023 and 2024.

Source: Eurostat; GDP projections used in the National Development Strategy; teams analysis.

North Macedonia continues to experience a relatively high unemployment rate, placing it among the economies with higher unemployment levels in the region, despite the downward trend observed in recent years (Figure 9 and Figure 10). Despite these positive developments, the employment structure remains unfavourable, particularly regarding gender representation. The gender employment gap has persisted over a long period and is associated with structural characteristics of the labour market, prevailing economic and social conditions, as well as the mismatch between labour supply and demand. In 2024, the employment rate for women was **49.6%** (approximately **292 thousand people**), compared with **66.0%** for men (approximately **392 thousand people**), among the active population aged 15–64.

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Figure 9. Unemployment rate in North Macedonia, 2019 – 2024, %

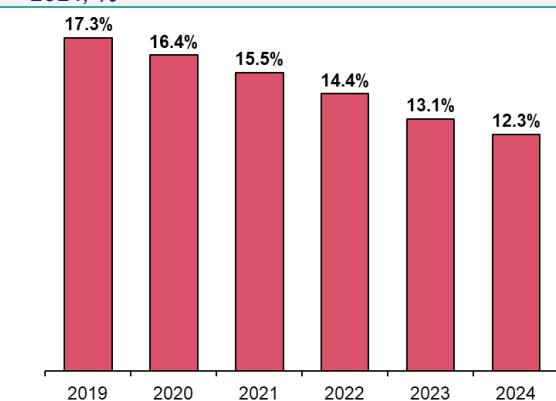
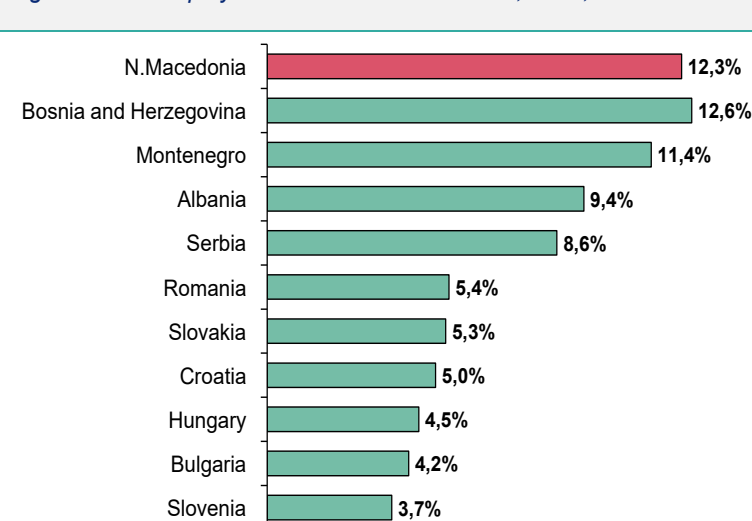


Figure 10. Unemployment rate in CEE and SEE, 2024, %



Source: Eurostat; INSTAT; MONSTAT, team analysis.

The results of the **Business Ready 2024 Index** indicate that North Macedonia offers a relatively favourable business environment, particularly with regard to the availability of infrastructure services and the conditions for establishing business entities, creating favourable preconditions for attracting private investment. However, the identified weaknesses in areas such as international trade, the labour market, and financial services point to the need for further institutional and regulatory improvements. Strengthening the business environment is essential for mobilizing the private capital required to finance climate change mitigation and adaptation measures (Figure 11).

Figure 11. Business environment by category, 2024

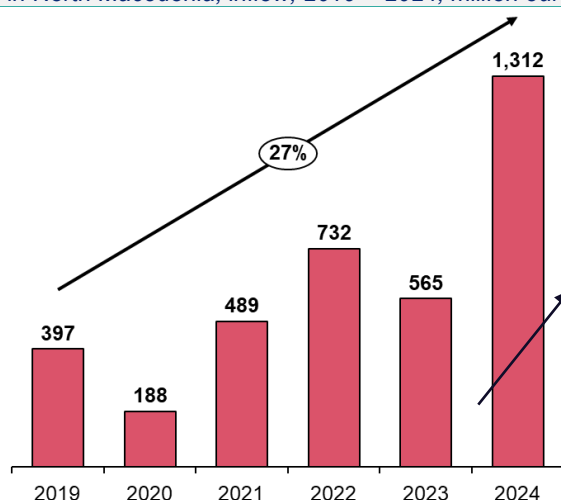
Category	Description	Performance (0 – 100)
Establishment of business entities	Assesses regulations, digital services, and operational efficiency related to business entry	90.83
Location of business entities	Assesses regulations, governance, and the efficiency of procedures for selecting a business location	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

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

2.1.3 Foreign Direct Investment

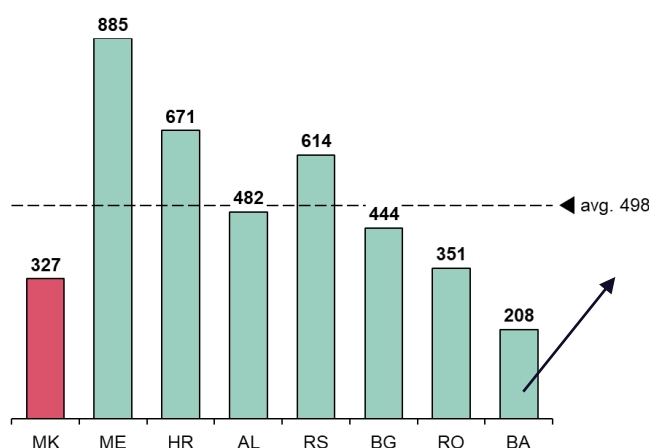
The energy sector has significant potential to attract foreign direct investment (FDI), which is a key driver of economic development and an important source of financing for climate change mitigation and adaptation measures. Globalization has increased the importance of foreign direct investment, particularly for developing countries such as North Macedonia. Given the country's limited domestic financial and investment capacity, creating a more favourable investment climate and improving the business environment remain key priorities. Additionally, the entry of new foreign companies can stimulate the modernization of domestic companies, improve their performance, and contribute to the advancement of economic development and competitiveness of the economy. In the long run, such economic trends create positive externalities. In 2024, foreign direct investment inflows into North Macedonia amounted to EUR 1,312 million, reflecting increased confidence among foreign investors in the country's macroeconomic stability and business environment. 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 13).

Figure 12. Foreign direct investments in North Macedonia, inflow, 2019 – 2024, million euros



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

Figure 13. Foreign direct investments per capita – Regional average, inflow 2019 – 2024, euros



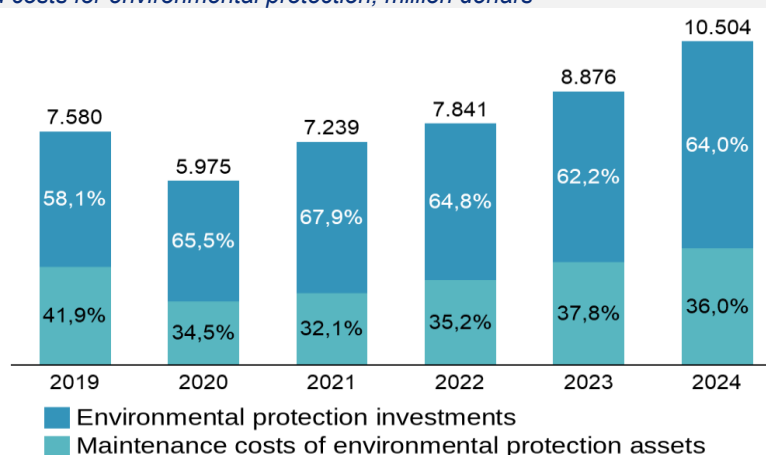
Note: The countries analysed for the region are North Macedonia, Montenegro, Croatia, Albania, Serbia, Bulgaria, Romania, and Bosnia and Herzegovina.

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

2.1.4 Business sector investments in environmental protection and climate policies

The private sector's commitment to environmental protection is reflected in its investments and expenditures aimed at preventing, reducing, and eliminating the degradation of natural resources and environmental pollution. Environmental protection expenditures comprise the total of capital investments and current expenditures incurred for activities related to environmental protection. These expenditures include investments and operating costs associated with ambient air protection, soil protection, water protection, wastewater and waste management, noise abatement, biodiversity conservation, radiation protection, environmental research and development (R&D), as well as other investments and current expenditures related to environmental protection. These expenditures and investments also partially encompass measures related to decarbonisation and the development of a circular economy, which are key pillars of the Green Agenda for the Western Balkans. The available data indicate an upward trend in such investments by the Macedonian business sector. In 2024, approximately MKD 10,540 million was allocated to environmental protection. These figures demonstrate that the Macedonian private sector is already contributing to the reduction of adverse environmental impacts, thereby establishing a foundation for further investments in green technologies and climate change adaptation and mitigation measures.

Figure 14. Investments and costs for environmental protection, million denars

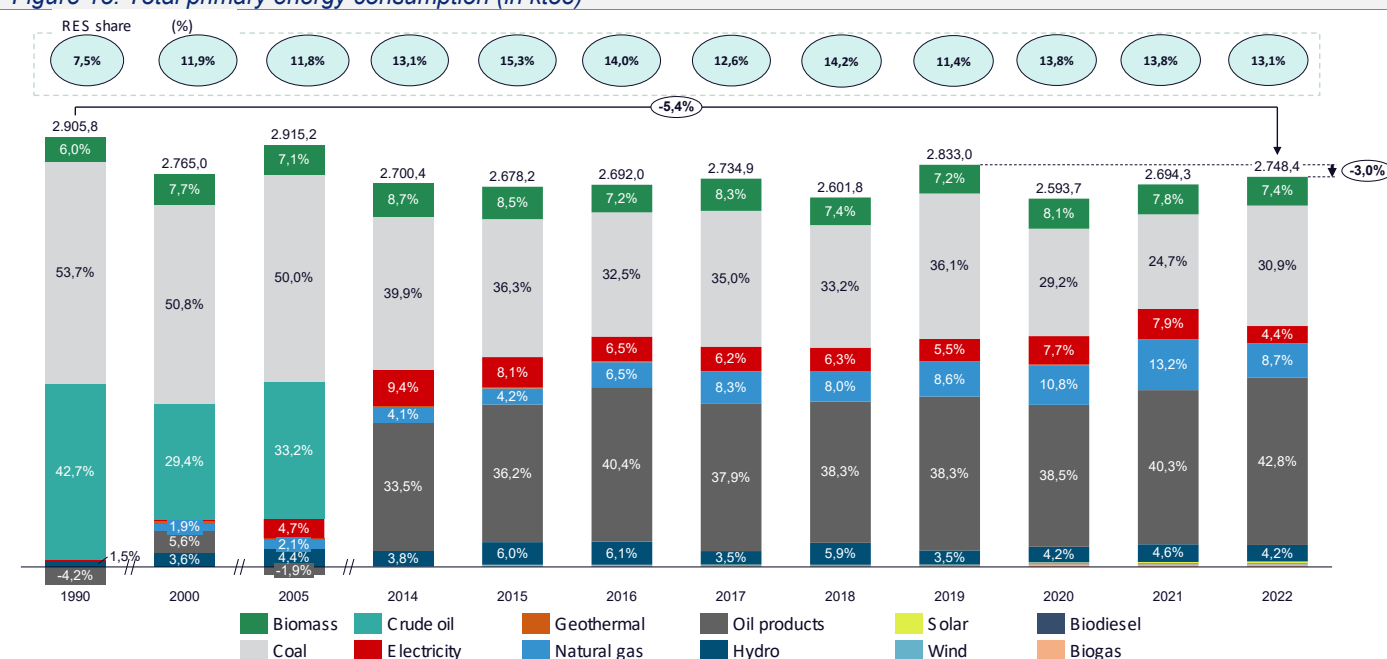


Source: State Statistical Office (MAKStat database), team analysis

2.2 Energy sector

North Macedonia's energy sector has traditionally been based on fossil fuels; however, a gradual diversification of energy sources has been observed over the past three decades. In 1990, fossil fuels accounted for more than 95% of total primary energy consumption, while in 2022 their share had declined to approximately 84% (Figure 15). Total primary energy consumption decreased by 5.4% over the 1990–2022 period and by 3% in 2022 compared with 2019. Although this reduction is relatively modest, it indicates a gradual transition towards cleaner energy sources and the increasing role of renewable energy sources (RES), whose share has increased from approximately 7.5% in 1990 to around 13% after 2022. At the same time, electricity imports, which were almost negligible in 1990 (0.2%), have become a significant component of the country's energy balance, accounting for approximately 5–6% of total energy consumption. This trend reflects North Macedonia's growing dependence on external supplies of electricity in years with lower domestic generation, especially in seasons when hydropower potential is limited due to reduced rainfall and snowfall.

Figure 15. Total primary energy consumption (in ktoe)



Source: IPCC software, team analysis

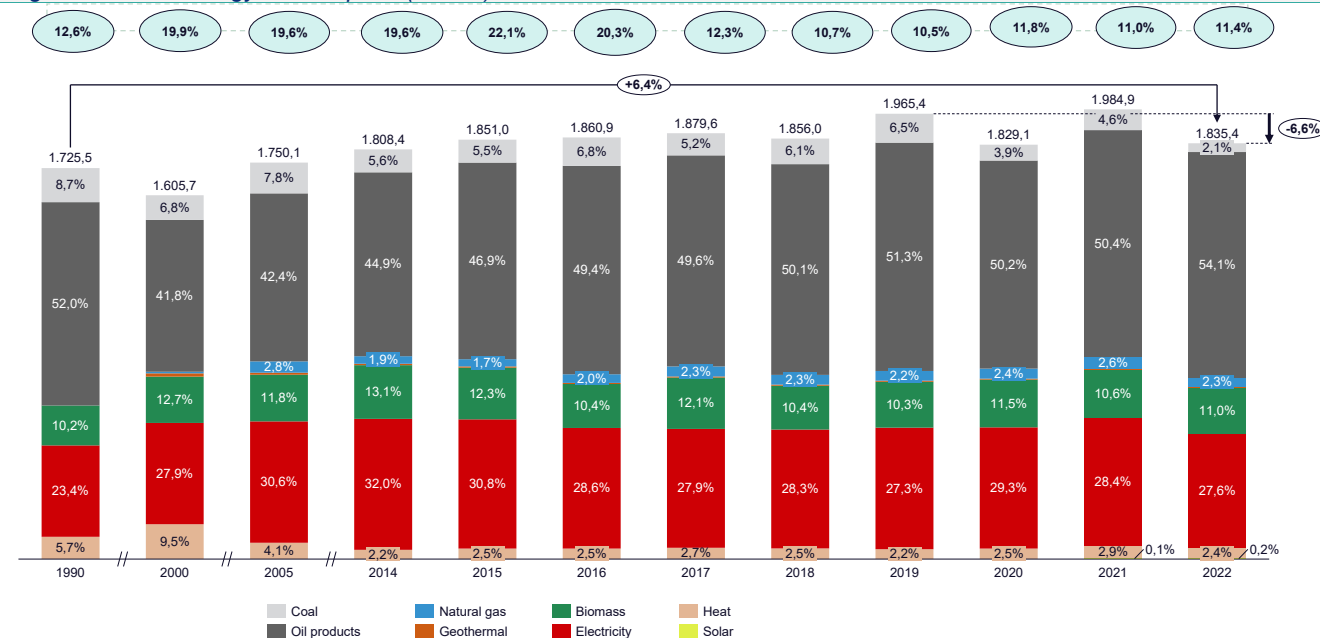
On the other hand, when analyzing final energy consumption, i.e. the energy used by households, transport, industry, and the commercial and public sectors, a different dynamic is observed. Final energy consumption reached a peak of nearly 2,000 ktoe in 2021, representing an increase of approximately 15% compared with 1990. However, in 2022 it declined by more than 7.5% relative to 2021. Petroleum products have remained the dominant energy source throughout the period, accounting for around 50% of final energy consumption, followed by electricity (28%), biomass (approximately 11%), and thermal heat and natural gas (around 2% each). These values indicate a stable but slowly

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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 to produce 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 also contributes to this.

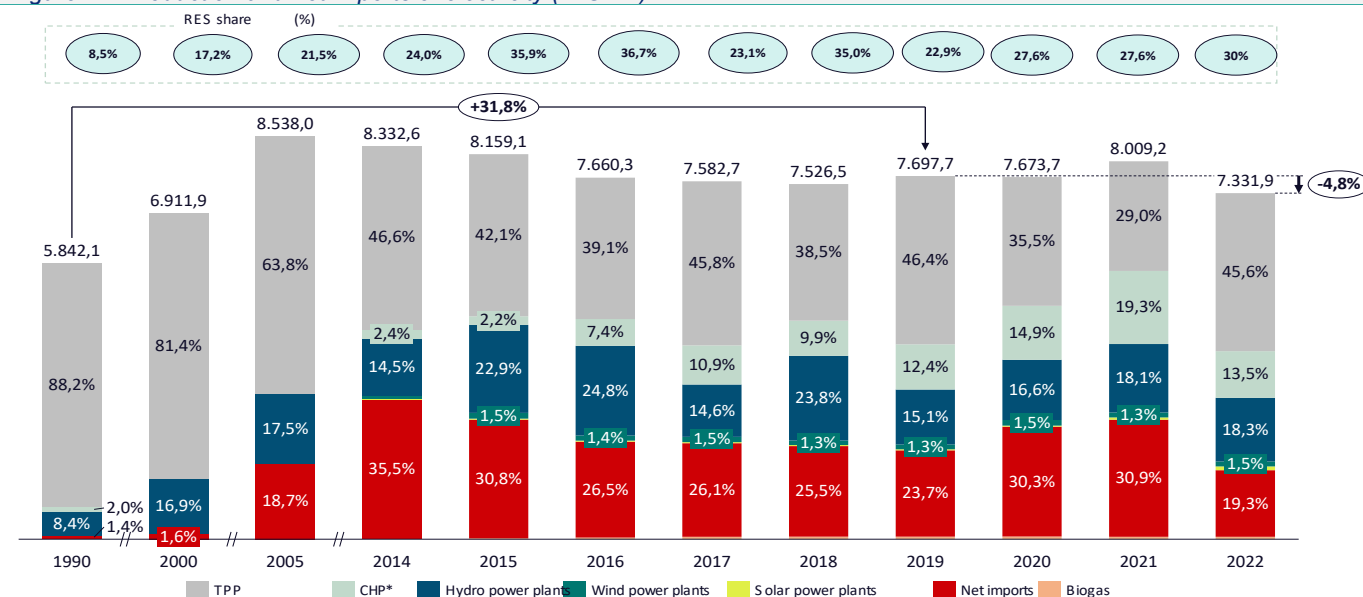
Figure 16. Final energy consumption (in ktoe)



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 part 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 17). At the same time, hydroelectric power plants and TETO 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 17. Production and net imports of electricity (in GWh)



Source: IPCC software, team analysis

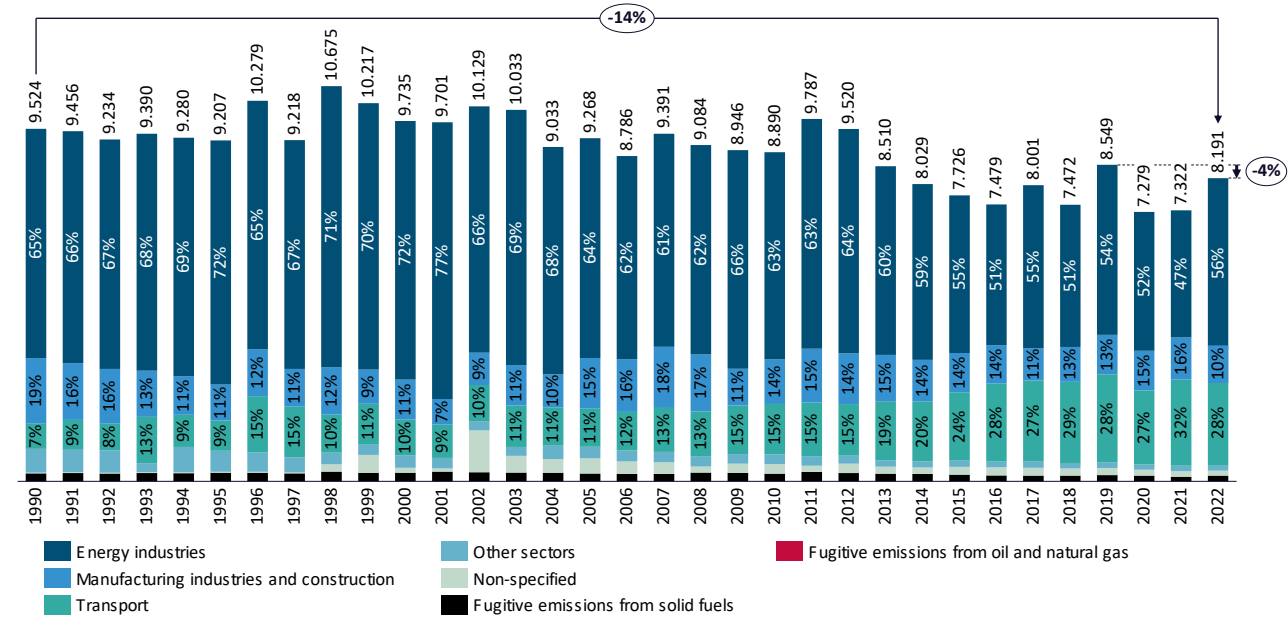
Note: In 1990 the value is for CHP (combined power plants) for own needs within industrial plants

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Total greenhouse gas emissions from the Energy sector fluctuated throughout the 1990–2022 period, while the category Energy Industries consistently remained the dominant source, typically accounting for between 47% and 77% of total emissions. The early years were characterized by high emission levels exceeding 9,000 Gg CO₂-eq, with a peak recorded in 1998, when emissions surpassed 10,600 Gg CO₂-eq (Figure 18). After 2011, emissions began to decline gradually as a result of reduced lignite-based electricity generation, increased electricity imports, and structural changes in the energy system. Total emissions decreased from around 9,800 Gg CO₂-eq to approximately 8,200 Gg CO₂-eq in 2022. A comparison between 2022 and 1990 shows an overall reduction in emissions of 14%, while the comparison between 2022 and 2019 indicates a more modest decrease of only 4%.

Among the other categories, Transport stands out as the only sector exhibiting continuous growth in greenhouse gas emissions, increasing from 679 Gg CO₂-eq in 1990 to 2,328 Gg CO₂-eq in 2022. This trend primarily reflects the growing rate of motorization, as well as the expansion of passenger and freight road transport. In contrast, emissions from Manufacturing Industries and Construction have been reduced by more than half, declining from 1,771 Gg CO₂-eq in 1990 to 832 Gg CO₂-eq in 2022.

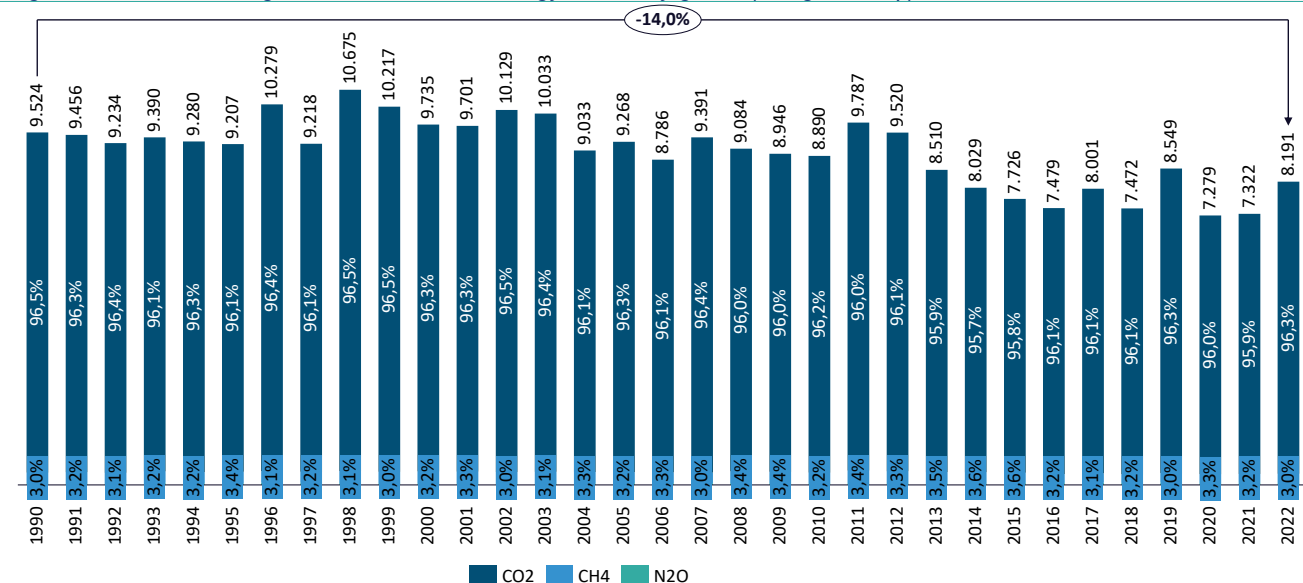
Figure 18. Greenhouse gas emissions in the Energy sector, by category (in Gg CO₂-eq)



Source: IPCC software, team analysis

Total greenhouse gas emissions from the Energy sector by gas (in Gg CO₂-eq) for the reporting years are presented in Figure 19. In 2022, carbon dioxide (CO₂) accounted for almost all greenhouse gas emissions from the Energy sector, representing 96.4% of total emissions, while methane (CH₄) and nitrous oxide (N₂O) contributed only 3.0% and 0.7%, respectively.

Figure 19. Greenhouse gas emissions in the Energy sector, by gases (in Gg CO₂-eq)



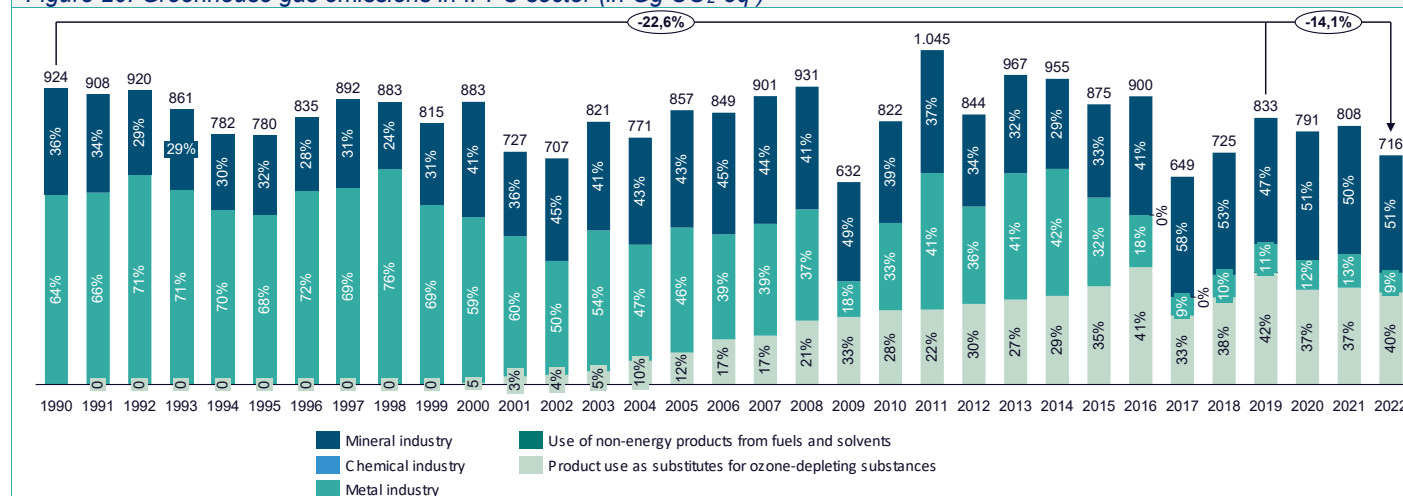
Source: IPCC software, team analysis

2.3 Industrial Processes and Product Use

Greenhouse gas emissions from Industrial Processes and Product Use (IPPU) in Macedonia originate primarily from manufacturing industries and the use of ozone-depleting substance substitutes in air-conditioning and refrigeration applications. Over the analysed period, emissions from the metal industry have shown a gradual decline. At the same time, the mineral industry has increased its share of total emissions and has become the dominant source of emissions within the sector. The remaining emissions are associated with the use of products that serve as substitutes for ozone-depleting substances.

It is important to emphasize that, in the years following 2020, the industrial sector in the Republic of North Macedonia faced a dual challenge: the impacts of the COVID-19 pandemic and the subsequent energy crisis. These events temporarily reduced industrial activity, contributing to a decline in greenhouse gas emissions from IPPU sector. In 2022, total IPPU emissions amounted to 716 Gg CO₂-eq, representing a reduction of 22.6% compared with 1990 and 14.1% compared with 2019 (Figure 20). Emissions from other IPPU categories, such as the chemical industry, the electronics industry, and the production and use of other products, are not present in the country.

Figure 20. Greenhouse gas emissions in IPPU sector (in Gg CO₂-eq)



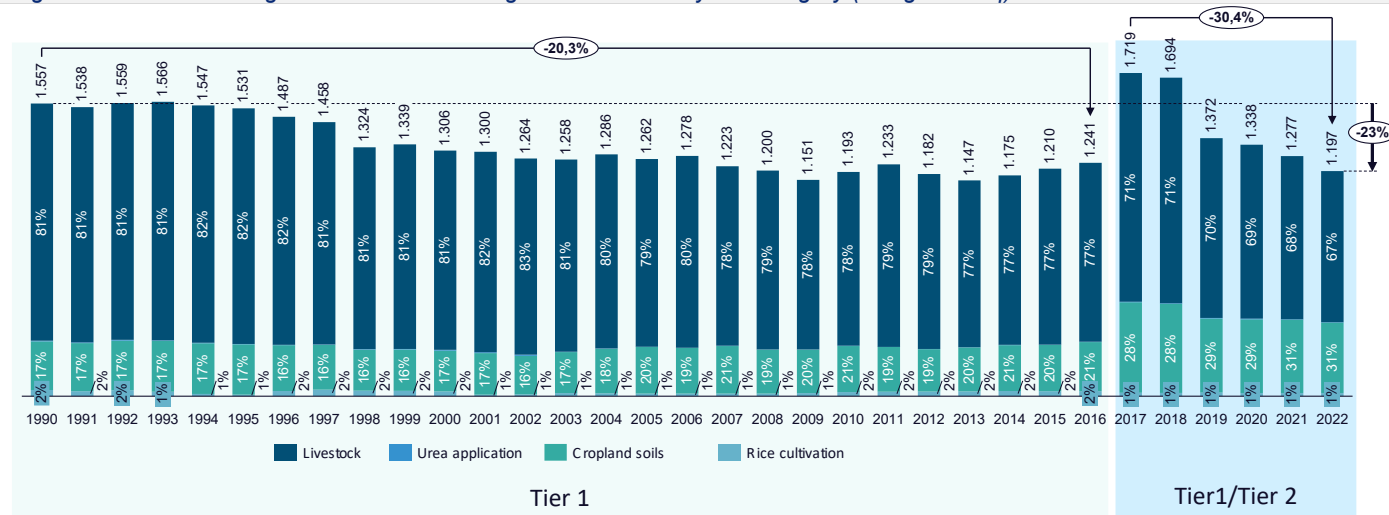
Source: IPCC software, team analysis

2.4 Agriculture

In Macedonia, livestock production activities emit greenhouse gases mainly as a result of enteric fermentation and manure management. On the other hand, greenhouse gas emissions from crop production are the result of several main sources, such as inappropriate and excessive fertilization with mineral fertilizers, which in the long term causes a serious reduction in organic matter in soils and significant CO₂ emissions, inappropriate management and application of manure, conversion of land use from extensive to intensive crop production systems, inappropriate management of arable land and incorrect fertilization management.

Livestock has consistently been the dominant source of greenhouse gas emissions within the Agriculture sector throughout the entire period under review. The share of livestock emissions accounted for approximately 77–83% during the period 1990–2016, when the Tier 1 methodology was applied, and between 67% and 71% during the period 2017–2022, when the Tier 2 methodology was adopted (Figure 21). Although emissions increased in 2017, this should not be interpreted because of an increase in livestock numbers, but rather as a result of the transition to the more detailed Tier 2 methodology. Overall, emissions show a declining trend over the entire period, primarily due to the reduction in livestock numbers in the country. What should be emphasized in this section is that in the next 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 soil is the second subcategory with the largest share of emissions in the Agriculture sector, which in the last six years (2017-2022) has contributed about 30%.

Figure 21. Greenhouse gas emissions in the Agriculture sector by subcategory (in Gg CO₂-eq)

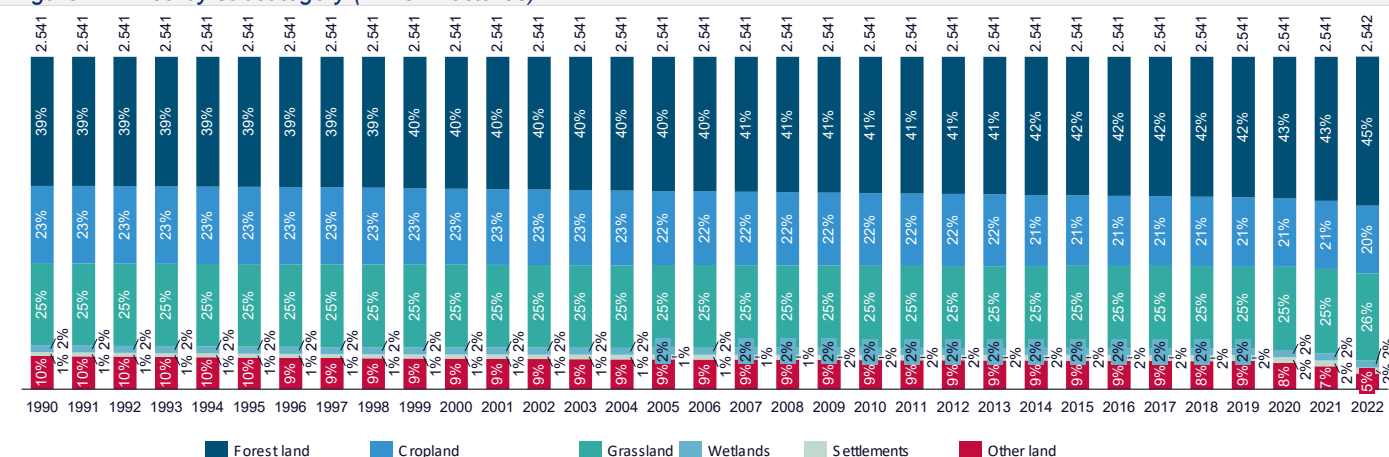


Source: IPCC software, team analysis

2.5 Forestry and Other Land Use

Over the 1990–2022 period, the land-use structure in Macedonia underwent a clear long-term transformation, with forest land gradually strengthening its dominant role (Figure 22). The share of forest land increased steadily from approximately 39% in the early 1990s to nearly 45% in 2022, reflecting the broader European trend of agricultural land abandonment. As agricultural land—particularly cropland—has been abandoned, its share has gradually declined from around 23% in 1990 to approximately 20% by the end of the analysed period. This trend points to structural changes in the agricultural sector, including reduced cultivation intensity and the conversion of agricultural land to other land-use categories. Pastures remain remarkably stable, at around 25% throughout the period, underscoring their role as a relatively constant component of livestock production. On the other hand, the fact that pastures are consistent does not correspond to the livestock numbers, as shown in the previous chapter on livestock farming, where livestock numbers are significantly decreasing. On the other hand, the fact that pastures are consistent does not correspond to the livestock numbers, as shown in the previous chapter on livestock farming, where livestock numbers are significantly decreasing.

Figure 22. Area by subcategory (million hectares)



Source: IPCC software, team analysis

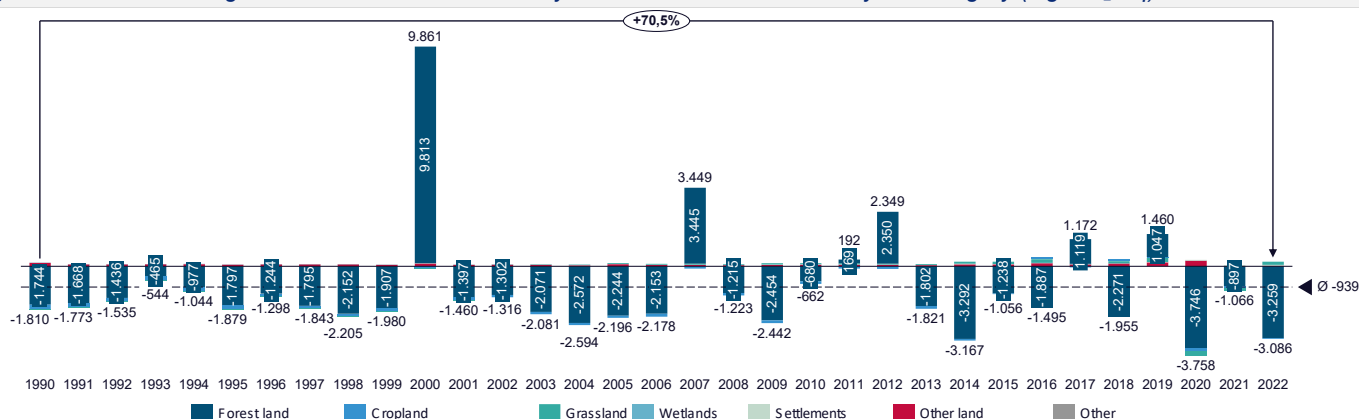
The results for the Land Use, Land-Use Change and Forestry sector confirm its role as the only structurally stable carbon sink in the national greenhouse gas inventory, while also exhibiting the interannual variability that is characteristic of this sector across Europe. Throughout most of the period under review, the sector generated consistently negative net emissions (approximately –1,500 to –3,000 Gg CO₂-eq) (Figure 23), indicating sustainable biomass management. The pronounced positive peaks observed in 2000, 2007, 2012, 2017, and 2019 represent temporary disruptions in the carbon sink capacity. Such fluctuations are commonly associated with forest fires, pest outbreaks, intensive harvesting, extreme climatic events, or methodological revisions and changes in land-use data. In the case of Macedonia, these anomalies are primarily due to forest fires.

In the period 1990–2022, carbon sinks averaged around 940 Gg CO₂-eq. In recent years (2018–2022), the sector exhibited an enhanced carbon sequestration capacity, with net removals reaching as much as –3,758 Gg CO₂-eq. This trend may reflect improvements in forest productivity, reduced harvesting intensity, and more effective forest

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management practices. Additionally, a comparison between 2022 and 1990 shows that the carbon sink increased by approximately 70%.

Figure 23. Greenhouse gas emissions from the Forestry and other land use sector by subcategory (Gg CO₂-eq)



Source: IPCC software, team analysis

2.6 Waste

Data from the national greenhouse gas inventory indicate that total emissions from the Waste sector increased by approximately 60.8% over the 1990–2022 period and by 5.3% between 2019 and 2022. As shown in Figure 24, Solid waste disposal is the dominant source of emissions, with its share increasing steadily to account for nearly 80% of total Waste sector emissions in 2022. Wastewater treatment and discharge subsector show a declining trend, indicating improvements in wastewater collection and treatment systems. The subsectors Biological treatment of solid waste and Waste incineration contribute only a small share of total emissions and exhibit relatively little change over the analysed period. Figure 24 also confirms the predominance of methane in the emissions profile, accounting for approximately 92–95% of total emissions, while CO₂ and N₂O make only a marginal contribution.

Figure 24. Greenhouse gas emissions from the Waste sector by category (Gg CO₂-eq)



Source: IPCC software, team analysis

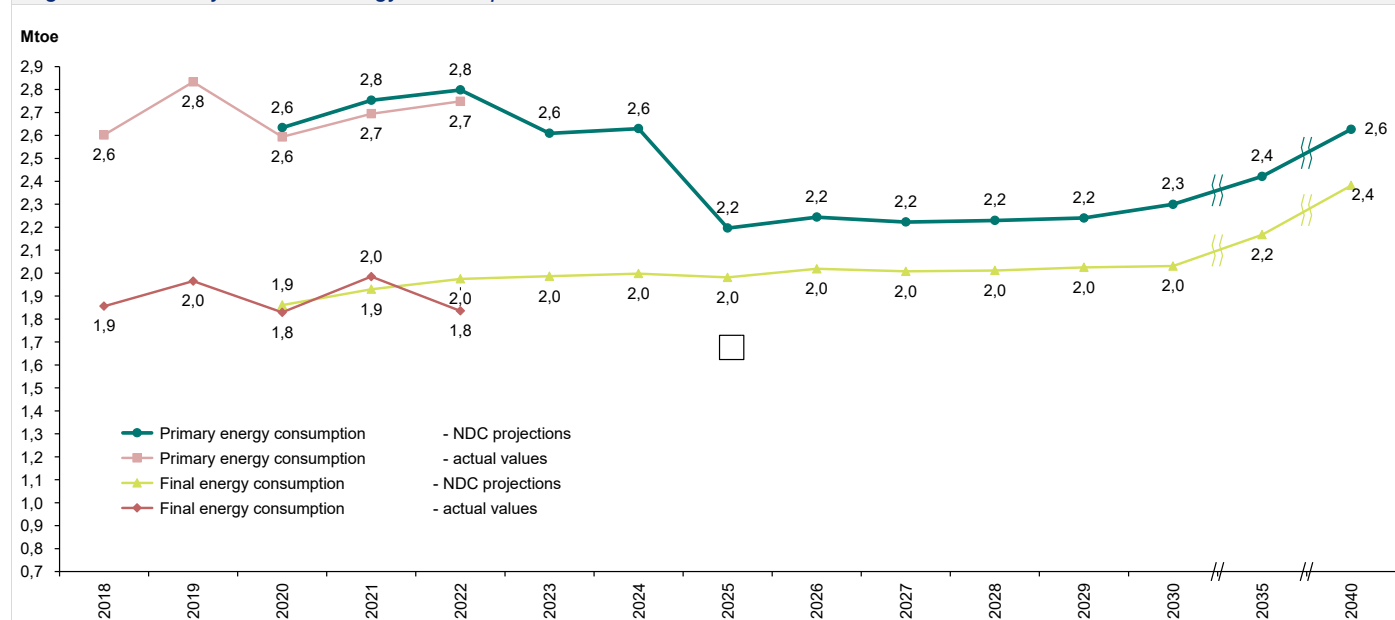
3 Monitoring, Reporting, and Verification

Monitoring, Reporting, and Verification (MRV) constitutes a key pillar in assessing progress in the implementation of mitigation measures and the achievement of commitments defined in national strategic documents. This chapter provides an assessment of the level of implementation of North Macedonia's Nationally Determined Contribution (NDC). As the latest available national greenhouse gas inventory includes data up to 2022, the analysis presented in this chapter is largely based on this reporting period. The MRV system enables the systematic monitoring of well-defined indicators, many of which are aligned with the Sustainable Development Goals and provides the basis for evaluating projected trends as well as the level of implementation of policies and measures. Although data availability remains limited for certain indicators, the majority are covered through national and international data sources, enabling a robust assessment of key parameters such as energy consumption, the share of renewable energy sources, energy productivity, import dependency, municipal waste generated per capita, and the proportion of forest land. This approach provides a clear assessment of the extent to which projected pathways are being realized in practice and helps identify areas where additional policies and interventions are required.

Given that the energy sector is the dominant source of greenhouse gas emissions, the analysis first examines trends in [primary and final energy consumption](#) as key indicators of energy efficiency (Figure 25). The results show that the values observed, based on the national energy balances, have consistently remained below the projected levels. Specifically, primary energy consumption ranged from 2.6 Mtoe in 2018 to 2.7 Mtoe in 2022, while the corresponding projections reached up to 2.8 Mtoe over the same period. A similar trend is observed for final energy consumption, which is approximately 1.8 Mtoe in 2022, compared with the projected value of 2.0 Mtoe.

This deviation can be regarded as a positive outcome, as it indicates more efficient energy use than originally projected. The observed trend is likely the result of a combination of energy efficiency policies, structural changes in the economy, and shifts in consumer behavior. If economic growth is not accompanied by a proportional increase in energy consumption, this suggests a decoupling of economic growth from energy use, which is a fundamental objective of sustainable development.

Figure 25. Primary and final energy consumption



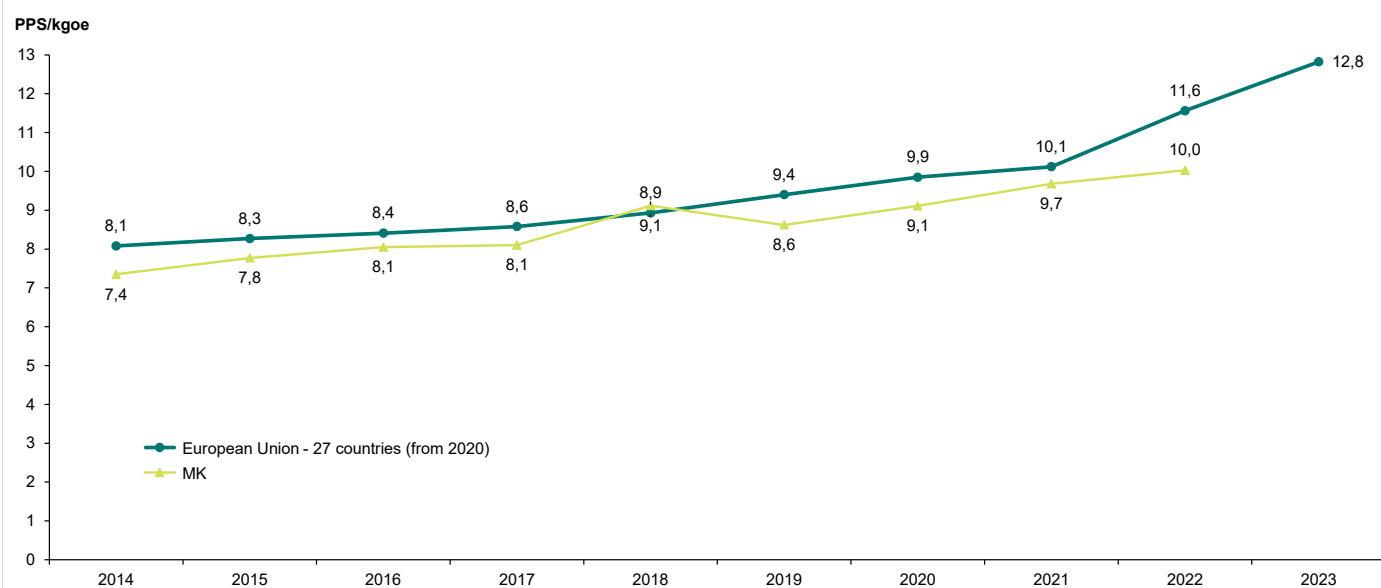
To support the findings regarding improved energy efficiency and the decoupling process between energy consumption and economic growth, the [energy productivity indicator](#) (PPS/kgoe) provides a relevant empirical basis (Figure 26). In North Macedonia, this indicator has shown continuous improvement, increasing from 7.35 in 2014 to 10.03 in 2022. This trend indicates that a higher economic value is being generated per unit of energy consumed, reflecting more efficient patterns of energy use.

Although these values remain below the EU-27 average, which increased from 8.08 in 2014 to 12.82 in 2023, the upward trend is clearly evident. It is important to emphasize that, despite the lower actual primary and final energy consumption compared to the projected levels, the country has achieved a steady increase in energy productivity. This indicates that reduced energy consumption does not reflect weakened economic activity, but rather results from structural

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transformations, effective demand-side policies, and improved energy management. At the same time, this trend signals progress towards a more efficient, resilient, and European standards-aligned energy system.

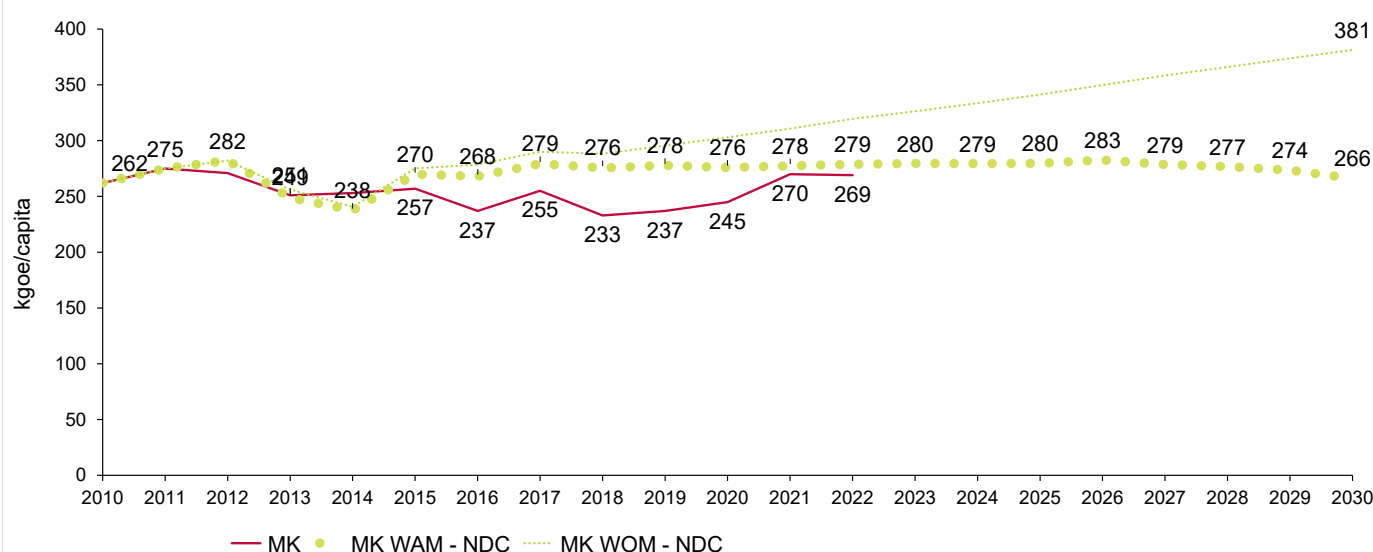
Figure 26. Energy productivity (PPS/Kgoe)



An additional indicator for assessing the effectiveness of energy efficiency measures and trends in final energy consumption is [household energy consumption per capita](#) (Figure 27). During the period 2018–2023, this indicator in North Macedonia consistently remained below the projected values, indicating more efficient energy use at the household level. The actual data show moderate fluctuations, increasing from 233 kgoe/capita in 2018 to 270 kgoe/capita in 2021, followed by a slight decrease to 269 kgoe/capita in 2022. However, throughout the entire period, the values remained below the expected levels.

Compared with the NDC scenarios, the difference is even more pronounced: the WAM scenario projects a level of approximately 279 kgoe/capita in 2022, while the WOM scenario indicates significantly higher consumption of 320 kgoe/capita in 2022. The fact that actual household energy consumption remains below both projections suggests that households have achieved higher levels of energy efficiency than initially anticipated. This is likely the result of technological improvements, investments in energy efficiency, and gradual changes in consumption patterns.

Figure 27. Final energy consumption in households per capita (kgoe/capita)



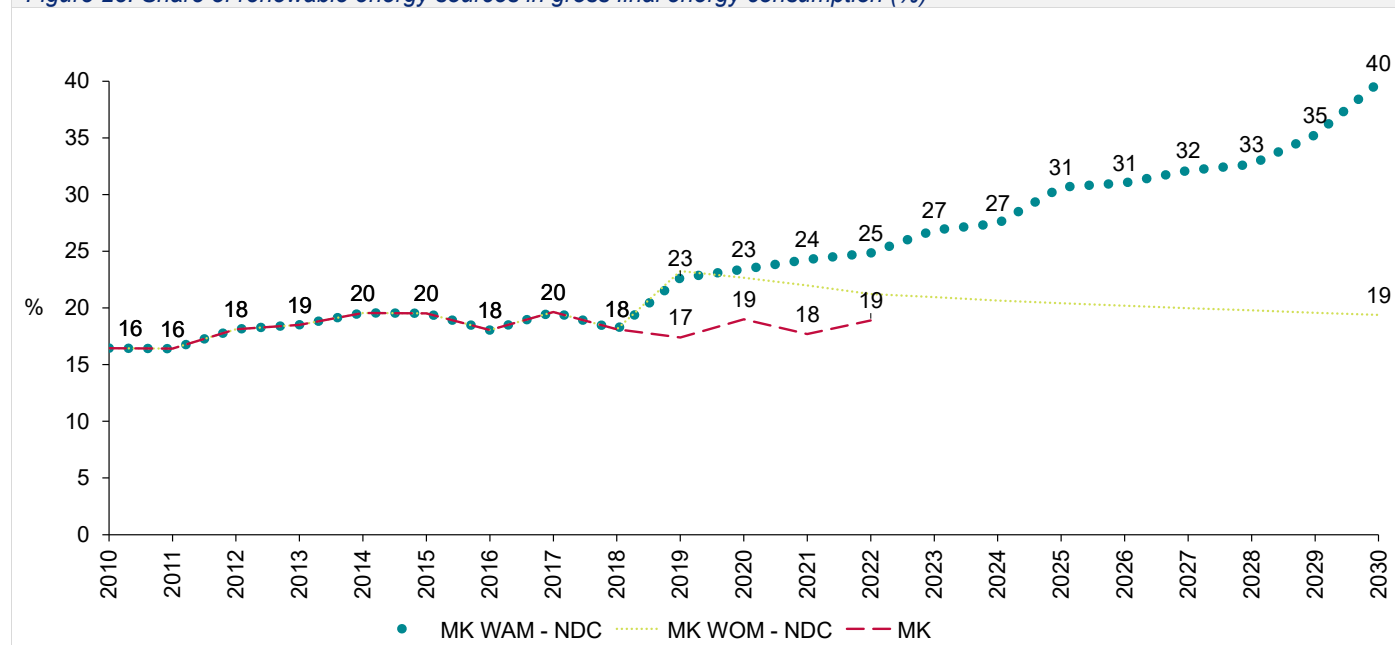
The [share of renewable energy sources](#) represents another key indicator of the country's progress towards a sustainable energy system. During the period 2018–2023, official data indicate an almost stagnant trend in this share, remaining at around 20% (Figure 28). However, this trend does not fully reflect the actual situation, as some key technologies are not adequately covered by the statistical system.

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The most significant discrepancy arises from the inclusion of heat pumps in the WAM scenario of the NDC, where they are treated as a renewable energy source in accordance with the Eurostat methodology, resulting in higher estimated values. In addition, some decentralized energy sources, such as rooftop photovoltaic systems and solar thermal collectors, are not fully recorded, leading to an underestimation of the actual share of renewable energy sources.

Therefore, the difference between the official data and the projections is largely methodological rather than a result of insufficient policy implementation. Nevertheless, a certain lag is evident in the transport sector, where the deployment of biofuels and electromobility remains limited. For a more accurate monitoring of progress, it is necessary to improve the statistical system and align it with European practices.

Figure 28. Share of renewable energy sources in gross final energy consumption (%)

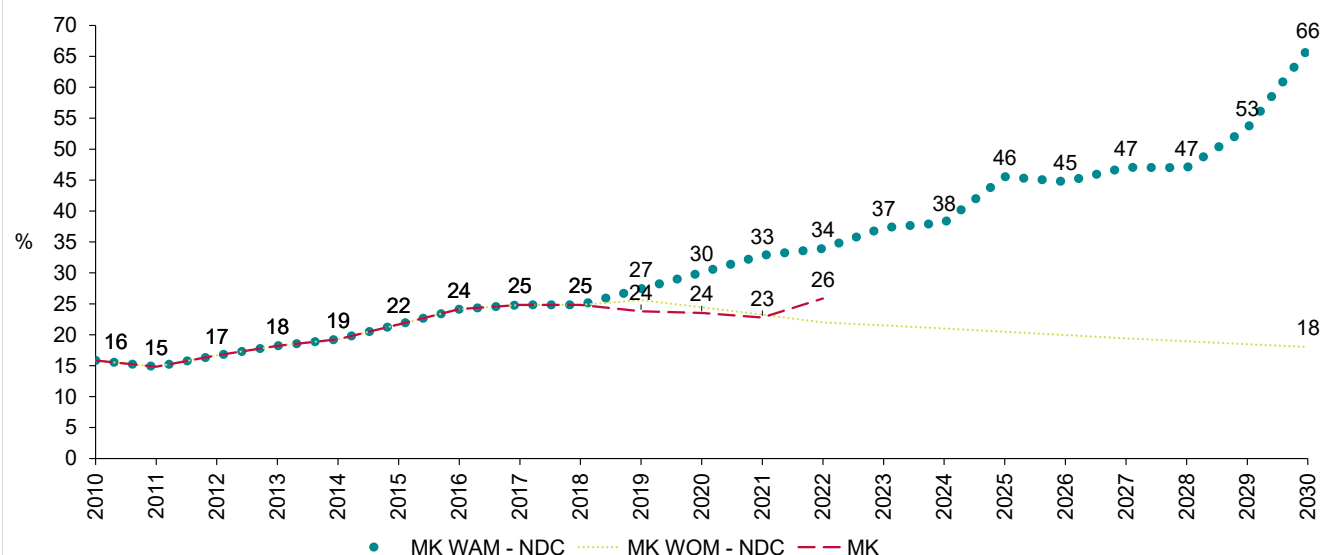


During the period 2018–2022, the share of renewable energy sources in gross final electricity consumption in North Macedonia exhibits different trends when comparing actual statistical data with the WAM and WOM scenarios from the NDC. According to official data, the share of renewable energy amounted to 25% in both 2018 and 2019, slightly declined to 24% in 2020 and 2021, and then increased to 26% in 2022 (Figure 29). The increase observed in 2022 is associated with the accelerated deployment of renewable energy capacities, particularly in the solar and wind energy segments. However, a significant portion of this growth is, once again, not fully reflected in the official statistics, primarily due to insufficiently developed mechanisms for recording decentralized generation, especially photovoltaic systems installed on residential and commercial rooftops, which are often not integrated into centralized data collection systems.

On the other hand, the WAM scenario projects a continuous increase in the share of renewable electricity, from 25% in 2018 to 34% in 2022, assuming full statistical coverage. In 2022, the actual values were considerably above the level projected under the WOM scenario (22%), while simultaneously narrowing the gap with the WAM target of 34%, indicating tangible progress in the integration of renewable energy sources.

Looking ahead, 2023 and 2024 are expected to represent a turning point. Electricity generation from solar sources already exceeds 800 GWh in 2024 (according to the annual report of the Energy Regulatory Commission¹), representing an increase of nearly 500 GWh compared to 2023. Preliminary estimates indicate that the share of renewable energy sources reached approximately 32% in 2023 and could exceed 37% in 2024. This suggests a realistic possibility of meeting, and even surpassing, the projections under the WAM scenario, marking a significant milestone in North Macedonia's energy transition.

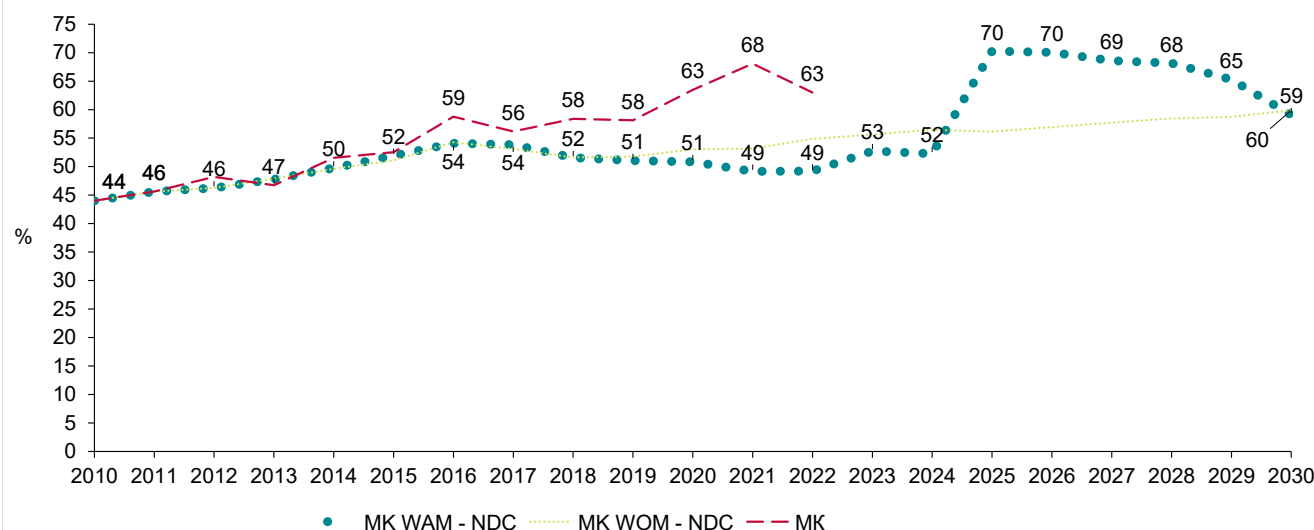
Figure 29. Electricity generated from renewable energy sources (%)



During the period 2018–2023, [energy import dependency](#) in North Macedonia increased significantly, deviating from the projections under both the WAM and WOM scenarios. According to actual data, import dependency rose from 56% in 2018 to 58% in 2019, reaching a peak of 68% in 2021, before stabilizing at 63% in 2022 (Figure 30). A key driver of this trend was the decline in domestic electricity generation from coal-fired power plants, resulting from ageing infrastructure and limited fuel availability. Consequently, imports of electricity, as well as primary energy sources such as coal, fuel oil, and natural gas, increased substantially, particularly during the 2021–2022 energy crisis, when price shocks and security-of-supply concerns necessitated the diversification of energy sources.

Looking ahead, projections for 2024 indicate a potential reversal of this trend. With increased domestic generation, primarily from solar energy, the closure of the Negotino power plant, and stabilized lignite supply through imports, a gradual reduction in import dependency is expected. Preliminary estimates suggest that, in 2024, this indicator will move closer to the values envisaged in the NDC and align with the level projected under the WAM scenario.

Figure 30. Energy import dependency (%)



The previously analysed indicators are directly linked to Sustainable Development Goal 7 (Affordable and Clean Energy), as they reflect progress in energy consumption, energy efficiency, and the integration of renewable energy sources. In addition, the following indicator relates to the transport sector and is relevant to SDG 9 (Industry, Innovation and Infrastructure) and SDG 11 (Sustainable Cities and Communities). Although the NDC does not establish specific quantitative targets for these aspects, the observed trends suggest limited effectiveness in the implementation of public and rail transport measures.

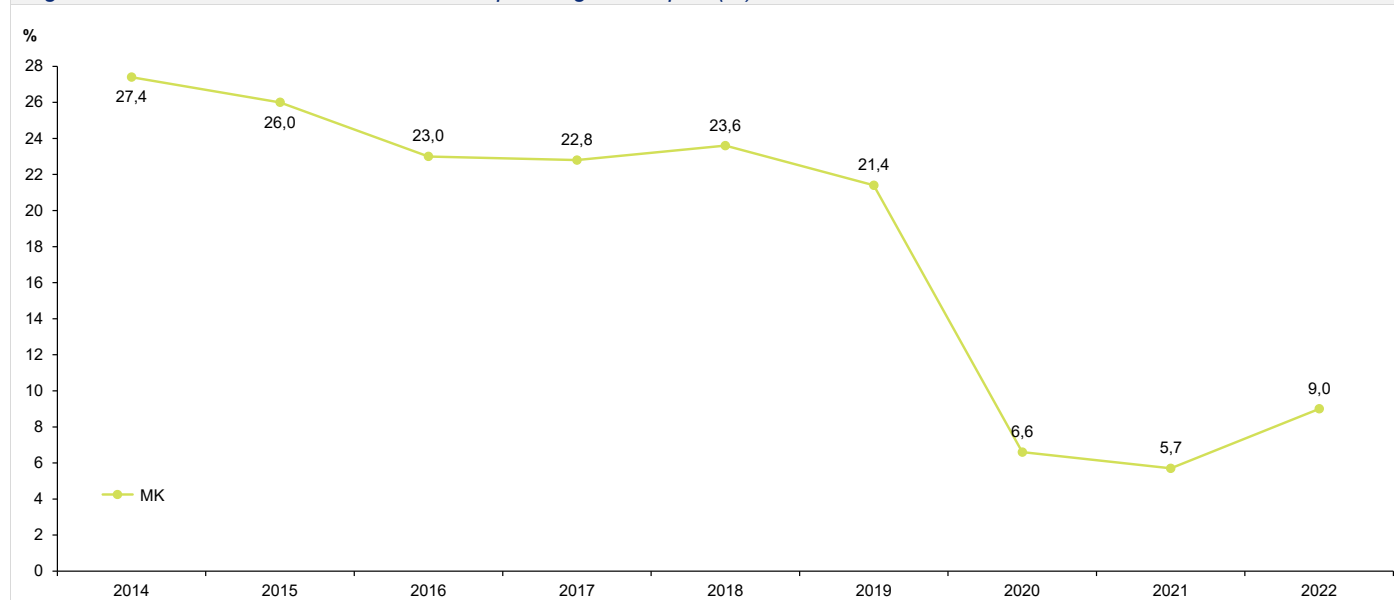
Official statistics show a continuous decline in the [share of bus and rail transport](#) in total passenger transport (Figure 31). From 27.4% in 2014, the share decreased to 21.4% in 2019, followed by a sharp decline to 6.6% in 2020 and 5.7% in 2021 (Figure 20), largely as a consequence of the COVID-19 pandemic. Although a partial recovery to 9% was

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recorded in 2022, the values remain significantly below pre-pandemic levels. This trend indicates a pronounced shift towards the use of private vehicles, with negative implications for emissions, traffic congestion, and energy efficiency.

In addition, rail transport has experienced a long-term decline in demand, with the number of passengers decreasing from 1.4 million in 2011 to only 0.41 million in 2022. These trends highlight the need for increased investments and targeted policy measures aimed at revitalising public transport in order to improve its accessibility, quality, and attractiveness, in line with the objectives of sustainable mobility and the green transition.

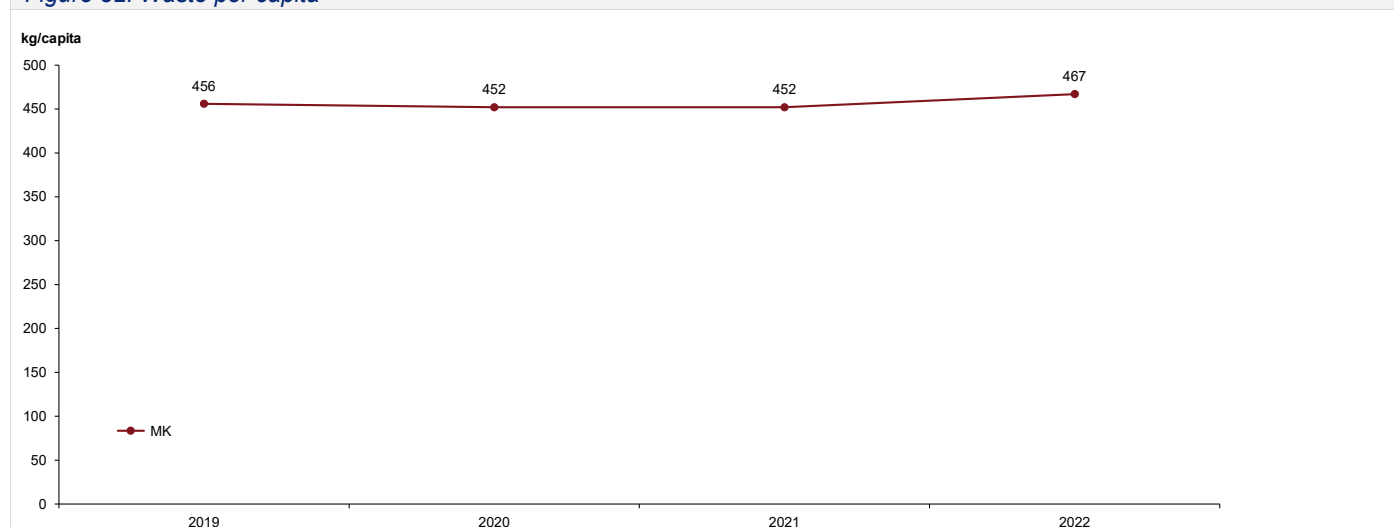
Figure 31. Share of buses and trains in total passenger transport (%)



In the waste sector, the indicator of [waste generated per capita](#) cannot be directly compared with the values presented in the NDC, primarily due to the revision of the population figures following the 2021 census. This change has a significant impact on per capita calculations and creates discontinuity in the time series, making it necessary to update the projections in order to ensure methodological consistency and comparability.

Actual data indicate a relatively stable level of waste generation, amounting to 456 kg per capita in 2019, 452 kg per capita in both 2020 and 2021, and increasing to 467 kg per capita in 2022 (Figure 32). A declining trend has been observed in the more recent period, with preliminary data for 2024 indicating a value of 438 kg per capita. Although this trend may be interpreted as a positive signal, a more detailed analysis is required to determine whether the reduction is the result of effective waste management policies.

Figure 32. Waste per capita

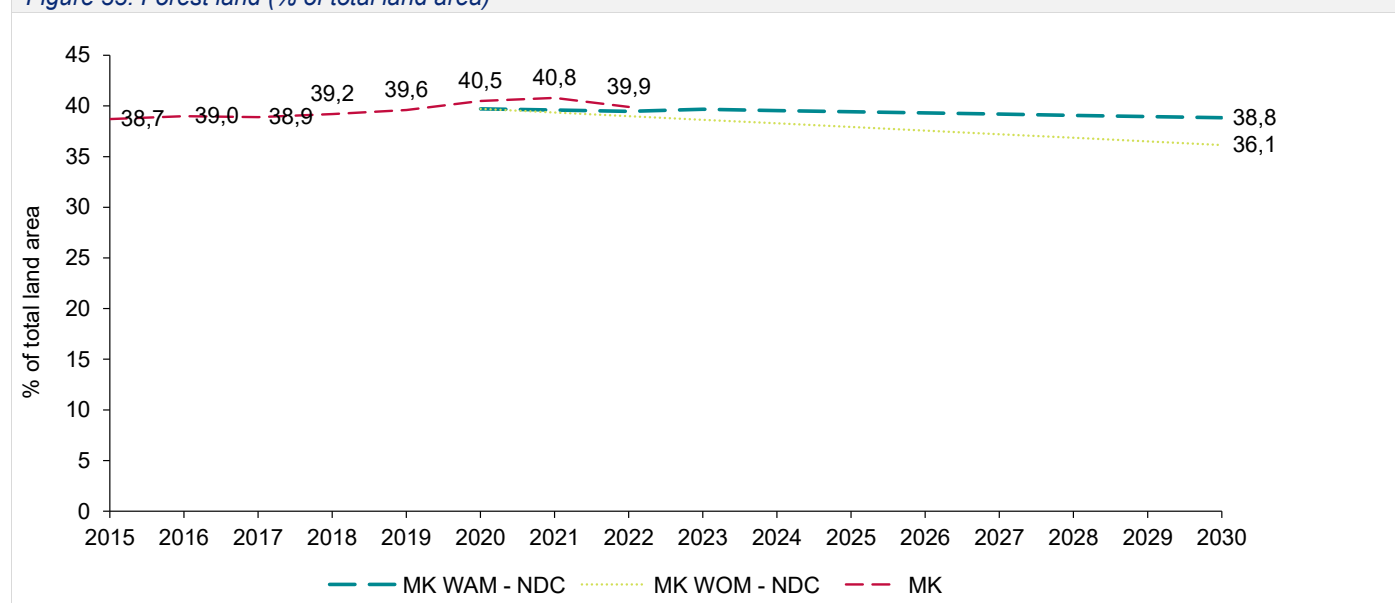


One of the key indicators for monitoring progress under SDG 15: Life on Land is [the share of forest area](#) in the total land area of the country. This indicator provides relevant insights into the condition of terrestrial ecosystems, sustainable forest management, and biodiversity conservation. According to the available data, forest cover, accounting for approximately 40% in 2019, increased to 41% in 2020 and 2021, before declining again to 40% in 2022 (Figure 33).

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This dynamic indicates the absence of significant net changes in forest area during the analysed period, which may be interpreted as evidence of relative stability, but also of limited progress in the expansion of forest ecosystems.

Figure 33. Forest land (% of total land area)



Within the agricultural sector, although no formal indicators are defined in the NDC monitoring framework, an indicative analysis was conducted by comparing actual data available up to 2022 with the projected values for 2025 and 2030 for key livestock categories (Table 1). This approach enables the identification of deviations that may have a direct impact on emission estimates and the achievement of mitigation targets.

The results indicate certain discrepancies between actual and projected values. Specifically, the number of cattle and horses is lower than projected, suggesting that these categories are overestimated in the scenarios, particularly in the case of cattle, which represent a significant source of methane emissions. Such overestimation may consequently lead to an overestimation of emissions. In contrast, the number of goats in 2022 significantly exceeds the projected values, indicating an underestimation of this livestock category.

These discrepancies highlight the need to revise and update the agricultural scenarios in order to ensure consistency between actual trends and the assumptions used in the models. Accurate and up-to-date data are essential for credible emission estimates and for the design of effective mitigation policies in the agricultural sector.

Table 1. Statistical (2016–2024) and projected data on livestock

	Statistical data							Projected data	
	2016	2017	2018	2019	2020	2021	2022	2025	2030
Horses	19263	17951	10041	8952	9154	11140	10659	19926	19931
Cattle	254768	255036	256181	217790	222202	177622	164751	232939	227699
Pigs	202758	202197	195538	135770	164074	186146	182604	168000	170000
Sheep	723295	724555	726990	684558	630634	633281	646488	577913	554953
Goats	101669	107466	117447	87581	95008	75753	80186	36559	28655
Poultry	1865769	1840173	1828287	1562089	1643462	1484025	1561933	1910712	2005922

4 Without Measures Scenario (WOM)

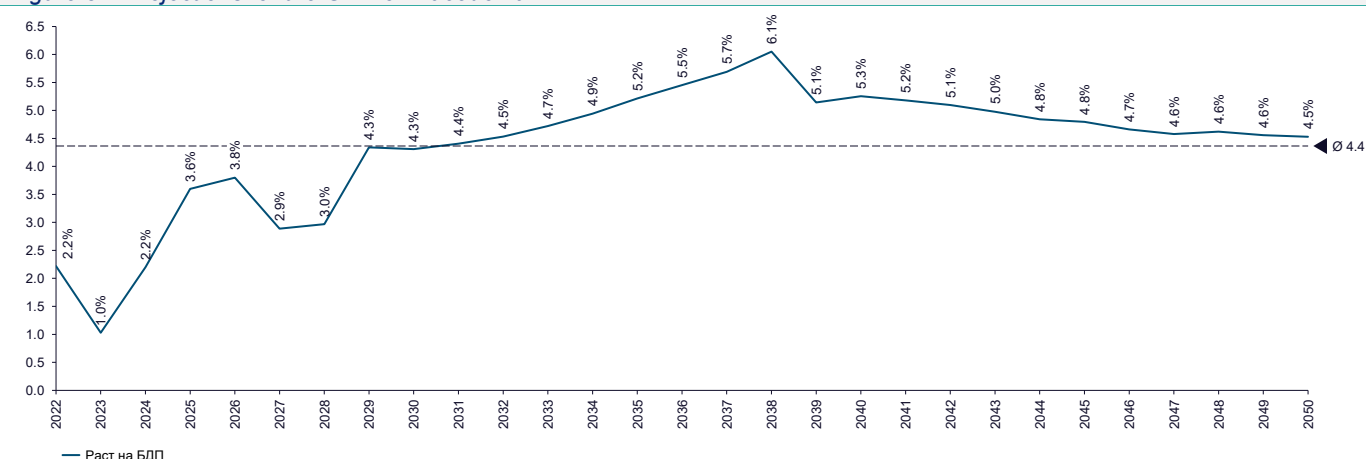
4.1 Energy

4.1.1 Key Assumptions

In general, most of the assumptions in the energy sector are based on the updated version of the Strategy for Energy Development until 2040. They include projections for:

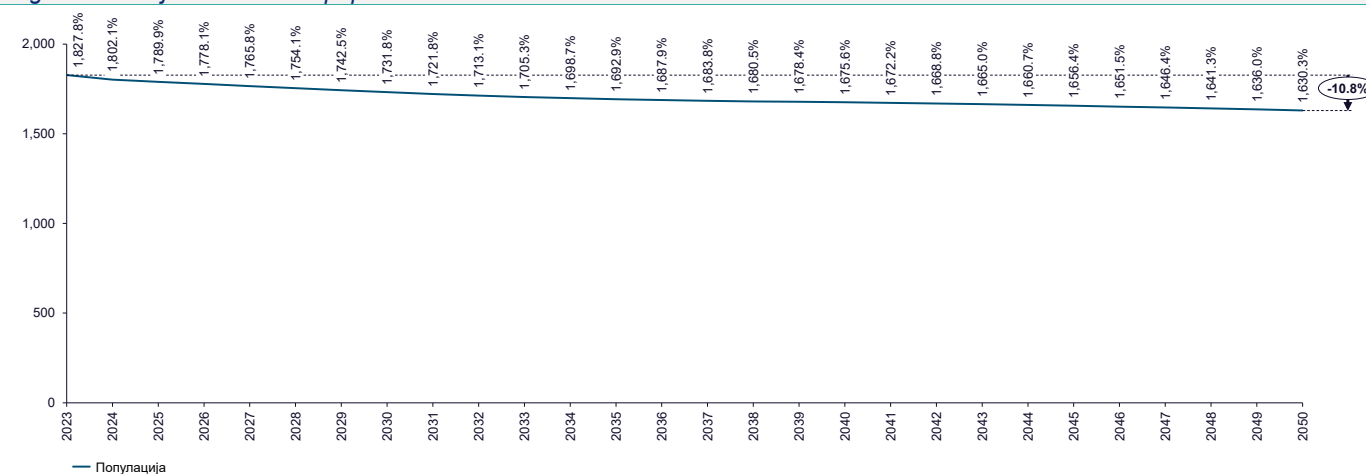
- GDP, average growth rate of 4.4 % (Figure 34)
- Population, decrease of 10% (Figure 35)
- Domestic fuel prices for the period 2012-2023 (Energy Regulatory Commission)
- Fuel prices – gas, coal, oil (World Energy Outlook (WEO) 2017-2023)
- Price of CO₂ emissions (UNDP study on a CO₂ tax in North Macedonia 2021 and WEO 2017-2023)
- Import price of electricity for the period 2012-2023 (HUPX)

Figure 34. Projections for the GDP of Macedonia



Source: National Development Strategy, team analysis

Figure 35. Projections for the population of Macedonia



Source: SSO, team analysis

In addition, the good practices established in previous reports are implemented in this report with updated data for the period 2018-2020, such as:

- Dependence of the growth of the production index of each industry on GDP,
- Dependence of the transport sector on the number of vehicles (new and old) purchased in Macedonia, the average number of kilometres travelled, the average number of tonnes of goods transported, etc.,
- Dependence of the residential and unspecified sector on detailed data on the number of households; members per household, total area, heated area, information on the construction of the buildings (windows,

insulation, year of construction, etc.), appliances used for heating and cooling and the degree of their use, number of refrigerators and other appliances, heating and cooling degree days.

4.1.2 Method

The MARKAL (MARKet Allocation) software package is used to support and assist in forecasting energy demand in the period through 2050. MARKAL is a complex model for planning the development of the entire energy sector at local, national and/or regional level.

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

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

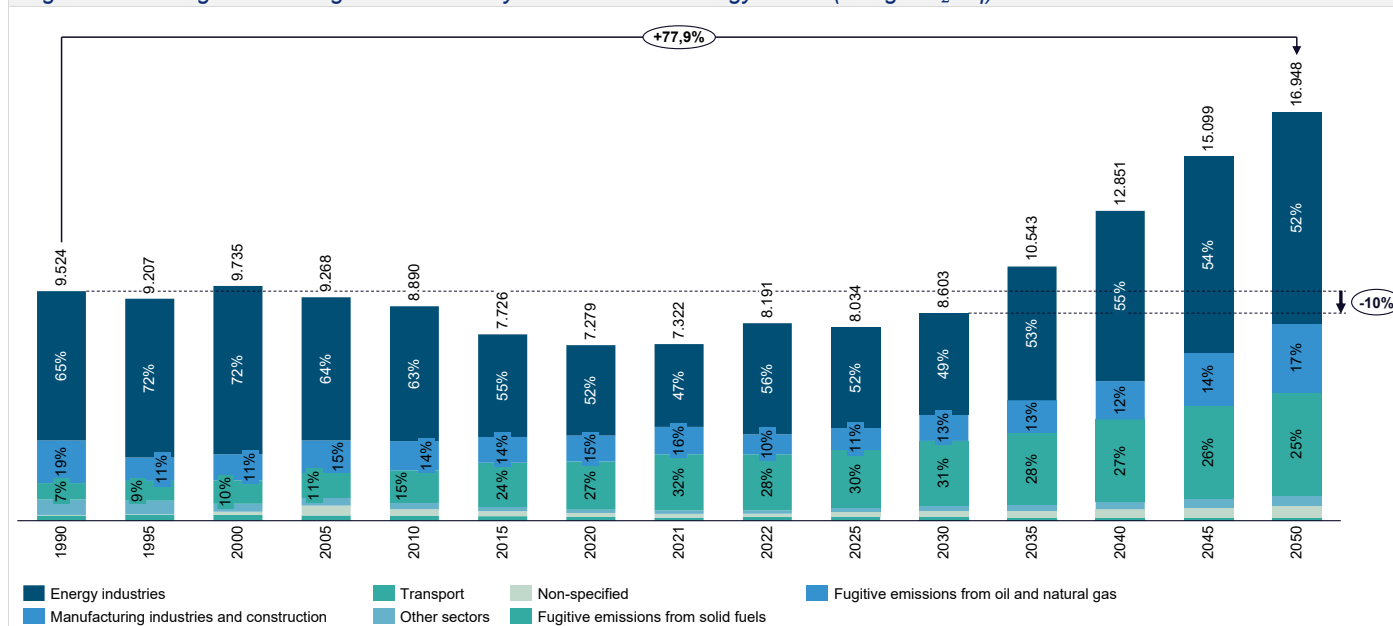
4.1.3 Results

In the period from 2025 to 2030, emissions from the energy sector in the WOM scenario show a pronounced upward trend. Already after 2030, an acceleration in the growth of emissions is observed, in parallel with the increase in primary energy consumption and electricity production from fossil fuels. By 2030, emissions from the energy sector increase by about 78% compared to the level in 1990, which represents a very significant increase. This only shows that in a scenario without new measures, a turn towards low-carbon sources is not expected, but on the contrary, a deepening of the dependence on existing technologies and fuels.

In the structure of emissions by subsector in the same period, the largest contribution is made by electricity production and fuel combustion in the energy industries. There is also a pronounced increase in emissions from transport, but nevertheless this sector remains secondary compared to the electricity sector. The share of the energy sector in total national emissions in 2045–2030 reaches about 55%, which practically means that almost the entire growth of emissions in the WOM scenario originates precisely from this sector.

This result has a clear political and strategic significance: without the introduction of new measures, energy will remain the key driver of the total growth of emissions through 2030. The WOM scenario in this way serves as a warning reference trajectory, showing where the system is heading if existing trends continue without interventions. At the same time, it precisely locates the greatest potential for reducing emissions, since any significant decarbonisation through 2030 will have to take place precisely in the energy sector, through the replacement of fossil fuels, electrification of consumers, primarily in the transport and industry sectors.

Figure 36. Total greenhouse gas emissions by sub-sectors in Energy sector (in Gg CO₂-eq)



4.2 Industrial processes and product use

4.2.1 Key assumptions

The IPPU sector includes emissions from the following categories: the mineral industry, the metal industry, and product uses as substitutes for ozone-depleting substances.

The main assumption considered in projecting greenhouse gas emissions in this sector is that emissions are largely dependent on the growth of the industrial production index within the respective industries. Based on this assumption, an analysis of the correlation between emissions and gross value added in each industrial category is carried out. However, this assumption does not apply to the category Product Uses as Substitutes for Ozone-Depleting Substances, where the main source of emissions originates from imported equipment and appliances (such as refrigerators and air-conditioning units). For this category, it is assumed that the import of such appliances is driven by GDP under the WOM scenario.

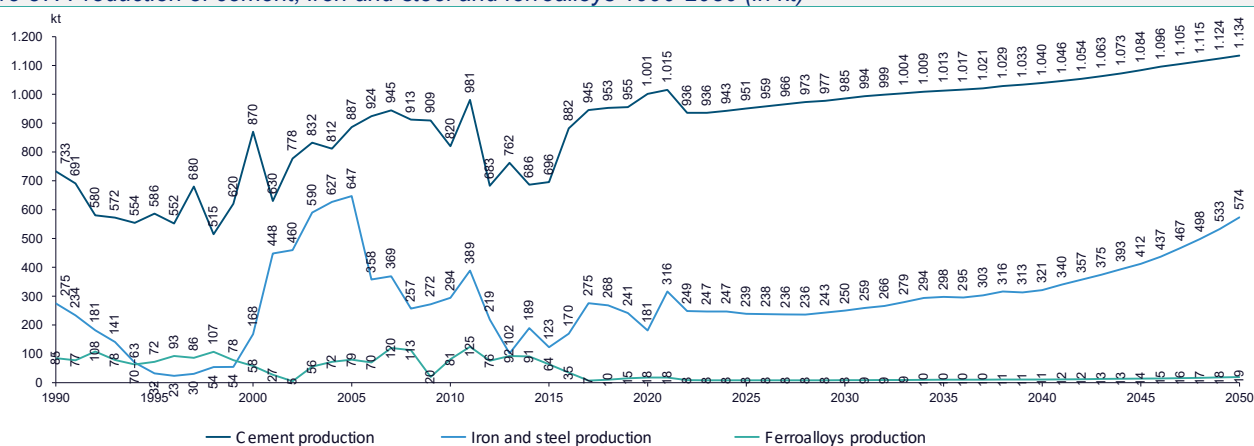
4.2.2 Method

Based on the projected industrial production index, detailed projections were developed for the industries covered under the IPPU sector. This approach was selected in order to provide realistic, consistent, and methodologically robust data that can be directly used in the IPCC software for greenhouse gas emissions calculations. In this way, the previous practice of applying a simple correlation between GDP and emissions, as was the case in the Fourth National Communication, is avoided, since economic activity does not always reflect the actual dynamics of industrial production across individual sectors.

The new approach significantly improves the consistency between historical data and projections. Rather than assuming that economic growth automatically leads to a proportional increase in emissions, emissions are now linked to actual physical industrial activity (e.g. cement, lime, and ferroalloy production). This allows for substantially improved modelling, better alignment with the IPCC methodology, and reduced uncertainty in the projections.

Figure 37 presents the historical and projected trends in the production of cement, lime, and ferroalloys during the period 1990–2030. It can be clearly observed that cement production after 2020 follows a more stable trend compared with historical developments and exhibits moderate growth, which is consistent with the expected industrial dynamics and market structure, as well as with the production capacity available in Macedonia.

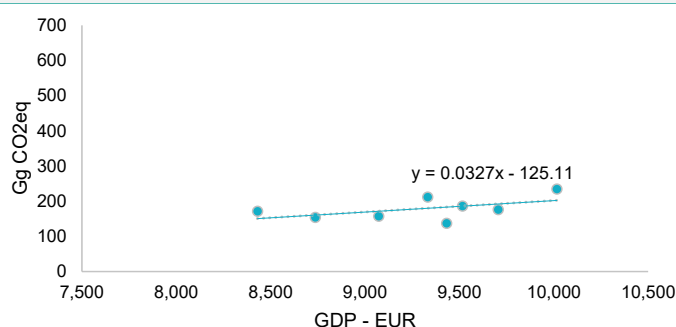
Figure 37. Production of cement, iron and steel and ferroalloys 1990-2030 (in kt)



Source: SSO, team analysis

For emissions from the category Product Uses as Substitutes for Ozone-Depleting Substances, a correlation analysis was carried out with the GDP of Macedonia. The estimated relationship, together with the macroeconomic GDP projections, was used to project emissions from this category for the period up to 2030 under the WOM scenario (Figure 38).

Figure 38. Dependence between greenhouse gas emissions in the category product use as substitutes for ozone-depleting substances and GDP

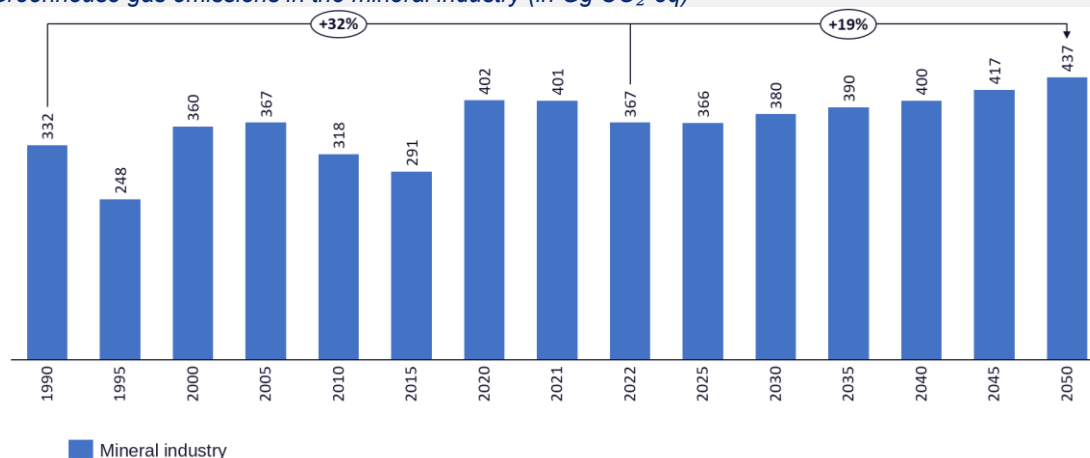


Source: Team analysis

4.2.3 Results

The results of the WOM scenario show that greenhouse gas emissions from the mineral industry will increase by about 19% by 2030, compared to the level from 2022 (Figure 39). This trend is a result of the expected increase in production activity in the sector.

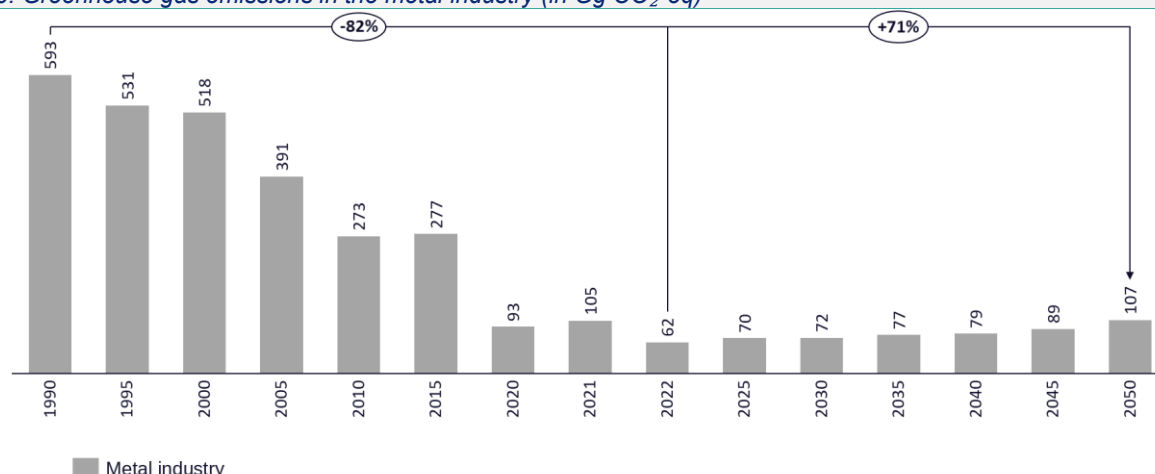
Figure 39. Greenhouse gas emissions in the mineral industry (in Gg CO₂-eq)



Source: IPCC model to 2030, team analysis

Emissions in the metal industry show a strong positive correlation with the growth of the production index in this category, whereby it is projected that by 2030 emissions will reach about 107 Gg CO₂-eq, which represents an increase of approximately 71% compared to the level from 2022 (Figure 40).

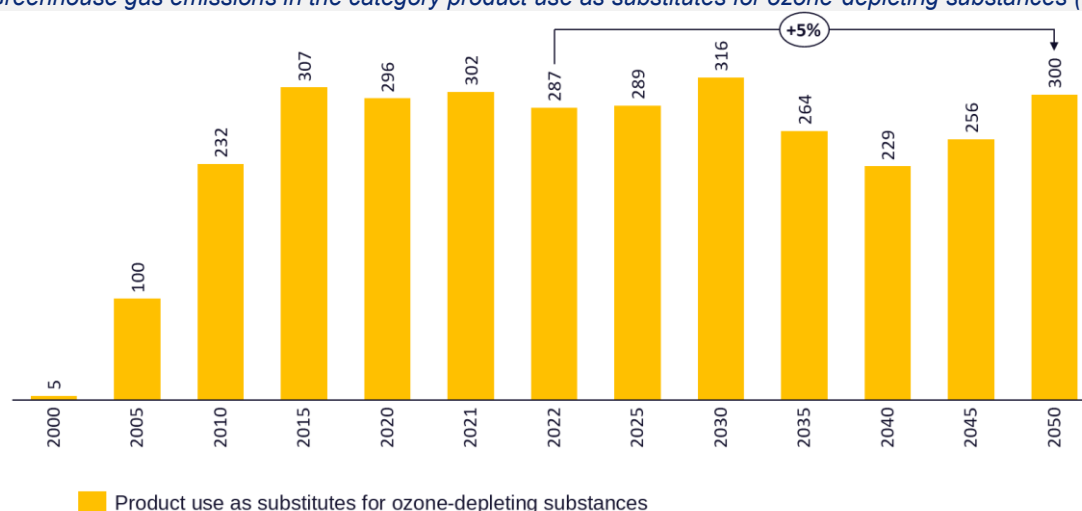
Figure 40. Greenhouse gas emissions in the metal industry (in Gg CO₂-eq)



Source: IPCC model to 2030, team analysis

Emissions from the category Product use as substitutes for ozone-depleting substances are expected to show a certain variability in the coming period. The projections show that by 2030 emissions from this category will be about 5% higher compared to the level of emissions from 2022. This moderate growth reflects the current dynamics of emissions from this category.

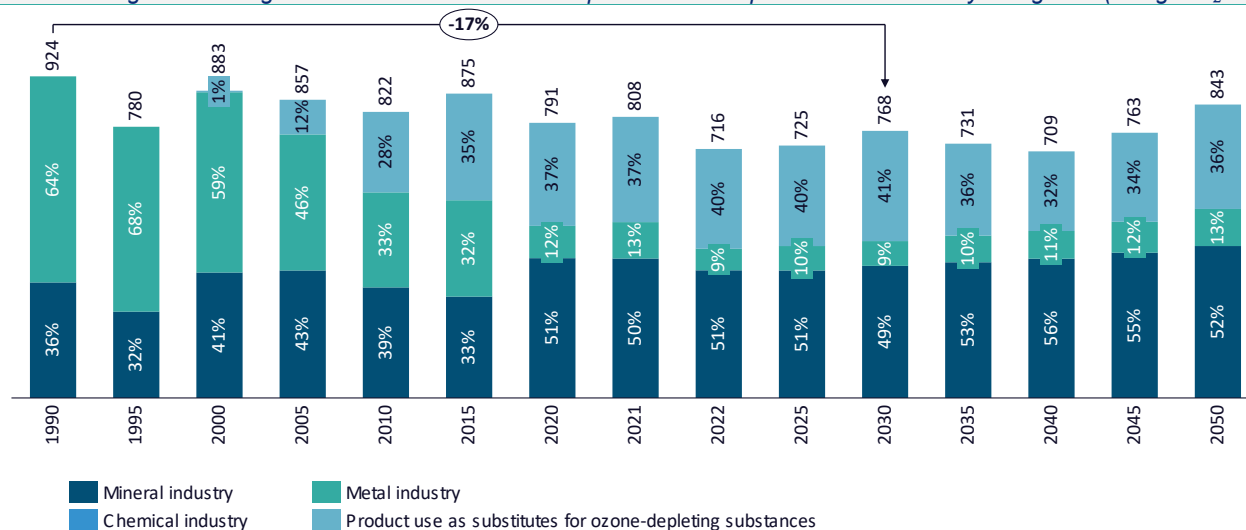
Figure 41. Greenhouse gas emissions in the category product use as substitutes for ozone-depleting substances (in Gg CO₂-eq)



Source: IPCC model to 2030, team analysis

The summarised projections for emissions in the Industrial Processes and Product Use (IPPU) sector indicate a moderate increase in total emissions through 2030. Compared to 2022, emissions are expected to increase by about 18%, reaching approximately 843 Gg CO₂-eq in 2030 (Figure 42). Within the sector, the mineral industry remains the dominant source of emissions, with a projected share of about 52% of total emissions in 2030. Emissions from the metal industry are expected to remain stable, whereby their relative share increases from 9% in 2022 to about 13% in 2030. On the other hand, the share of emissions from the category product use as substitutes for ozone-depleting substances in the total emissions from the Sector decreases from 40% in 2022 to about 36% in 2030.

Figure 42. Total greenhouse gas emissions in the industrial processes and product use sector by categories (in Gg CO₂-eq)



Source: IPCC model to 2030, team analysis

4.3 Agriculture

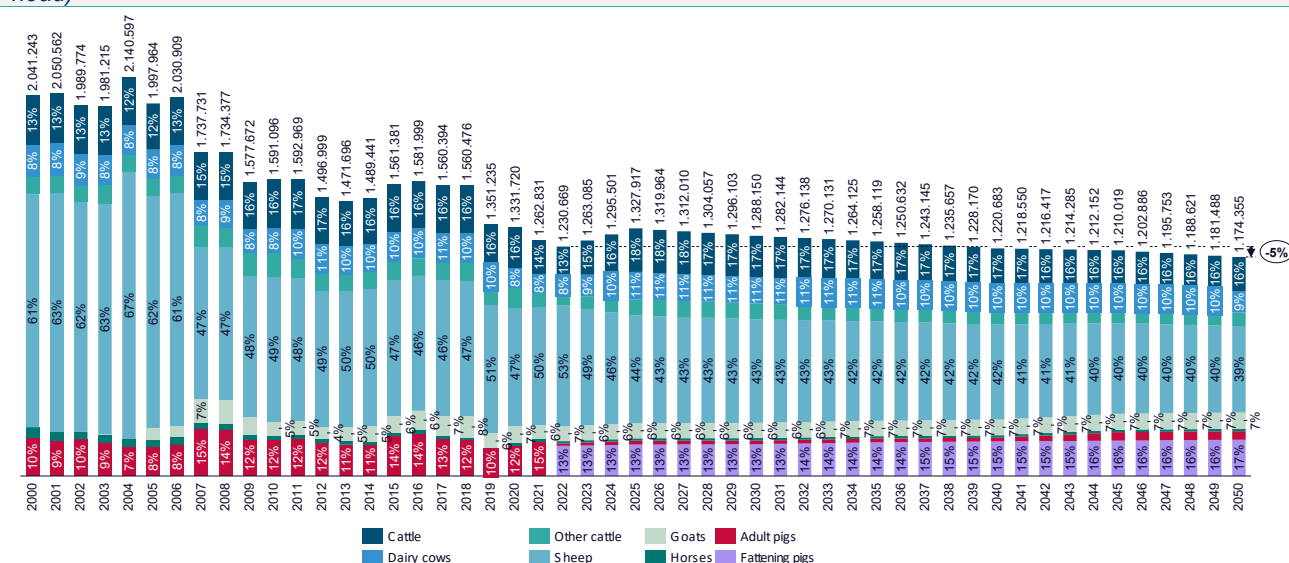
4.3.1 Key assumptions

Emissions in agriculture, for the most part, depend on the number and structure of livestock, as well as on the manner of managing stable manure. This applies in particular to methane emissions from enteric fermentation and emissions related to the storage and treatment of manure. For this reason, the dynamics of the livestock fund represents one of the main drivers of total emissions in the sector. In addition, changes in agricultural practices or technologies can significantly affect the trend of emissions over a longer period of time, although in the WOM scenario it is assumed that such interventions will not occur.

In the WOM scenario, a detailed projection of the number of animals by category through 2030 has been prepared (Figure 43). According to these projections, the total number of livestock will gradually decrease and in 2030 will be about 5% lower compared to 2022. At the same time, the structure of the herds remains almost unchanged, without significant reallocations between types of livestock. This approach reflects the logic of an "inertial" scenario, in which the sector continues to function without significant policies, programmes or technological changes. By category of livestock it can be seen that cattle and sheep remain dominant in the total structure, while the number of pigs records a gradual increase, which is related to the increased breeding in intensive production systems.

A key assumption in the scenario is that the systems for managing stable manure will remain the same as in 2022. This means that no greater introduction of controlled systems, such as covered lagoons or advanced technologies for manure treatment, is envisaged. The same applies to the practices of storage and use of manure, which remain traditional. In addition, no measures are envisaged for improving the nutrition of livestock or using additives for reducing methane, which further strengthens the conservative nature of the WOM scenario.

Figure 43. Data on the population of farm animals used for the inventory of greenhouse gases from livestock (number of head)



Source: IPCC model to 2030, team analysis

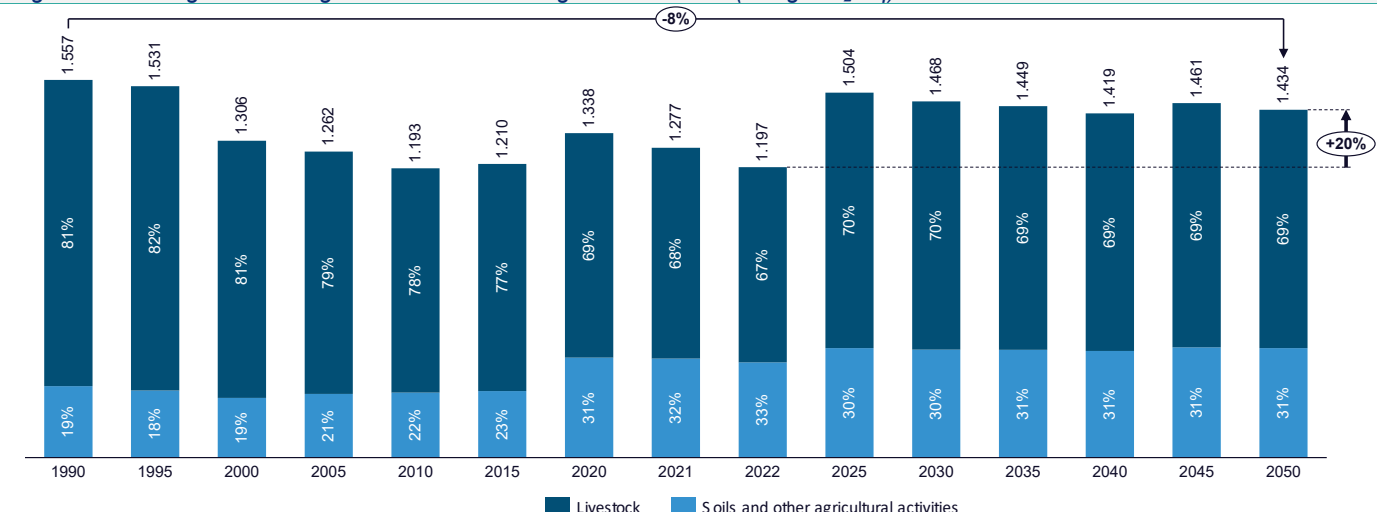
4.3.2 Method

In the agriculture sector, the projections of greenhouse gas emissions through 2030 have been prepared using the IPCC software, with the aim of providing full consistency between historical data and future trends. This approach allows the use of methodologically standardised calculations, which are harmonised with international reporting obligations. In this way, simplified approximations are avoided and it is guaranteed that the results are technically comparable and reliable. At the same time, the application of the IPCC tool allows for greater harmonisation of the agriculture sector with the other sectors in the national inventories and projections.

4.3.3 Results

Figure 44 shows the historical and projected emissions from the agriculture sector, presented by two main groups: livestock and soils and other agricultural activities. In the entire period analysed, livestock remains the dominant source of emissions, with a share of approximately 70% after 2025. Compared to 1990, a decrease in total emissions of about 8% is observed, but from 2022 to 2030 there is a moderate growth of about 20%. This growth is mainly due to emissions from livestock, while the activities related to soils are almost unchanged.

Figure 44. Total greenhouse gas emissions in the agriculture sector (in Gg CO₂-eq)



Source: IPCC model to 2030, team analysis

These results provide a clear picture of how the agriculture sector would develop under conditions where there are no additional policies or measures for decarbonisation. This is precisely what creates a stable basis for comparison with the scenarios with policies and for assessing the potential for reducing emissions through technological and management improvements. In this way, the projections serve as an analytical tool to support the process of policy-making and strategic planning in agriculture.

4.4 Forestry and other land use

4.4.1 Key assumptions

In the forestry and other land use sector, the projections through 2030 have been made on the basis of the assumption that the situation from 2022 will remain unchanged. This means that the conversion of land between different categories will be maintained at the same level and there will be no additional changes to the areas. In order to have consistency with the greenhouse gas inventory, the emission factors also remain the same and no changes in the methodology are expected. This means that, in the WOM scenario, it is assumed that there will be no additional urbanisation, nor conversion of forest, agricultural or grassland areas into other categories of land. This is a conservative approach which shows how the sector would develop if new policies, subsidies or programmes for land management were not implemented. In this way a "status quo" picture is created.

For the category of fires, in forest ecosystems, the historical average from the period 1990–2022 is applied, which amounts to about 9000 hectares annually. It is assumed that this volume of burnt areas will remain the same in the future, without a trend of increase or decrease. Within the framework of the WOM scenario, no new measures for prevention or better management of fires are considered, such as early warning systems, expanded forestry services or active rehabilitation programmes. Although in reality such factors can vary, here they are treated as stable in order to provide a clear and simple analytical basis for comparison with the scenarios with policies. With this, fires remain as a constant source of emissions and loss of carbon from forest ecosystems.

In the area of firewood harvesting, the amount of biomass used is consistent with the results of the MARKAL model for the WOM scenario. This harmonisation is particularly important, since it provides coherence between the forestry sector and the energy sector, where biomass appears as fuel. Neither an accelerated increase nor a decrease in the demand for fuelwood is assumed, but rather a stable trend in accordance with the results of the energy sector. With this, a realistic framework is provided which links natural resources and energy use.

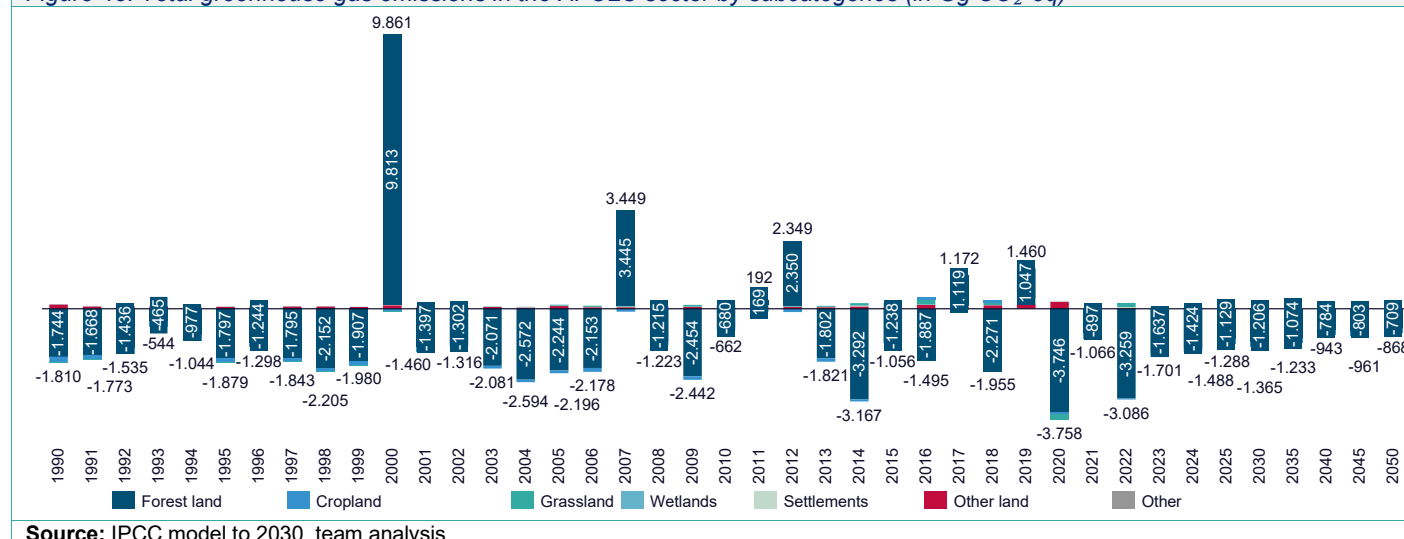
4.4.2 Method

In the Forestry and other land use sector, the projections of greenhouse gas emissions through 2030 have been prepared using the IPCC software, with the aim of providing full consistency between historical data and future trends.

4.4.3 Results

In the "Forestry and land use" sector, sinks dominate, i.e. for the greatest part of the period the sector removes more CO₂ than it emits. The largest contribution to the sink is made by forest land, which continuously provides significant carbon storage. In 2020 and 2022, the sinks have one of the highest levels, reaching approximately 3.8 to 3 Mt CO₂-eq annually, respectively. After 2030, the sink gradually decreases, and by 2030 its level is around 0.8 Mt CO₂-eq. This trend indicates that although forests will continue to have the role of a sink, their capacity for carbon storage is slightly declining over time. The other categories of land, such as cropland and grassland, have a much smaller and relatively stable contribution to the total balance. Such dynamics indicate that the conservation and management of forests remains a key factor for maintaining the sink. At the same time, the sector represents a significant balancing element in the national inventory of greenhouse gases and has an important role in the long-term climate objectives.

Figure 45. Total greenhouse gas emissions in the AFOLU sector by subcategories (in Gg CO₂-eq)



Source: IPCC model to 2030, team analysis

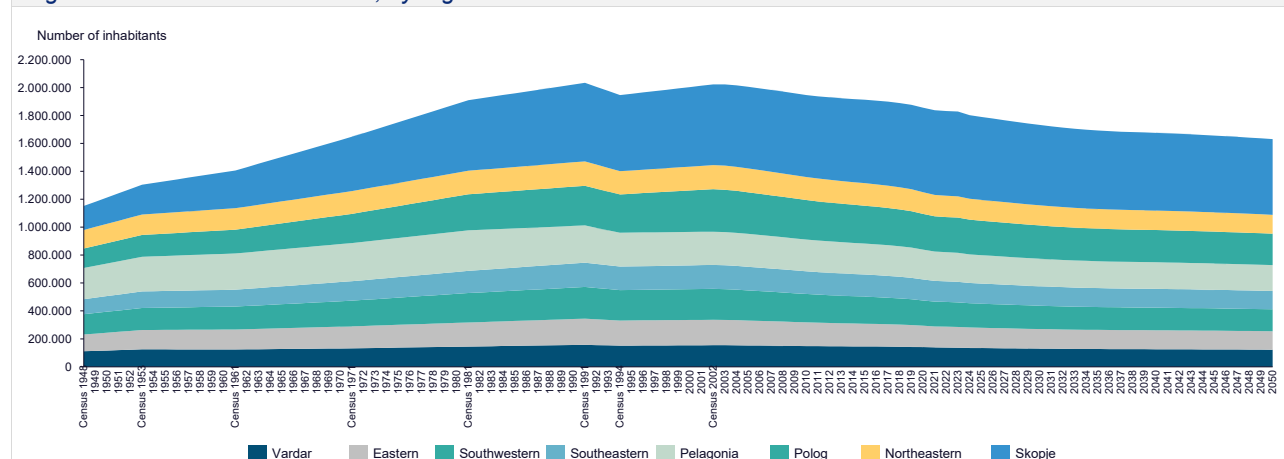
4.5 Waste

In the Waste sector, key changes have been made compared to previous reporting. Namely, in accordance with the Greenhouse Gas Inventory and taking into account the regional nature of solving the problem with waste (where the main measure for mitigating climate change is seen in the establishment of an integrated system of regional centres for the collection, separation, recycling and energy recovery of waste), for the first time a model has been made in which this sector is elaborated by regions. The modelling of emissions was carried out at regional level, including all input data collected and processed by regions, in the period from 1950 to 2030. In this way, a more precise comparison between the regions in the country is enabled — both in terms of historical and current emissions, and for future scenarios for reducing emissions with the opening and functioning of each regional centre for waste management.

4.5.1 Key assumptions

In accordance with this, the key assumptions are also defined at regional level. In terms of the input data, **the number of inhabitants** is one of the key ones in this sector (Figure 46). As stated in the Greenhouse Gas Inventory, data have been entered for the period from 1950 to 2022 by regions, based on the censuses that were held in the country in the years 1948, 1953, 1961, 1971, 1981, 1991, 1994, 2002. For the periods between the censuses an interpolation has been made. For the period from 2003 to 2023, updated data after the census in 2021 have been taken. For the period 2024-2030, the data from the National Development Strategy have been used, i.e. from the IFs model (Combined scenario), whereby in fact the use of the same values for the main drivers in all sectors is harmonised.

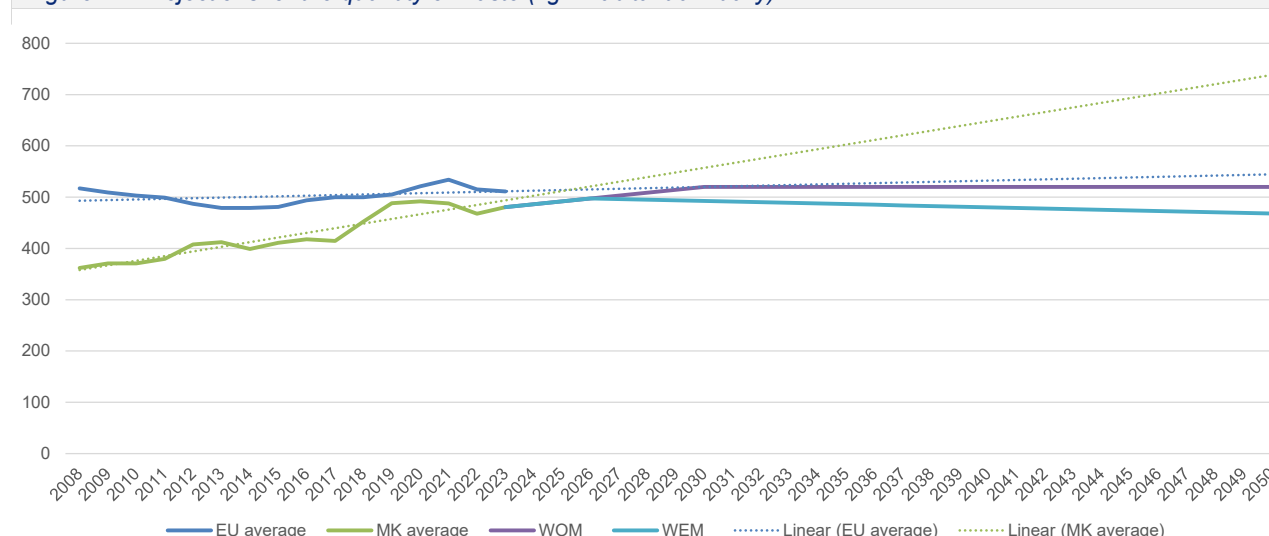
Figure 46. Number of inhabitants, by regions



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

The amount of waste per capita is also a key factor for calculating the projections for emissions from the Waste sector. Accordingly, an analysis of historical data on the amount of waste per capita in Macedonia, as well as the average in Europe (Figure 47), has been made. For the WOM scenario, it is assumed that the amount of waste will grow until 2030, when it will reach the projected average for Europe (if a linear regression of the European average is observed). After that, it is assumed that the amount of waste will remain at the same level, i.e. will not decrease until 2030.

Figure 47. Projections for the quantity of waste (kg/inhabitant/annually)

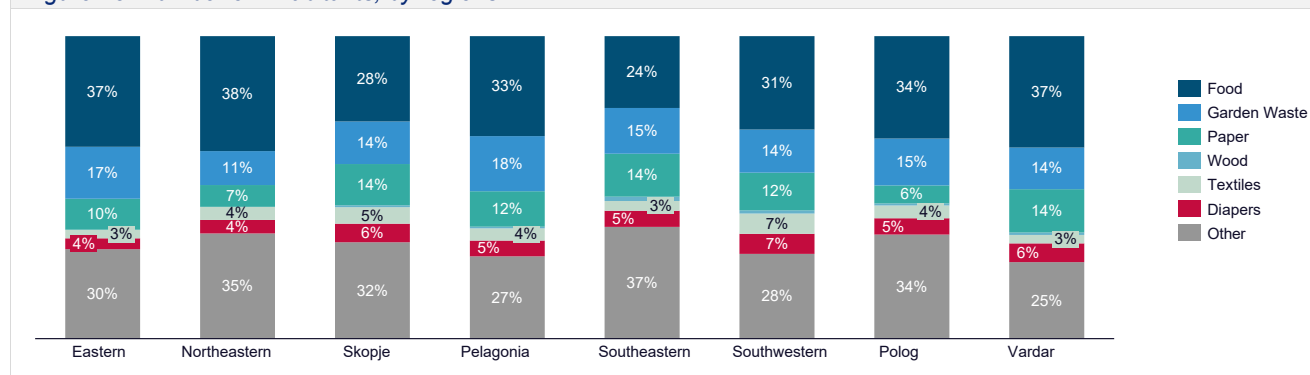


Source: State Statistical Office, EUROSTAT, team analyses

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In terms of the [composition of the waste](#) that ends up in the landfills, it is assumed that the percentage distribution (food, garden, nappies, paper, textiles, wood and other waste) will be the same as in 2023 by regions (Figure 48), i.e. there is no implementation of recycling.

Figure 48. Number of inhabitants, by regions



Source: Regional Waste Management Plans

In terms of the [type of landfills](#), in the WOM scenario it is assumed that there will be no changes compared to 2023, i.e. Uncategorised landfills will not be closed and there will be no opening of new Managed landfills through 2030. The only landfill that falls into the "Managed" category will remain only the Drisla landfill.

As input data in the category Biological treatment of solid waste is [the quantity of waste that is composted](#). For this data, in the WOM scenario it is assumed that the quantity remains the same in the period through 2030, as it was in 2023.

In terms of the input data for the category [Incineration and open burning](#), it is assumed that the "Drisla" landfill will remain the only landfill that possesses a facility for the incineration of medical waste. Accordingly, the data on the quantities of medical waste that is incinerated through 2030 will be the same as in 2023, i.e. it is assumed that a sterilizer will not be additionally used. In terms of the input data for open burning, in accordance with the recommendations from the IPCC Guidelines from 2006, it is assumed that the part of the waste that is burned is equal to the part of the waste that is not taken to landfills. It is assumed that during the entire period through 2030, 90% of the waste is taken to a landfill, while the remaining waste is burned.

In the category [Treatment and discharge of wastewater](#), the same data are used for the type of connection of the households: connected to sewerage, septic tanks, without installation and free flow. In the WOM scenario it is assumed that the type of connection will remain the same in the entire period through 2030. In industry it is assumed that the quantity of products by type of industry will remain the same during the entire period. Also, the WOM scenario envisages that there will be no opening of new treatment plants.

4.5.2 Method

For the purpose of preparing the projections of greenhouse gas emissions from the Waste sector for the period through 2030, a model based on the IPCC Inventory Software was developed. Within the framework of the software, two separate databases were created, which correspond to the WOM scenario and the WEM scenario, whereby each database reflects the relevant assumptions and policies characteristic of the corresponding scenario.

The modelling was carried out through an upgrade of the existing national greenhouse gas inventory, whereby the regional approach applied in the inventory, together with the structures of the activities, the emission factors and the other input parameters, is retained also in the projection part. In this way, full methodological harmonisation between the historical data and the future projections is provided, as well as consistency in the time series.

The advantage of using the IPCC Inventory Software lies in the possibility of directly using the IPCC methodologies, automatic application of the relevant emission factors and a clear delineation of the individual subsectors of the Waste sector, such as solid waste disposal, wastewater treatment and management of other waste streams. In addition, the software allows analysis of the results by regions and transparent analysis of how each individual measure affects emissions

4.5.3 Results

The results of the WOM scenario for the Waste sector indicate a significant increase in total greenhouse gas emissions in the period analysed. Namely, by 2030 emissions from this sector are projected to grow by 111%, reaching 1090 Gg CO₂-eq, compared to the level from 1990 (Figure 49).

During the entire period of the projections, solid waste disposal remains the dominant source of emissions, with a share of about 85% of total emissions in 2030. On the other hand, emissions from wastewater treatment show a declining

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trend even within the framework of the WOM scenario, which is to the greatest extent due to the projected decline in the number of inhabitants through 2030. Nevertheless, despite the decrease, this subcategory continues to have a relatively significant share, i.e. about 13% of total emissions in 2030.

Although demographic trends also affect the quantities of landfilled solid waste, the accumulation of waste in the landfills over time, under conditions of an absence of measures for capturing or utilising the landfill gas, results in a continuous increase in emissions from this subsector. This effect represents a key driver of the growth of emissions in the WOM scenario.

In terms of the distribution of emissions by gases, methane convincingly dominates in the total emissions from the Waste sector within the framework of the WOM scenario. Namely, in 2030 the share of CH₄ amounts to about 96% of total emissions (Figure 50).

Figure 49. Total greenhouse gas emissions in the Waste sector by subcategories (in Gg CO₂-eq)

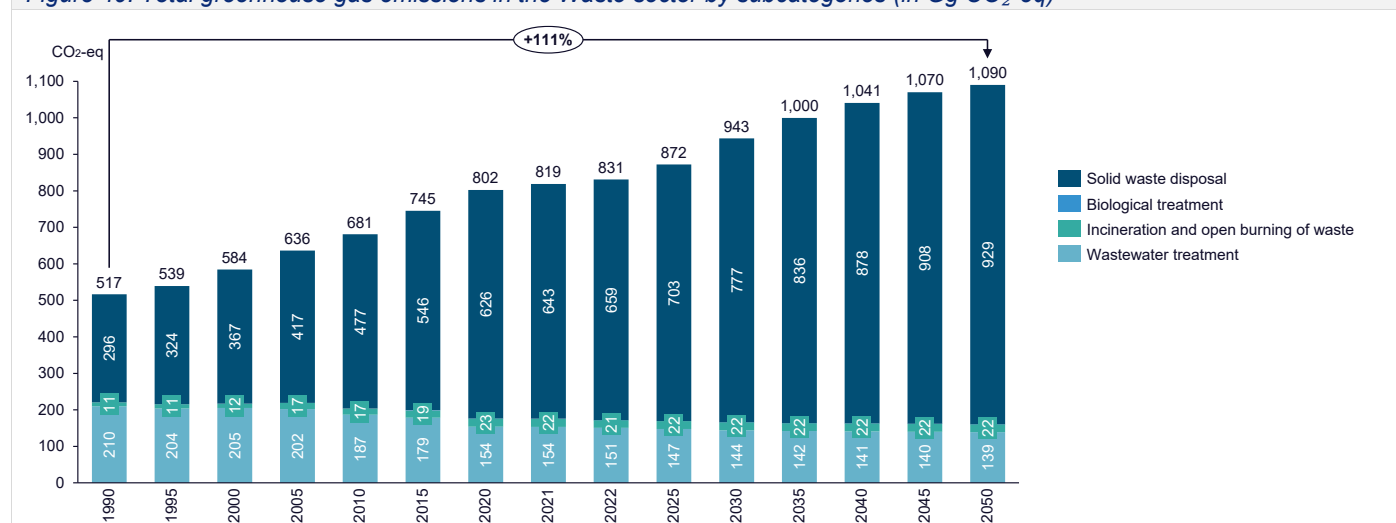
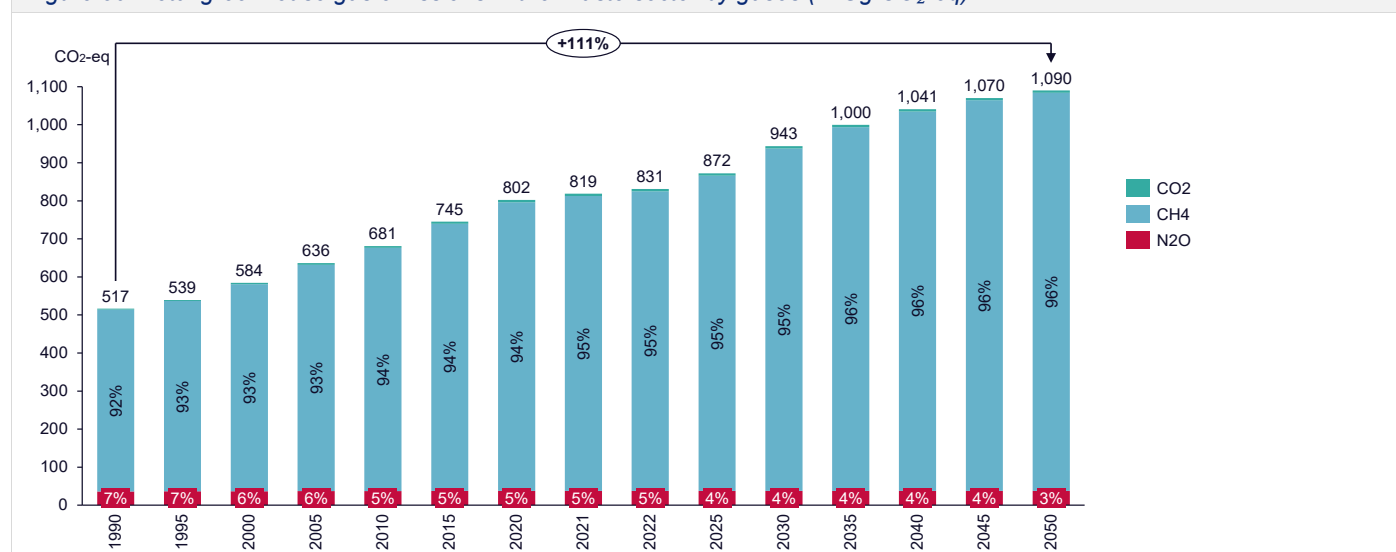


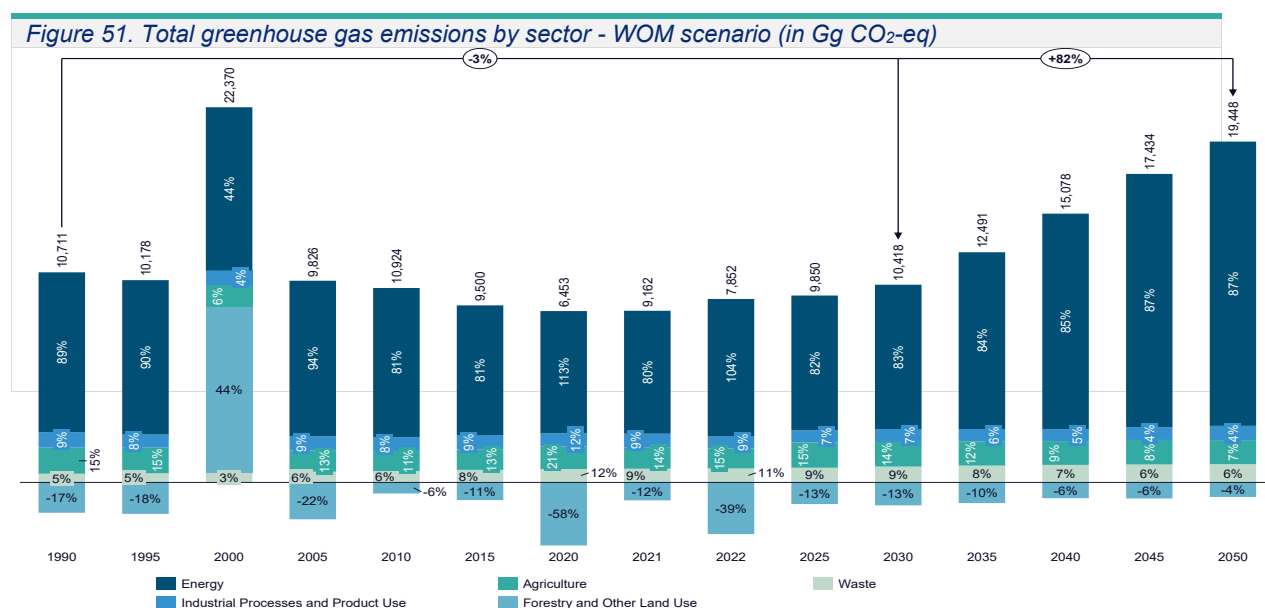
Figure 50. Total greenhouse gas emissions in the Waste sector by gases (in Gg CO₂-eq)



4.6 Total emissions

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

These results clearly show that the WOM scenario represents a path of limited progress through 2030, after which accelerated growth of emissions follows, if additional measures are not introduced. The structural dependence on fossil fuels remains the main driver of the trend, and the natural sink from forestry is not sufficient to compensate for the growth of emissions. This scenario therefore serves as an important reference point for assessing the need for policies and interventions, which would change the trajectory of emissions and would allow harmonisation with the long-term climate objectives.



5 Mitigation measures and their individual effect

This chapter presents the policies and measures for climate change mitigation that are considered within the measures scenario. **In total, 69 policies and measures have been analysed and distributed across sectors as follows: 32 measures in the Energy sector, 1 measure in the Industrial Processes and Product Use (IPPU) sector, 4 measures in the Agriculture sector, 2 measures in Forestry and 5 measures in Land Use, 9 measures in the Waste sector, as well as 16 Additional measures.** In this way, the chapter provides a comprehensive overview of measures that directly contribute to emission reductions, as well as the broader institutional, regulatory, and strategic framework that enables their implementation.

Each policy and measure is presented in tabular form in order to ensure that the information is clear, systematic, and easily comparable. For each measure, key information is provided regarding its title, description, and main objective, the type of policy instrument, the relevant sector, the greenhouse gases affected, the starting year of implementation, the responsible institutions, and the expected contribution to emission reductions. In addition, where relevant, information is provided on the implementation status, the assumptions underlying the assessment, the key implementation steps, indicators for monitoring progress, and contributions to broader development and sustainability objectives.

This approach allows each measure to be considered not in isolation, but as part of a broader and interconnected decarbonisation framework. It thereby facilitates a clearer understanding of the specific provisions of each measure, its role in reducing emissions, and the institutions responsible for its implementation. The effects of policies and measures, particularly in terms of emission reductions, energy savings, and other expected outcomes, are assessed relative to the Without Measures (WOM) scenario, which serves as the reference baseline for comparison. Consequently, this chapter represents an important tool for understanding the country's planned pathway towards low-carbon development and for monitoring actual progress in the implementation of climate policies.

5.1 Energy

5.1.1 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 modeling 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			

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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

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 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 modeling 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	
			 	

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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 modeling 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	

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 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   

PAM4INCENTIVES 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
 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 - 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			

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			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
			2018		2025
	Progress	Installed capacity (MW)	/		200
	Emission reduction (Gg CO ₂ -eq)				2030
					108
Other		Primary energy savings (ktoe)			21.5
	Finance		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).						

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Planned steps	- 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)		
	- 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		
	Source of funding		
 Implementing entity	24.3 million euros		
	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		
 Contribution to achieving Sustainable Development Goals	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 modeling and least-cost optimization using the MARKAL model. IPCC methodology			
 Assumptions	It is planned to build 800 MW solar capacity by 2030.			

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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, Fotirka, Palteks, Alpinkom, 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)		3.3	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

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 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 modeling 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	
			

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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 modeling 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			
						

5.1.2 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 modeling 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			

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 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 modeling 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	
			5.2	
			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			

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 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 modeling 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 labeling 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-labeling 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	Value in the last reporting year		Target value	
	2016-2018		2030	
 Progress	Number of devices sold (A+++, A++, A+, A)		7789	
Emission reduction (Gg CO ₂ -eq)			2030	
			42.4	

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Other	Final energy savings (ktoe)		1.6
	Primary energy savings (ktoe)		2.3
 Finance	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	
 Monitoring entity		• Manufacturers and suppliers of electrical equipment and household appliances	
		• End users	
 Contribution to achieving the Sustainable Development Goals		• Ministry of Energy, Mining and Mineral Resources	
		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 labeling 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 modeling 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		106.1
	Final energy savings (ktoe)		
	Primary energy savings (ktoe)		142.0
	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 CENTERS 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 centers 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 modeling 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 Center of the City of Skopje has been opened - Free advice to users on reasonable electricity consumption provided by the EVN Customer Service Center			
Planned steps	- Broadcasting TV commercials, announcements, campaigns and documentaries - Expansion of the Energy Efficiency Platform - Continuous work on existing and opening of new information centers.			
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			

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 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 centers 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 modeling 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 aluminum 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) 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 totaling 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			

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			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 (m ²)	1481469	
		Energy consumption per heated/cooled area (kWh/m ²)	158	
	Emission reduction (Gg CO ₂ -eq)		2030	
			20.5	
			40.1	
	Other	Final energy savings (ktoe)	47.8	
Primary energy savings (ktoe)				
	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)

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PAM15 RECONSTRUCTION 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 centers, 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 modeling 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)	

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 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

PAM16RECONSTRUCTION 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 buildings self-	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 modeling 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.			

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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	5.3	
	Primary energy savings (ktoe)	7.3	
	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 modeling 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			

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		- 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
	Progress	Area under renovation (m ²)	SEE PAM 14
	Emission reduction (Gg CO ₂ -eq)		2030
	Other	Final energy savings (ktoe)	63.6
		Primary energy savings (ktoe)	12.3
	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 modeling 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.			

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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 modeling 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		

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		• Establishment of an Energy Efficiency Fund	
Indicators	Value in the last reporting year		Target value
	2016-2018*		2030
	Progress	Area under renovation (m ²)	
			2030
	Emission reduction (Gg CO ₂ -eq)		16.6
Other	Final energy savings (ktoe)		8.3
	Primary energy savings (ktoe)		10.3
	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 modeling 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-		

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			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			36.3	
			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 modeling 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		

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	Planned steps		- Completed tenders and/or street light replacement underway in more than 10 municipalities - Promotional activities undertaken for the implementation of public-private partnership (PPP)
			- 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
			37.9
Other	Final energy savings (ktoe)		7.8
	Primary energy savings (ktoe)		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 modeling and least cost optimization using the MARKAL model. IPCC methodology			
Assumptions	Increased rate of advanced energy efficiency technology due to public procurement by 7%			

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	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-labeling 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)					
	Primary energy savings (ktoe)	1.4				
		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 modeling 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			
	20 million euros 4.28 million euros for a project for individual metering in 30 existing buildings			
	Source of funding			
	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			

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 Monitoring entity	- Energy Regulatory Commission - Ministry of Energy, Mining and Mineral Resources
 Contribution to achieving the Sustainable Development Goals	direct indirect   

5.1.3 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 modeling 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	

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 Finance	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 modeling 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	Final energy savings (ktoe)			8.8
	Primary energy savings (ktoe)			12.6
 Finance	Budget	120 million euros		
	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			

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 Monitoring entity	• Regulatory Commission for Energy, Water and Municipal Waste Management Services • Ministry of Energy, Mining and Mineral Resources				
 Contribution to achieving the Sustainable Development Goals	<table><tr><th data-bbox="636 226 900 282">direct</th><th data-bbox="900 226 1484 282">indirect</th></tr><tr><td data-bbox="636 282 900 403"></td><td data-bbox="900 282 1484 403"></td></tr></table>	direct	indirect		 
direct	indirect				
	 				

PAM26INTRODUCTION 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 modeling 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 - 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	- 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)		
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	
			

5.1.4 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 modeling 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			
	 Steps taken	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

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Other	Final energy savings (ktoe)	91.7
	Primary energy savings (ktoe)	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	
 Contribution to achieving the Sustainable Development Goals	direct and	indirect
	    	

PAM28 RENEWAL 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

- 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	planning	• National Transport Strategy • Energy Development Strategy of the Republic of North Macedonia until 2040 • Vehicle Law • Law on Vehicle Tax		
 Methodology	• Energy modeling 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			

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			• 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
				22.1
	Other	Final energy savings (ktoe)		18
		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 modeling 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			

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 Contribution to achieving the Sustainable Development Goals	direct and	indirect
		  

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 modeling 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	
Emission reduction (Gg CO ₂ -eq)			2030	
			3.0	
Other	Final energy savings (ktoe)		1	
	Primary energy savings (ktoe)		1	

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 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 modeling 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.			
	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.			
	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 the indicator
	report year			
	2016-2018	2020	2025	2030

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Progress	Increase in tonne-km in rail transport (tkm)	
		2030
	Emission reduction (Gg CO ₂ -eq)	24.6
Other	Final energy savings (ktoe)	10.2
	Primary energy savings (ktoe)	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 modeling 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.			
	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.			
Planned steps				

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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.

5.2 Industrial Processes and Product Use

PAM33 IMPLEMENTATION 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)			

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		• 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	<table><tr><th colspan="2">Value in the last reporting year</th><th>Target value</th></tr><tr><td colspan="2">2022</td><td>2030</td></tr></table>	Value in the last reporting year		Target value	2022		2030
Value in the last reporting year		Target value						
2022		2030						
	Progress	<table><tr><td>HFC [tons]</td><td>403</td><td>0</td></tr></table>	HFC [tons]	403	0			
HFC [tons]	403	0						
	Emission reduction (Gg CO ₂ -eq)	<table><tr><td></td><td></td><td>2030</td></tr><tr><td></td><td></td><td>225.6</td></tr></table>			2030			225.6
		2030						
		225.6						
	Finance	<table><tr><td>Budget</td><td> • N/A </td></tr><tr><td>Source of funding</td><td> • Montreal Protocol Fund, private sector </td></tr></table>	Budget	• N/A	Source of funding	• Montreal Protocol Fund, private sector		
Budget	• N/A							
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><td>direct</td><td>indirect</td></tr><tr><td></td><td></td></tr></table>	direct	indirect		 		
direct	indirect							
	 							

5.3 Agriculture, forestry and other land use

5.3.1 Livestock farming

PAM34REDUCING 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			

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 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.			

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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			
	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;			

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	- 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								
 Progress	<table><tr><th>Indicator value in the last reporting year</th><th colspan="2">Indicative trajectory</th><th>Indicator target value</th></tr><tr><th>2022</th><th>2025</th><th>2030</th><th>2035</th></tr></table>	Indicator value in the last reporting year	Indicative trajectory		Indicator target value	2022	2025	2030	2035
	Indicator value in the last reporting year	Indicative trajectory		Indicator target value					
	2022	2025	2030	2035					
	- 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	<table><tr><td>Budget</td><td> 1 million US dollars </td></tr><tr><td>Source of funding</td><td> - Private sector, IPARD Programme </td></tr></table>	Budget	1 million US dollars	Source of funding	Private sector, IPARD Programme				
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
		

PAM37REDUCTION 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.			

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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.	0					
Emission reduction (Gg CO ₂ -eq)						2030	
						0.7	
 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		
							

5.3.2 Agriculture

Of the 11 proposed measures in the AFOLU sector, 5 measures in the field of crop agricultural production are listed under 5.3.4, 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

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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	Indicator value in the last reporting year Indicator target value
Progress	2025 2030
Emission reduction (Gg CO₂-eq)	2030 93.6
Finance	Budget Source of funding
Implementing entity	• \$108.0 million • Private sector, IPARD Programme • MAFWE
Monitoring entity	• MAFWE
Contribution to achieving the Sustainable Development Goals	direct indirect 13 CLIMATE ACTION

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.

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 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	<table><tr><th>Indicator value in the last reporting year</th><th colspan="2">Indicative trajectory</th><th>Indicator target value</th></tr><tr><th>2025</th><th>2030</th><th>2040</th><th>2030</th></tr></table>				Indicator value in the last reporting year	Indicative trajectory		Indicator target value	2025	2030	2040	2030
Indicator value in the last reporting year	Indicative trajectory		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											

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 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 (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%.				
 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;			

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Emission reduction (Gg CO ₂ -eq)				2030
				1.0
 Finance	Budget	• \$1.0 million		
	Source of funding	• Private sector, IPARD Programme		
 Implementing entity	• MAFWE			
 Monitoring entity	• MAFWE			
 Contribution to achieving the Sustainable Development Goals		direct		indirect
				

5.3.3 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)			

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		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		Budget: 1.45 million euros
	Source of funding		PE "Nacionalni Shumi", other forestry enterprises
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 modeling, 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	In the implementation phase			
Steps taken	There are nurseries producing more than 8,000,000 seedlings per year.			
Planned steps	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 Phase I - seedling production			

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		- 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)		
Finance	Budget	
	Source of funding	
Implementing entity		MAFWE
Monitoring entity		MAFWE
Contribution to achieving the Sustainable Development Goals	direct	
	indirect	

5.3.4 Other land use

PAM43CONVERSION 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		

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		• 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
	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.

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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)			
Emission reduction (Gg CO ₂ -eq)			2030	
			28	
 Finance	Budget	\$1.15 million		
	Source of funding	• Private sector, IPARD Programme		
 Implementing entity	• MAFWE			
 Monitoring entity	• MAFWE			

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 Contribution to achieving the Sustainable Development Goals	direct		indirect	
				
PAM45CULTIVATION 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	• 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.			
 Planned steps	• 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	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	
			8.9	

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 Finance	Budget	1.2 million dollars
	Source of funding	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,			

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		- 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		Indicator value in the last reporting year		Indicator target value
		2025		2030
	Progress	Area (ha) of arable land enriched with biochar. Amount of carbon sinks per hectare and total.		
Emission reduction (Gg CO ₂ -eq)				
				2030
				110
	Budget	35 million dollars		
	Source of funding	Private sector, IPARD Programme		
	Implementing entity	MAFWE		
	Monitoring entity	MAFWE		
Contribution to achieving the Sustainable Development Goals		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			

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 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.		
	- 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	\$54.5 million		
	Private sector, IPARD Programme		
 Monitoring entity	MAFWE		
	Ministry of Energy, Mining and Mineral Resources		
 Contribution to achieving the Sustainable Development Goals	direct		indirect
			

5.4 Waste

PAM48 ESTABLISHMENT OF REGIONAL CENTERS FOR INTEGRATED WASTE MANAGEMENT

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

DESCRIPTION: The measure covers the establishment and commissioning of five regional centers 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				

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 Methodology [for estimating emissions]	IPCC methodology				
 Assumptions	- Opening of regional waste management centers 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 centers begins				
Indicators	<table> <tr> <th>Indicator value in the last reporting year</th><th>Indicator target value</th></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 Amount of compost (kt)	0				
Emission reduction (Gg CO ₂ -eq)	<table> <tr> <td></td><td>2030</td></tr> <tr> <td></td><td>270</td></tr> </table>		2030		270
	2030				
	270				
 Finance	<table> <tr> <td>Budget</td><td> 60 million euros </td></tr> <tr> <td>Source of funding</td><td> - Local self-government through public utility companies, public-private partnership, EU funds </td></tr> </table>	Budget	60 million euros	Source of funding	Local self-government through public utility companies, public-private partnership, EU funds
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	<table> <tr> <td>direct</td><td>indirect</td></tr> <tr> <td>   </td><td>  </td></tr> </table>	direct	indirect	 	
direct	indirect				
 					

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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 centers 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 centers 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	

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 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.			

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Planned steps	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.		
	- 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  Progress Quantity of selected municipal waste (kt) Emission reduction (Gg CO₂-eq)	Indicator value in the last reporting year		Indicator target value
	2022		2030
			2030
			53.2
Finance Budget Source of funding	2 million euros		
	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
	  		

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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, Figure 41), 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 centers, "repair" initiatives)			
Indicators  Progress Amount of waste per inhabitant (kg/inhabitant) Emission reduction (Gg CO₂-eq)	Indicator value in the last reporting year	Indicative trajectory		Indicator target value
	2022	2030	2040	2030
		121	231	319
Budget				
 Finance	n.a			
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			

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 Monitoring entity	• Ministry of Environment and Physical Planning		
 Contribution to achieving the Sustainable Development Goals	direct	indirect	
			

PAM52CONSTRUCTION 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		Indicator target value
	2022	2030	2040	2030	
 Progress	Total installed capacity of newly built wastewater treatment plants (p.e.)		0	1,121,674	1,121,674
Emission reduction (Gg CO ₂ -eq)				2030	
				25	

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	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
		  

PAM53IMPROVED 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] Steps taken Planned steps	• In the planning phase / • 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

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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		
 Contribution to achieving the Sustainable Development Goals		direct	indirect	
				

5.5 Additional measures

PAM54 INTRODUCTION OF MRVA SYSTEM AND NATIONAL CARBON PRICING MECHANISM

MAIN OBJECTIVE: To establish a functional national carbon pricing mechanism supported by an 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 an 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 modeling, 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			

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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			

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 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 modeling,			
 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			

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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		
Monitoring entity		• Public Enterprise Elektrani na Republika Severna Makedonija (ESM)		
		• Ministry of Labor and Social Policy		
Contribution to achieving the Sustainable Development Goals		• Donors		
		• Ministry of Energy, Mining and Mineral Resources		
		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 technical and	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)			

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		- 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		
Finance	Source of funding	- Depending on the type of smart community - 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			

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		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 analyzing 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			
	Source of funding	- 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			
		direct			
		indirect			
Contribution to achieving the Sustainable Development Goals		  			

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 modeling (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	
	Interconnection capacity		Target value of the indicator	
		2018		2030
Progress				Interconnector with Greece built
 Emission reduction (Gg CO ₂ -eq)	2030		2040	2030
 Finance	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	
			 	

CHAPTER 5

PAM60DEVELOPMENT 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 modeling with the MARKAL model.			
 Assumptions				
Implementation status [idea, planning phase, in implementation phase]	In the implementation phase			
Steps taken	- Klečovce - 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			
	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		
				

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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 modeling 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			
	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

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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 neighboring 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 modeling, 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 coupling realized
 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	
 Finance	Budget	n.a		
	Source of funding	• Distribution operator • Electricity suppliers		
 Responsible body for implementation	• Participants in the electricity market • Ministry of Energy, Mining and Mineral Resources			
 Monitoring entity	• Energy Regulatory Commission			

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 Contribution to achieving the Sustainable Development Goals	direct	indirect
		 

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 centers 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 centers			
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	• A different budget every year		

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	Source of funding	State budget and potential donors
	Responsible body for implementation	- 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 modeling (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	

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	2018	2030
Progress		
 Number of innovations		2030
Number of researchers		
Budget	on	
 Finance	- Innovation and Technological Development Fund - Horizon Europe - Chamber of Commerce of the Republic of North Macedonia	
Source of funding		
 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			

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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			

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Indicators	Indicator value in the last reporting year		Target value of the indicator
	2018		2030
Progress			
 Emission reduction (Gg CO ₂ -eq)			2030
Budget			
 Finance	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			

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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).			

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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 2018 Target value of the indicator 2030
Progress	
Number of pilot projects	2030
Adopted strategy	
Budget	n.a
Finance	
Source of funding	• Grants • Donations • Private investments
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 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE 13 CLIMATE ACTION 7 AFFORDABLE AND CLEAN ENERGY

6 Mitigation Scenarios

To assess the possible development of greenhouse gas emissions over the coming period, this report presents scenarios illustrating how emissions may evolve depending on the extent to which climate change mitigation policies and measures are implemented. The analysis is based on two main scenarios: the With Existing Measures (WEM) scenario and the With Additional Measures (WAM) scenario. Both scenarios were developed using common assumptions concerning economic development, demographic trends and technological progress.

The WEM scenario describes the development of emissions when only policies and measures that have already been adopted and initiated are implemented. Under these conditions, emission reductions occur gradually and remain limited in scale, reflecting ongoing regulatory activities, existing investments and the natural replacement of technologies. By contrast, the WAM scenario describes the emissions trajectory under the enhanced and coordinated implementation of measures across all relevant sectors. It therefore provides an assessment of the potential for a deeper transformation of the energy system, industry and other sectors, as well as the effects of more intensive deployment of modern technologies and emission-reduction policies.

The difference between the two scenarios arises primarily from the energy and forestry sectors, while the same assumptions and values are applied in the Industrial Processes and Product Use (IPPU) and agriculture sectors. In the energy sector, the WAM scenario includes all measures presented in the previous chapter, resulting in more pronounced decarbonisation than under the WEM scenario. In the forestry sector, the scenarios differ in terms of fire management and the pace of afforestation. The WEM scenario includes measures relating to livestock, together with a reduction in the average area affected by fires from 9,000 ha to 6,000 ha by 2030, whereas the WAM scenario envisages a more ambitious reduction to 3,000 ha by 2030, together with additional afforestation. At the same time, the area of transitional woodland decreases from 95,000 ha to 80,000 ha by 2030, with a further reduction of 5,000 ha every five years through 2030, while the area of deciduous forest increases, particularly through afforestation with oak.

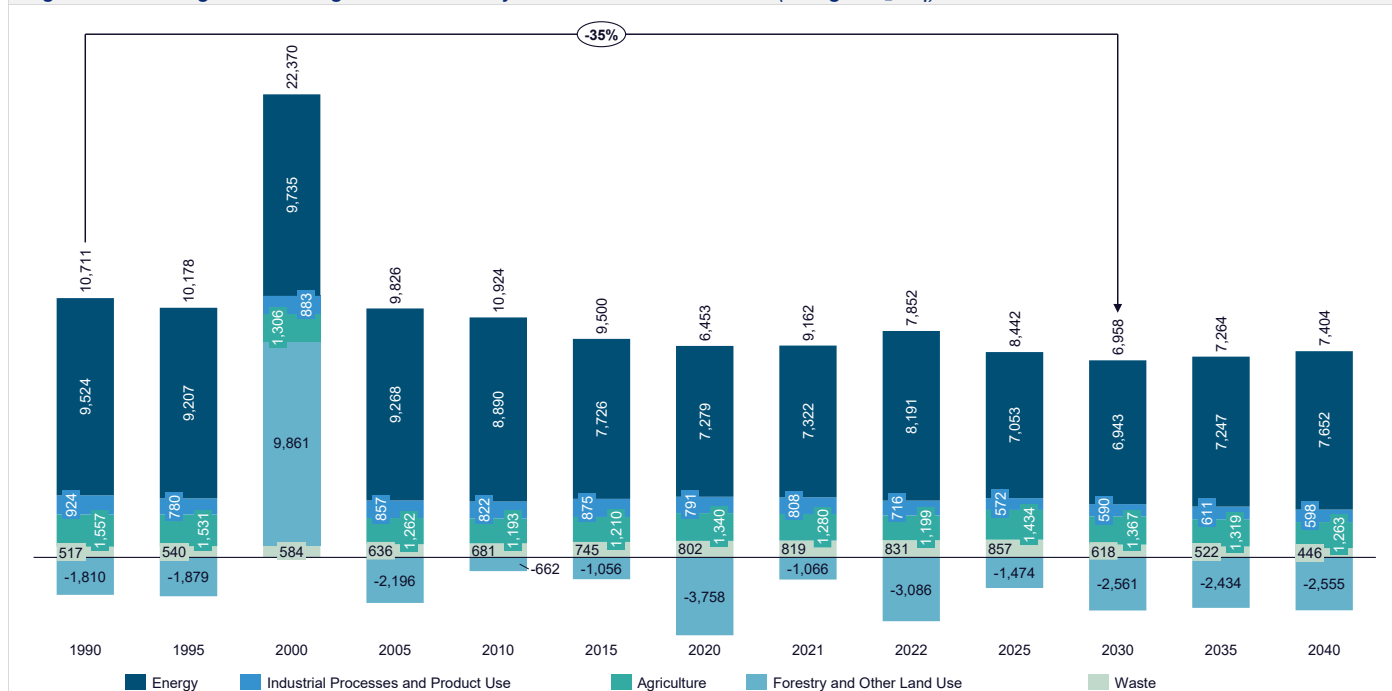
6.1 With Existing Measures Scenario (WEM)

Under the With Existing Measures (WEM) scenario, total national greenhouse gas emissions decline gradually, but only to a limited extent, through 2040. Relative to 1990, total emissions fall from 10,711 kt CO₂-eq to 7,004 kt CO₂-eq in 2040, representing a reduction of approximately 35% (Figure 52). This trend indicates that existing policies and measures achieve a certain degree of decarbonisation, but do not generate the transformational momentum required for deeper emission reductions. Although the reduction is evident, it occurs more slowly than would be required for more ambitious alignment with long-term climate objectives.

The sectoral composition of emissions shows that the energy sector remains the most significant source of emissions throughout the entire period. Despite certain improvements, substantial emissions persist in this sector, indicating that changes in energy production, transformation and consumption are not sufficiently far-reaching. To ensure security of electricity supply, the continued operation of two units at REK Bitola is envisaged. This approach is consistent with the updated draft National Energy and Climate Plan, which recognises the role of REK Bitola primarily in maintaining the stability of the electricity system during the transition period. Although this decision entails higher costs associated with CO₂ emissions, it is considered necessary to ensure security of supply and system stability, particularly while alternative capacities remain limited.

The Industrial Processes and Product Use sector retains a relatively stable share throughout the period, indicating that the scenario does not involve a fundamental change in its emissions trajectory. Agriculture also remains a continuous source of emissions, with a moderate but stable contribution to the overall balance, while the waste sector has the smallest share and shows a slight decline towards the end of the period. The Forestry and Other Land Use sector is particularly important because it acts as a net sink during most of the period, partially offsetting emissions from the other sectors. Nevertheless, although the sink helps reduce net emissions, it is insufficient to change the overall picture: under the WEM scenario, emissions remain structurally dependent on the energy sector, while reductions in the other sectors are limited. The WEM scenario therefore represents a realistic projection of development under the continuation of current policies, while also clearly demonstrating that more pronounced and systemic decarbonisation cannot be expected without additional measures.

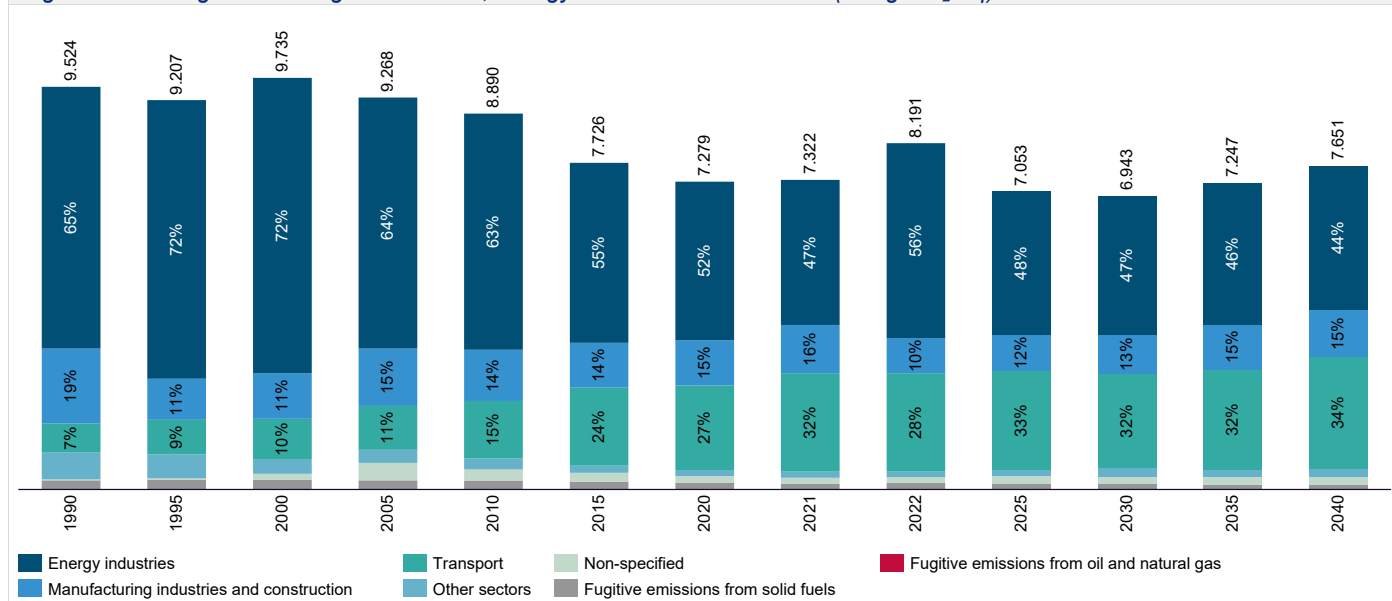
Figure 52. Total greenhouse gas emissions by sector – WEM scenario (in Gg CO₂-eq)



Further insight into the changing greenhouse gas emissions trend is provided by the distribution of emissions within the energy sector. The share of energy industries gradually decreases from approximately 65–72% in the initial years to about 47% in 2030 and around 44% in 2040 (Figure 53). At the same time, the share of transport increases substantially, reaching approximately 33% in 2030, which indicates the growing importance of this subsector in total energy-sector emissions. The share of industry within the energy sector varies over the period analysed, but averages approximately 14%.

These trends show that, despite the reduction in emissions from electricity generation, the transformation of energy-consuming sectors is not sufficiently strong, particularly in transport, where emissions remain high and acquire even greater relative importance. As a result, the structure of energy-sector emissions merely shifts away from production towards a greater contribution from transport and other energy-consuming sectors, highlighting the need for more intensive measures targeting final energy consumption, especially in the transport sector.

Figure 53. Total greenhouse gas emissions, Energy sector – WEM scenario (in Gg CO₂-eq)



Emissions from the Industrial Processes and Product Use sector are relatively stable, with minor variations around 800–900 kt CO₂-eq (Figure 54). Over the projection period, a moderate decline is observed, with emissions falling to approximately 571 kt CO₂-eq by 2025 and then remaining at around 600 kt CO₂-eq through 2040. This indicates that certain improvements and more efficient technologies are being introduced in industry, but that they are insufficient to

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produce a substantial reduction in emissions. Consequently, industry remains an important source of emissions over the longer term.

In contrast to industry, agriculture shows a slight increase in emissions through 2025, after which they stabilise at approximately 1,260 kt CO₂-eq through 2040 (Figure 55). This means that agricultural emissions do not decline significantly, but remain almost unchanged compared with 2022 levels. This is because these emissions are associated with biological processes and production practices that are more difficult to change. Therefore, without the introduction of additional, targeted measures, agriculture remains a persistent source of emissions that is difficult to reduce.

Figure 54. Total greenhouse gas emissions, IPPU sector – WEM scenario (in Gg CO₂-eq)

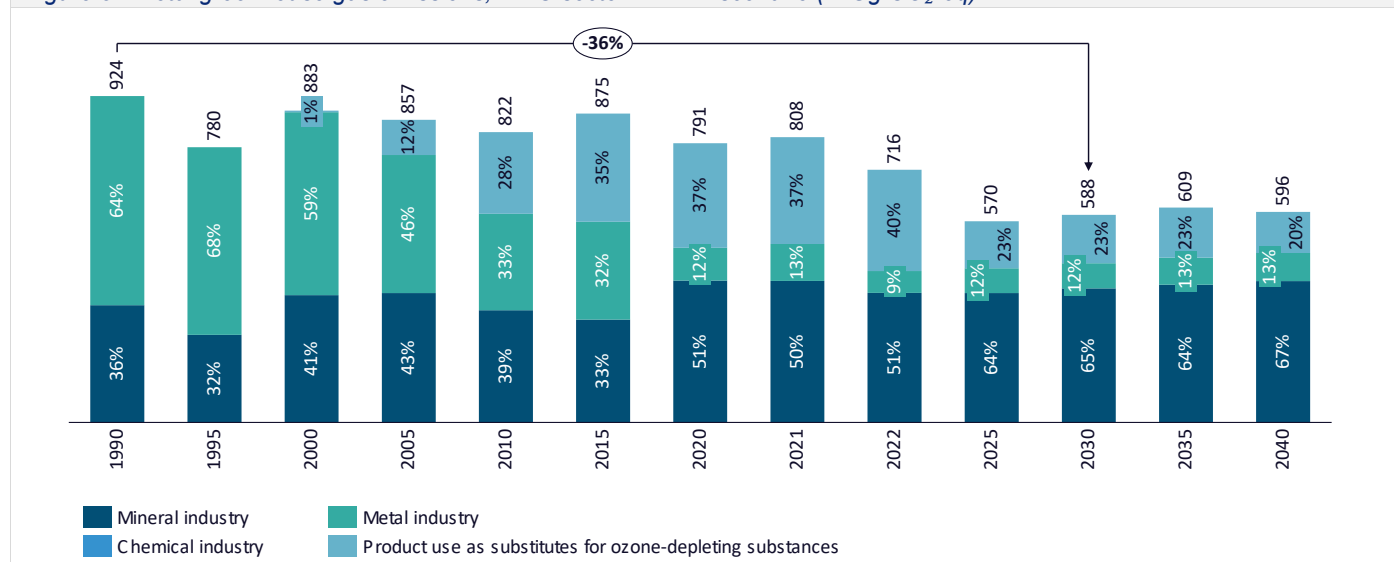
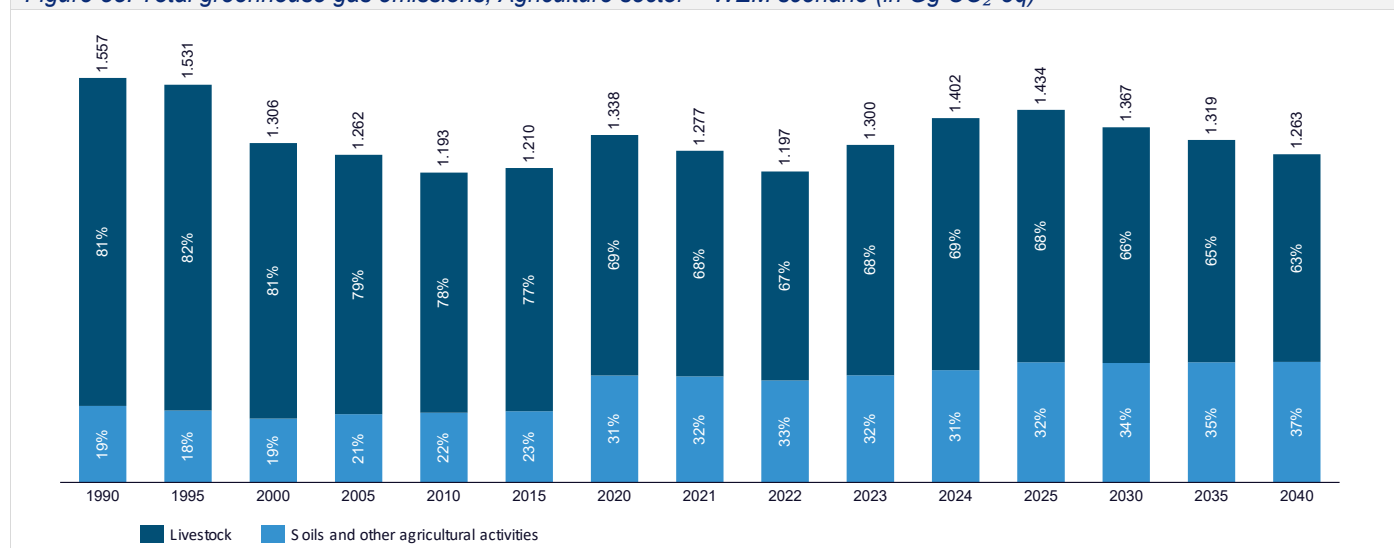


Figure 55. Total greenhouse gas emissions, Agriculture sector – WEM scenario (in Gg CO₂-eq)



The Forestry and Other Land Use sector plays an important role in the national balance, as it represents a net CO₂ sink throughout the period analysed. However, Figure 56 shows that its contribution is not constant, but changes over time depending on the balance between removals and emissions across the different land categories. During the historical period, the net sink generally ranges from approximately –1,800 to –2,600 kt CO₂-eq. During the projection period, the net effect remains negative, reaching approximately –2,500 kt CO₂-eq in 2030 and remaining at that level through 2040.

By contrast, the waste sector shows a clear downward trend in emissions. After reaching higher values in previous years, at approximately 800–850 kt CO₂-eq, emissions gradually decline to around 600 kt CO₂-eq in 2030 and then fall further to approximately 450 kt CO₂-eq in 2040 (Figure 57). This trend indicates continuous improvement in waste management, particularly through reduced landfilling, improved waste treatment and lower emissions from wastewater. As a result, the waste sector gradually reduces its contribution to total emissions, providing a positive indication of the effectiveness of existing measures in this sector.

Figure 56. Total greenhouse gas emissions, Forestry and Other Land Use sector – WEM scenario (in Gg CO₂-eq)

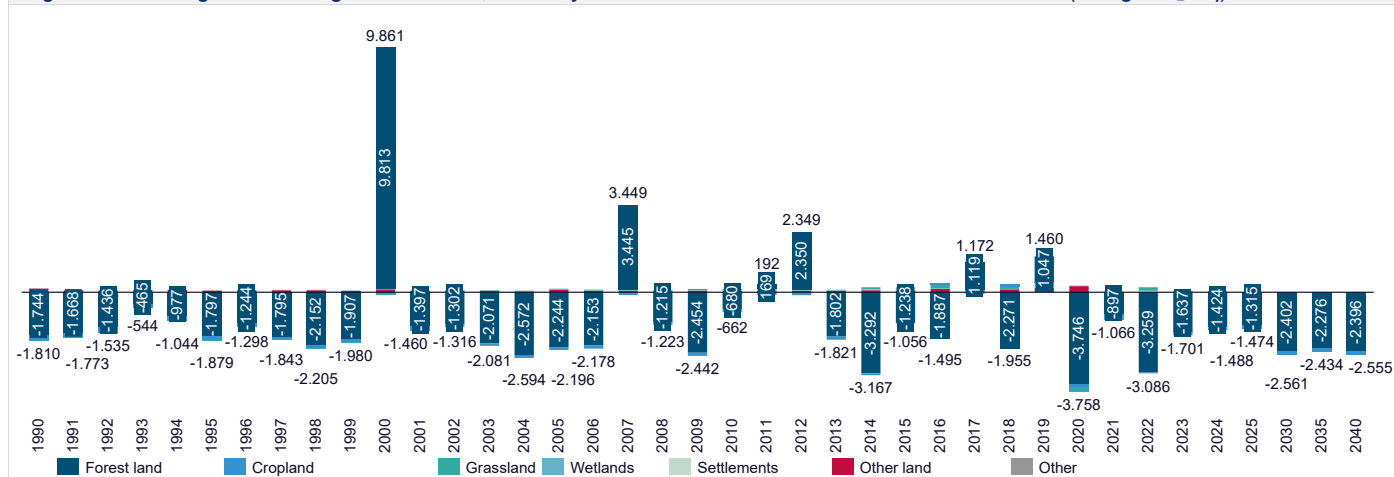


Figure 57. Total greenhouse gas emissions, Waste sector – WEM scenario (in Gg CO₂-eq)



6.2 With Additional Measures Scenario (WAM)

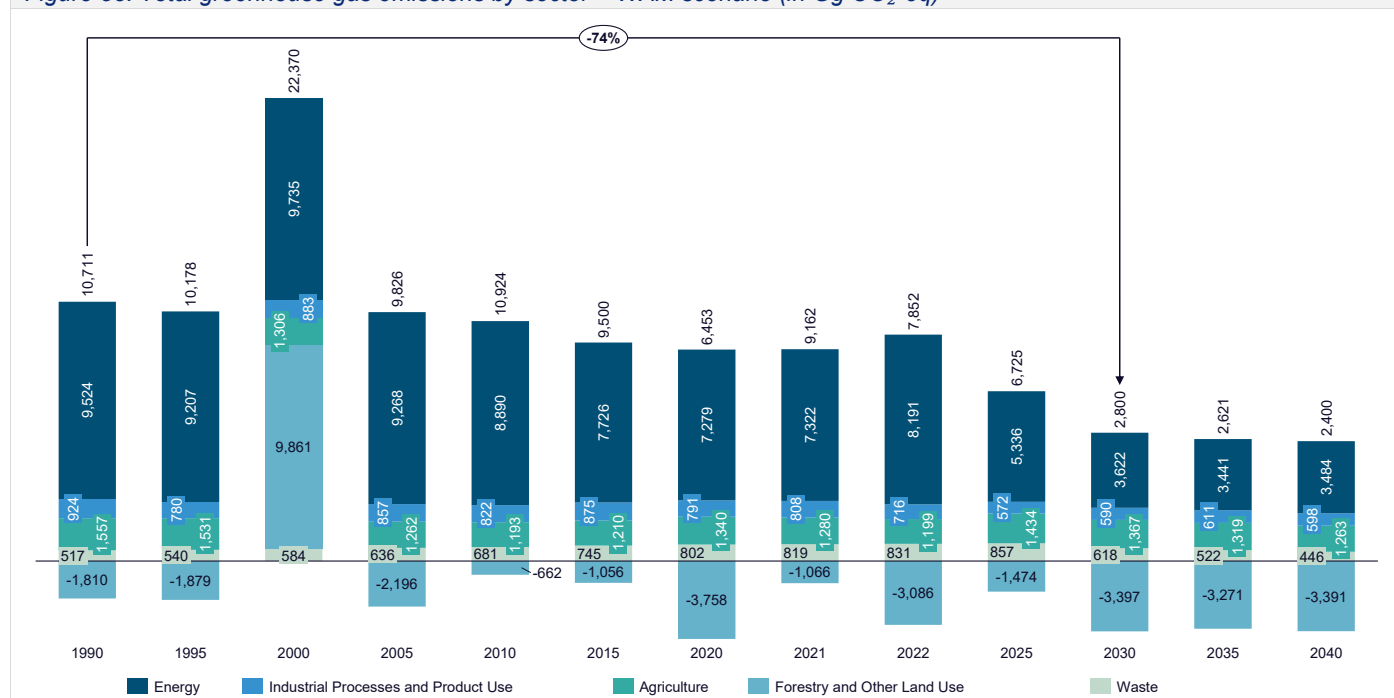
Under the scenario involving the full implementation of climate change mitigation measures, total national greenhouse gas emissions follow a clear and sustained downward trajectory over the period 2025–2040. Already in the first phase of the projections, by 2030, emissions decline by more than 74% compared with 1990 (Figure 58), indicating the substantial and early effectiveness of the policies and technologies introduced across the sectors. Most of this reduction originates in the energy sector through the replacement of fossil fuels with renewable energy sources, improvements in energy efficiency and the electrification of the transport and energy sectors. At the same time, forestry and land use retain their stable role as a sink, further reducing the national net emissions balance.

After 2030, the downward trajectory continues with an even more pronounced trend. By 2040, net emissions are 77% below the 1990 level. The projections show that the contribution of the energy sector to total emissions gradually declines as a result of the high level of decarbonisation in energy production and supply.

This integrated implementation scenario represents a state-of-the-art pathway for national decarbonisation, aligned with long-term climate objectives and European policies. The results clearly demonstrate that a systemic approach combining the energy transition, land management, industrial innovation and circular models creates a cumulative effect that exceeds the individual contribution of each sector considered separately. At the same time, sinks in the forestry sector remain crucial to achieving a low-carbon balance. This scenario represents a realistic prospect for transformation towards a low-emission economy, provided that the measures are implemented consistently, in a coordinated manner and with a long-term vision.

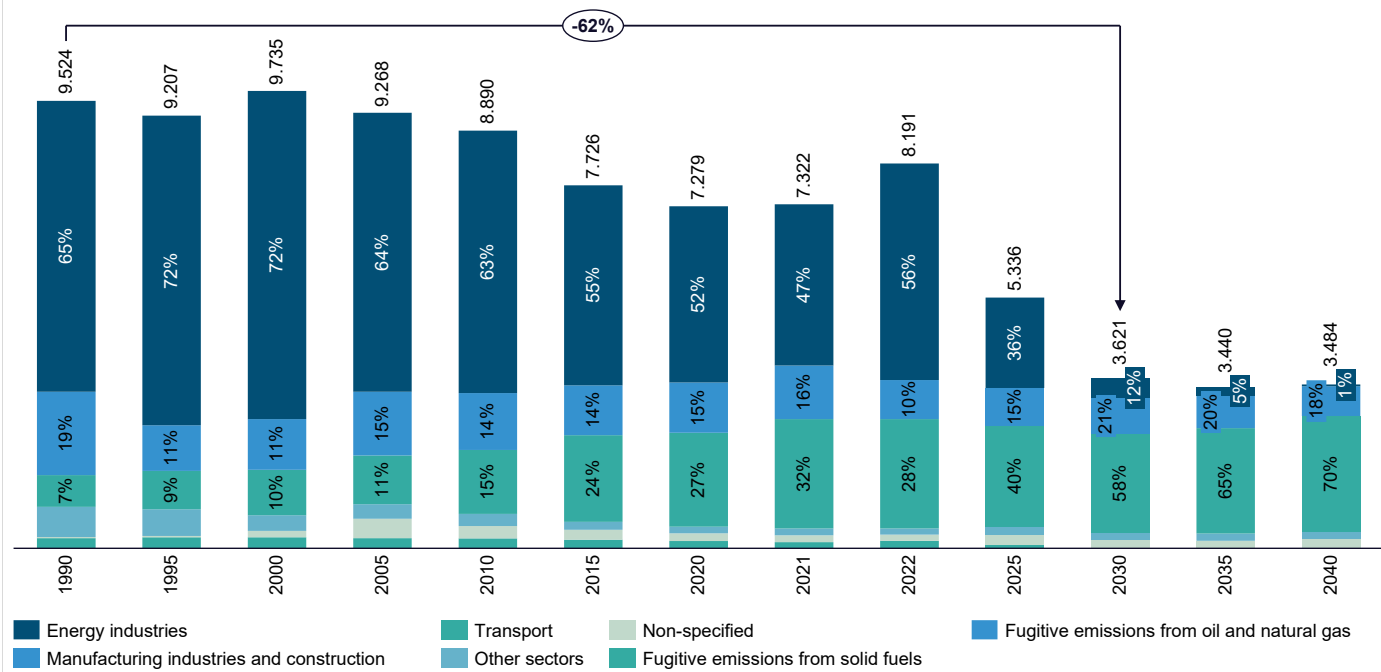
This section presents only the sectors for which additional measures are envisaged, while the remaining sectors – Industrial Processes and Product Use (IPPU), agriculture and waste – are presented and analysed in the previous chapter.

Figure 58. Total greenhouse gas emissions by sector – WAM scenario (in Gg CO₂-eq)



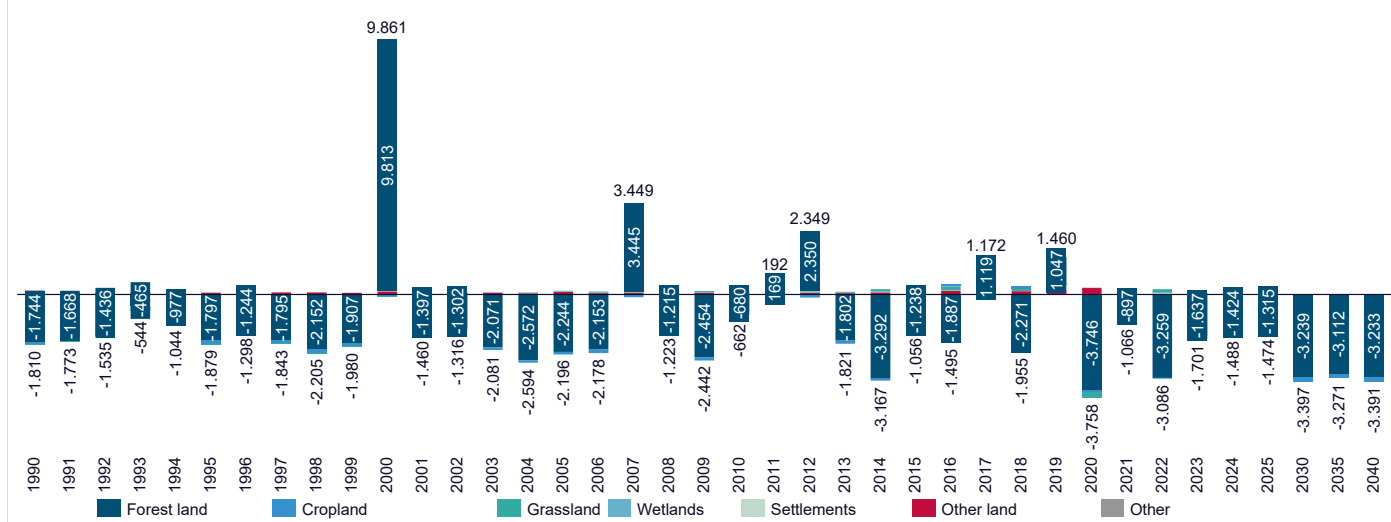
Up to 2022, emissions from the energy sector range between 7,200 and more than 9,700 kt CO₂-eq, while with the implementation of the measures they fall to approximately 5,300 kt CO₂-eq in 2025 (Figure 59). The downward trend continues thereafter, with emissions reaching approximately 3,500 kt CO₂-eq in 2040. This represents a dramatic structural reduction and clearly indicates the strong effects of decarbonisation, energy efficiency and the increased share of renewable energy sources.

Figure 59. Total greenhouse gas emissions, Energy sector – WAM scenario (in Gg CO₂-eq)



In 2022, the sink in the Forestry and Other Land Use sector amounts to –3,086 kt CO₂-eq, and after 2030 it stabilises between –3,000 and –3,400 kt CO₂-eq (Figure 60). Through 2040 it remains at the 2030 level, thereby continuing to serve as a critical offsetting mechanism in the national balance.

Figure 60. Total greenhouse gas emissions, Forestry and Other Land Use sector – WAM scenario (in Gg CO₂-eq)



7 Comparison with the National Energy and Climate Plan

This chapter aims to provide a clear understanding of the differences between the results presented in this report (BTR) and those in the National Energy and Climate Plan (NECP), including its updated version, which was prepared in parallel with this report, given that the two documents were developed using different methodological approaches. Although continuous efforts were made to align them during preparation, certain differences are unavoidable, primarily because of the different modelling logic applied. The BTR uses an integrated energy model that optimises the entire energy system – production, transformation and consumption – whereas the NECP applies a more sector-specific approach, with particular emphasis on the electricity system. This means that decisions in the BTR are made at system level on the basis of cost optimisation and constraints, while certain parameters in the NECP are defined exogenously, which logically leads to some divergence in the results.

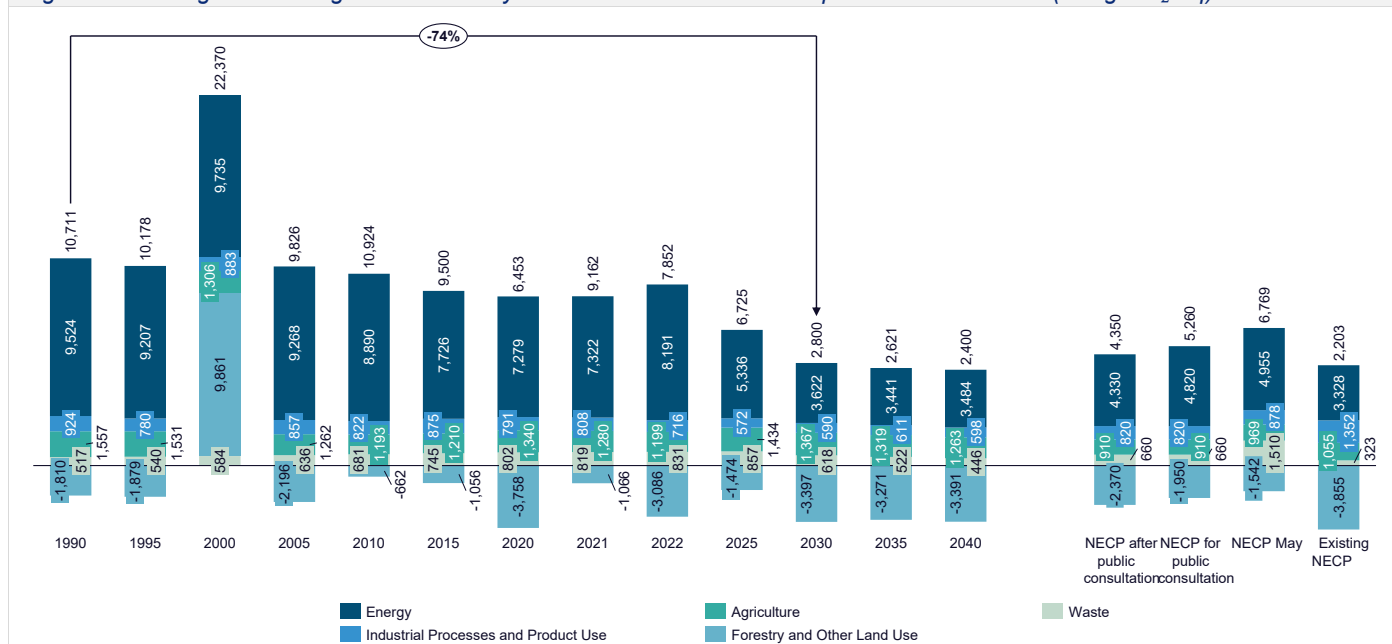
Nevertheless, it is important to emphasise that substantial efforts were made during preparation to align the two documents. The NECP underwent several revisions and versions, gradually moving closer to the results of the model calculations. At the same time, the mitigation section of the BTR was further adjusted to ensure greater consistency, particularly for the reference WEM scenario. As a result, key assumptions were harmonised, including the operation of REK Bitola through 2040, which is an important element in aligning the energy balances and emissions. These adjustments significantly reduced the differences between the documents and improved their comparability.

The National Energy and Climate Plan is one of the country's key strategic documents, as it defines the national greenhouse gas emission-reduction targets for 2030 and the direction of the long-term energy transition. It provides a framework for alignment with European climate policies, investment planning and the definition of sectoral decarbonisation measures. Consequently, comparing the results of the WAM scenario in this report with the NECP targets is essential, as it enables an assessment of whether the proposed policies and measures are sufficient to meet the strategic objectives or whether a further increase in ambition is required.

Figure 61 presents net greenhouse gas emissions by sector, including the historical period, the WAM scenario projections, and a comparison with the adopted NECP and the different versions of the updated NECP. Under the With Additional Measures scenario, net emissions amount to approximately 2,800 kt CO₂-eq in 2030, declining further to 2,621 kt CO₂-eq in 2035 and 2,400 kt CO₂-eq in 2040. This represents a reduction of approximately 74% compared with 1990 and reflects a high level of ambition that is very close to the Energy and Climate Plan adopted in 2023 and to the targets defined by the Energy Community.

Compared with the NECP, the WAM scenario values are lower than those in the “NECP after public consultation” (4,350 kt CO₂-eq), the “NECP for public consultation” (5,260 kt CO₂-eq) and the “May NECP” (6,769 kt CO₂-eq), while they are very close to, but still slightly higher than, the “existing NECP” value (2,203 kt CO₂-eq). These differences are small and expected, given the different methodological approaches and assumptions. Overall, the results confirm that the WAM scenario is closely aligned with the NECP and represents a robust and realistic pathway for achieving the national climate objectives.

Figure 61. Total greenhouse gas emissions by sector – WAM scenario compared with the NECP (in Gg CO₂-eq)



The largest differences between the results presented in this report (BTR) and those in the NECP, as also noted in the plan itself, arise from the energy sector and the Forestry and Other Land Use sector, particularly in the 2030 target year. In the Forestry and Other Land Use sector, one of the key reasons for the differences is that removals from perennial plantations were systematically covered and calculated for the first time in the latest inventory, covering 2020–2022. This approach, which is fully consistent with the IPCC methodology, was retained in the BTR analyses, whereas the NECP uses different assumptions and input data. Additional differences concern the treatment of burned areas and their effect on the sink, which also influences net emissions.

In the energy sector, the differences are even more pronounced and are related to the different approaches used to define electricity production and trade. As shown in Figure 62 and Figure 63, the NECP envisages a substantial increase in domestic production, reaching more than 13,000 GWh in 2040, with strong growth in renewable energy sources – particularly solar and wind – while retaining a certain level of fossil-fuel-based generation. This growth is directly linked to the assumption of high electricity exports, positioning the country as a net exporter in the region.

By contrast, in the BTR WAM scenario, although an effort was made to bring the assumptions closer to those of the NECP by increasing exports, the results are generated by an optimisation model covering the entire energy system. This means that production and export volumes are not specified in advance, but are determined by the most cost-effective solution. Consequently, total production in the WAM scenario reaches approximately 10,000 GWh in 2040, which is lower than the values in the NECP. At the same time, the generation mix is dominated by renewable energy sources, at approximately 6,783 GWh in 2040, while fossil technologies make a relatively limited contribution.

It is important to emphasise that the high-export assumption in the NECP has a direct impact on greenhouse gas emissions. Increased production for export entails greater utilisation of generation capacity, including gas-fired power plants, resulting in higher emissions than under the optimisation solution used in the BTR. In the WAM scenario, the model balances costs, emissions and demand; although the export level projected in the NECP is not reached, lower emissions and a more efficient allocation of resources are achieved.

Overall, despite these differences, the trends in the two documents are similar: strong growth in renewable energy sources, a gradual reduction in dependence on fossil fuels and an increase in total production. The differences arise from the distinct methodological approaches – an optimisation model versus an assumption-based scenario – and from different aspirations concerning the country's role in the regional electricity market, rather than from substantive inconsistencies in policy.

Figure 62. Electricity needs and supply, WAM scenario (in GWh)

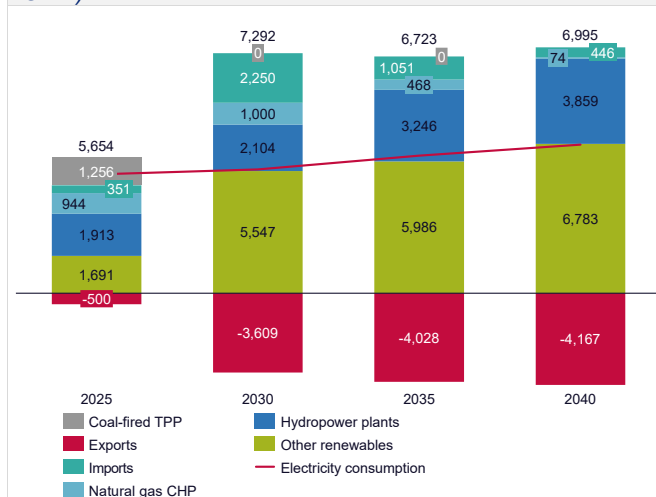
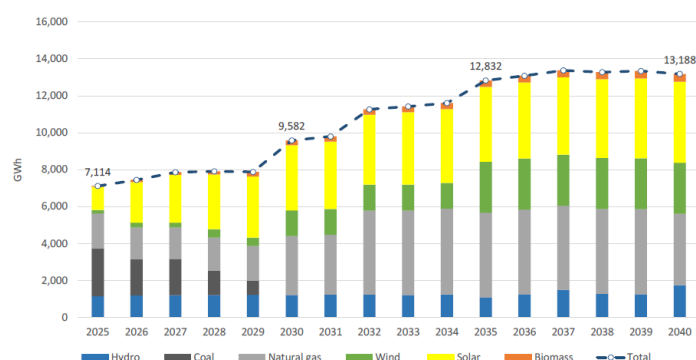


Figure 63. Electricity production, updated NECP



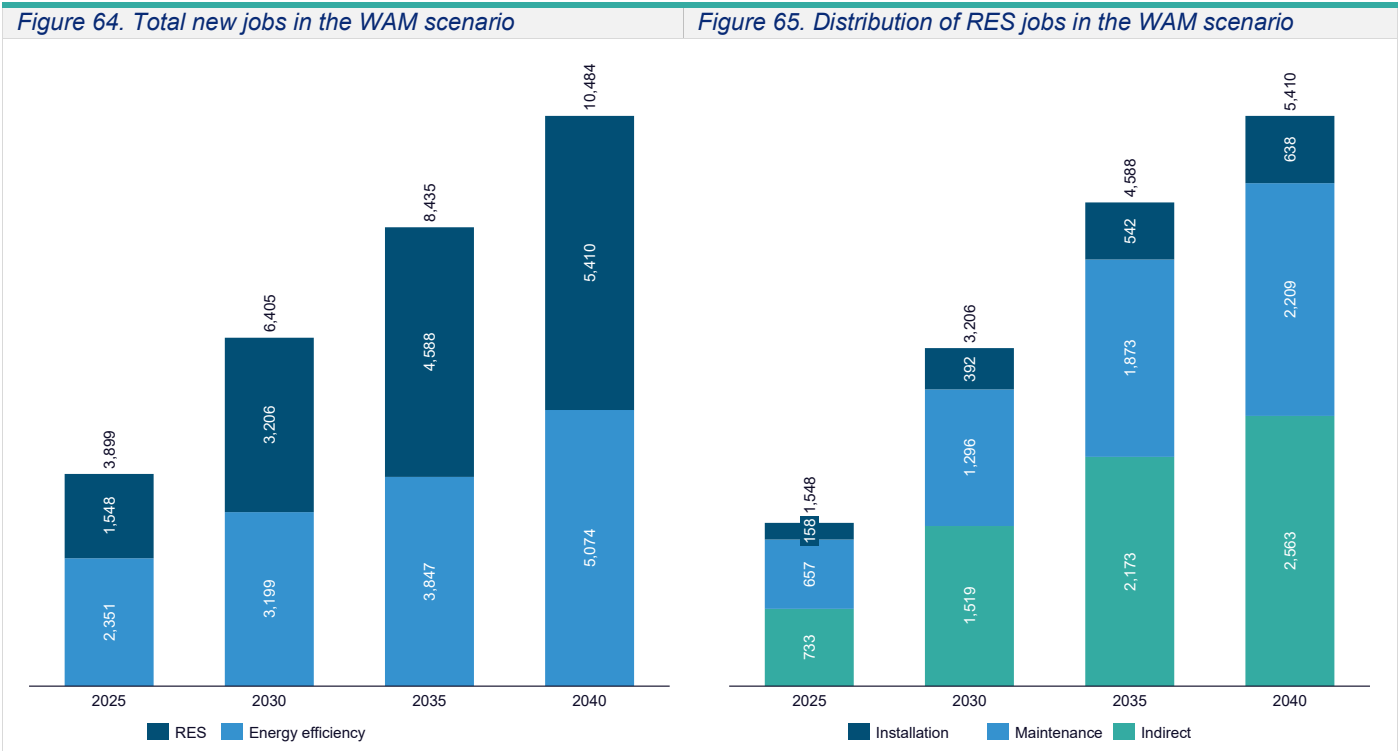
These differences should not be interpreted as inconsistencies, but rather as the result of different methodological approaches and preparation timeframes. On the contrary, the analysis shows that the two documents are largely consistent in terms of the trends and direction of the energy transition. The differences are relatively small and arise mainly from the different treatment of certain technologies, the timing of investments and system optimisation in the BTR. This chapter therefore serves as a guide to the correct interpretation of the results and confirms that, despite the methodological differences, there is a high degree of alignment between the BTR and the NECP.

8 Additional Benefits and Investments

The analysis of the WAM scenario shows a significant social impact through the creation of new jobs. The total number of jobs increases from 3,899 in 2025 to 6,405 in 2030 and reaches 10,484 in 2040 (Figure 64), representing an almost threefold increase over the period analysed. This growth is directly linked to the gradual strengthening of policies and measures and to increased investment activity in the energy sector.

The employment structure shows that the contribution of renewable energy sources is slightly larger than that of energy efficiency during the period 2030–2040. In 2025, of the total 3,899 jobs, approximately 2,351 are associated with energy efficiency and 1,548 with renewable energy sources (RES). This trend gradually changes, and by 2030 the contributions are almost equal, with 3,206 jobs from renewable energy compared with 3,199 from energy efficiency; the difference becomes particularly pronounced after 2035, when renewable energy dominates with 4,588 jobs, compared with 3,847 from energy efficiency. By 2040, the difference is even greater, with 5,410 jobs from renewable energy compared with 5,074 from energy efficiency.

A more detailed analysis of employment in renewable energy shows that, in 2025, the largest share of jobs is associated with indirect activities (733), while maintenance accounts for 657 jobs and installation for 158. By 2030, all categories record substantial growth: indirect jobs reach 1,519, maintenance jobs 1,296 and installation jobs 392 (Figure 65). These results show that, as the renewable energy sector develops, long-term activities such as maintenance and support services become increasingly important, while installation remains important but accounts for a relatively smaller share. At the same time, the steady growth in energy-efficiency employment shows that measures involving the renovation and construction of new energy-efficient buildings, as well as heating technologies, provide sustained demand for labour.

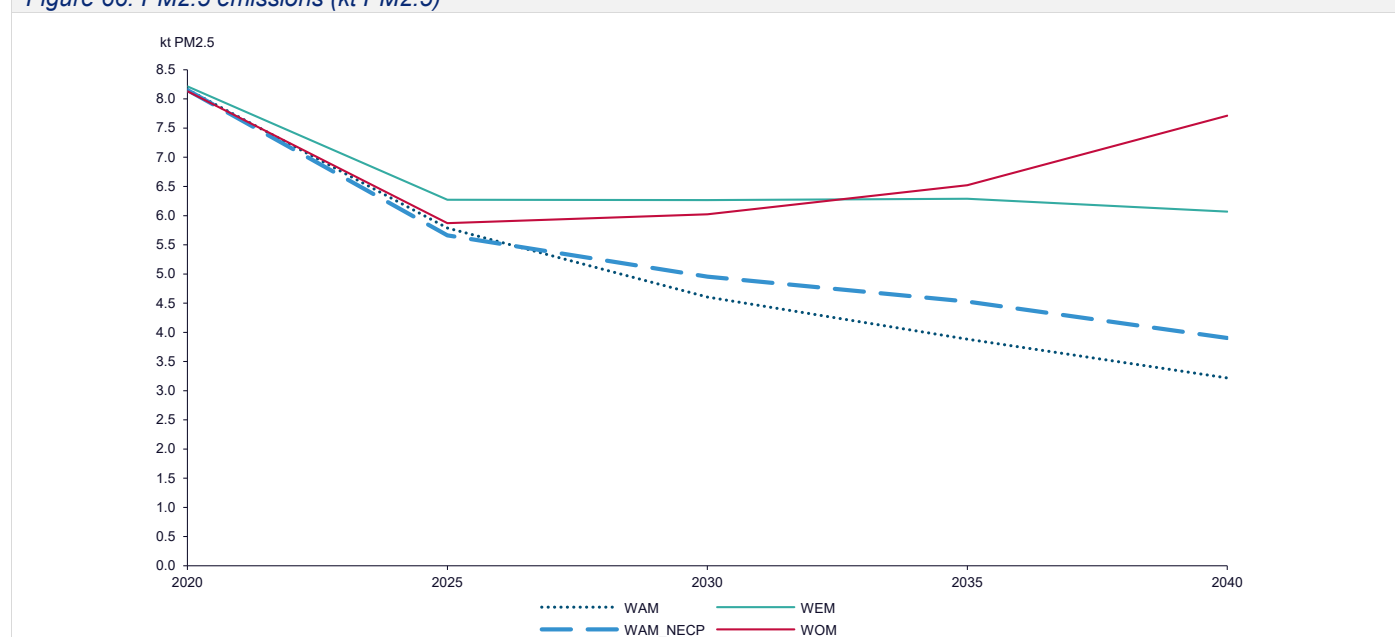


In this report, the health effects of the proposed measures have not been analysed using the detailed methodology applied in the Fourth National Communication, where the World Health Organisation’s CaRBonH tool was used. Instead, a simplified assessment has been undertaken by analysing trends in PM2.5 emissions, which are one of the key indicators of impacts on public health. The next report will provide a more detailed quantification of the health and economic benefits, including effects on mortality and morbidity, while the present report focuses on changes in emissions as an indirect indicator of potential health benefits.

The results show clear differences between the scenarios. Under the WAM scenario, PM_{2.5} emissions decline from approximately 8.1 kt in 2020 to around 5.7 kt in 2025 and then continue to fall to approximately 3.2 kt in 2040. A similar, though less pronounced, downward trend is also observed under the WAM_NECP scenario, where emissions reach approximately 3.9 kt in 2040. By contrast, the reduction under the WEM scenario is limited, from approximately 8.2 kt in 2020 to around 6.0 kt in 2040, while the WOM scenario even shows a renewed increase after 2025, with emissions reaching approximately 7.7 kt in 2040. This clearly indicates that, without additional measures, improvements in air quality are constrained and there is also a risk of deterioration.

The reduction in PM_{2.5} emissions under the WAM scenario results from the implementation of measures in four key sectors: households, industry, energy production and the commercial sector. The largest contribution is expected from households, through the replacement of inefficient heating systems and increased use of cleaner energy sources, which directly reduces local air pollution. Industry also contributes through the introduction of more efficient technologies and emission controls, while in the energy sector the transition to renewable energy sources and the reduced use of fossil fuels have a significant effect. The commercial sector also contributes, although to a lesser extent, through improvements in energy efficiency and changes in the energy sources used.

Figure 66. PM_{2.5} emissions (kt PM_{2.5})



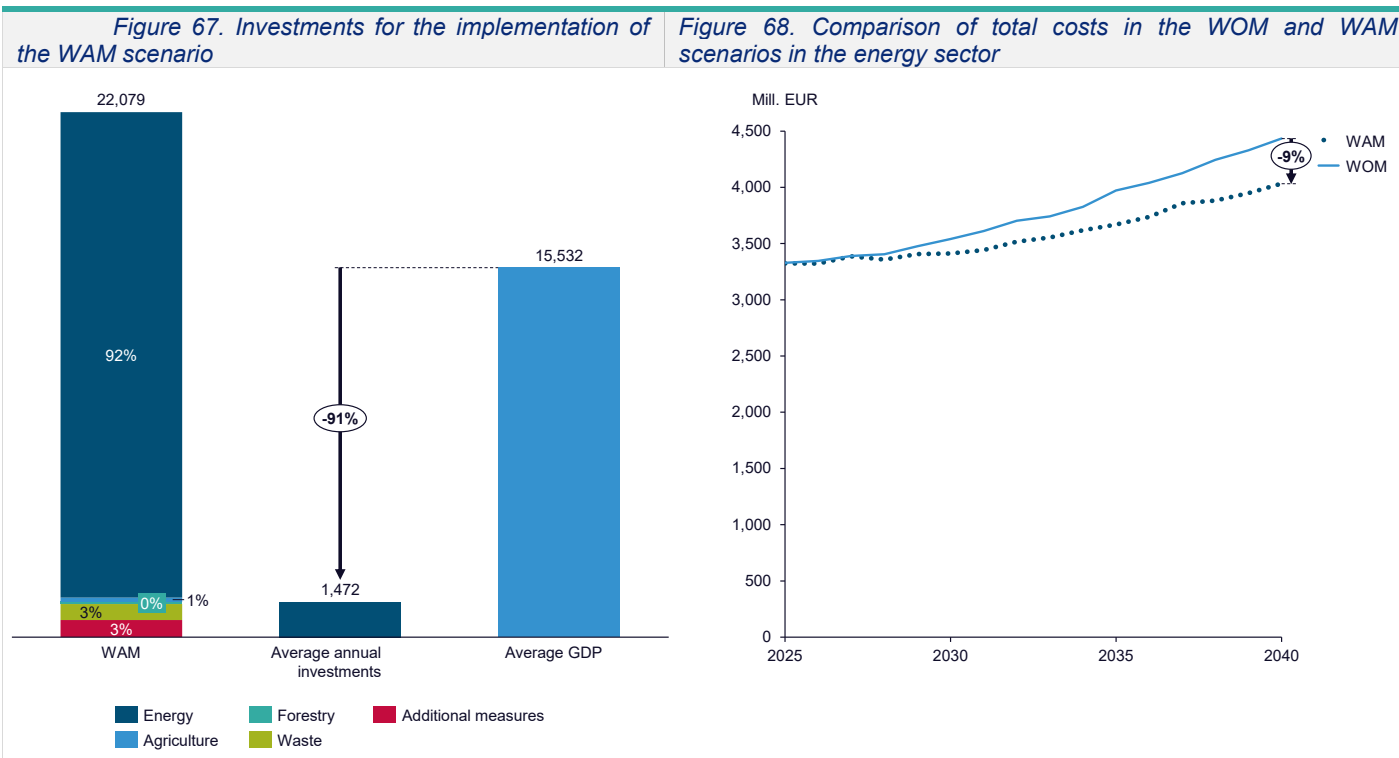
Implementation of the With Additional Measures (WAM) scenario requires substantial financial resources. It is important to emphasise, however, that the investments presented represent an additional cost relative to the Without Measures (WOM) scenario – that is, the incremental investment required to achieve decarbonisation. Total investment amounts to approximately EUR 22 billion (Figure 67), with by far the largest share, more than 92%, directed towards the energy sector. The remainder relates to the waste sector, at approximately 3%, forestry, at around 1%, and other additional measures, at approximately 3%, indicating that transformation of the energy system is the principal driver of investment.

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When annualised, these investments amount to approximately EUR 1,472 million per year, representing around 9% of average annual GDP, which is approximately EUR 15.5 billion. Although substantial, this amount could be mobilised through a combination of public and private investment, particularly considering that part of the funding will come from international funds, development banks and the private sector. In addition, if the measures are implemented in a coordinated manner and the “energy efficiency first” principle is followed, the total investment requirement may be reduced by avoiding duplication.

The analysis of total energy-system costs, on the other hand, leads to an important conclusion: although the WAM scenario requires higher initial investment, it results in lower total costs over the long term. As shown in Figure 68, total costs under the scenario with measures are approximately 9% lower in 2040 than under the scenario without measures. This is due to lower fuel costs, particularly for fossil fuel imports, increased energy efficiency and a larger share of renewable energy sources, which require higher initial investment but have lower operating costs.

Overall, the results show that the transition to a low-carbon economy entails costs, but also represents an economic opportunity. Although substantial investment is required in the initial phase, it is offset by lower system costs, greater energy independence and more stable energy prices. The WAM scenario can therefore be regarded as a financially justified and sustainable solution that delivers both economic and climate benefits over the long term.



9 Indicators

North Macedonia's contribution to global efforts to achieve sustainable development is assessed in this report through the integrated application of the global framework of indicators for the Sustainable Development Goals (SDGs) and the requirements of the United Nations Framework Convention on Climate Change (UNFCCC), particularly in the context of the Enhanced Transparency Framework (ETF). In this respect, the indicators constitute a key analytical instrument enabling systematic monitoring of progress in implementing the proposed policies and measures, as well as their quantified evaluation in relation to the Nationally Determined Contributions (NDCs) and long-term climate objectives.

On the one hand, the SDG indicators are used to monitor the dynamics and effectiveness of measure implementation, enabling an assessment of whether they lead to real emission reductions and improved sustainability across different sectors. On the other hand, some of these indicators are applied for comparative analysis, positioning North Macedonia's progress relative to countries in the region and the European Union, ensuring a high level of comparability thanks to the standardised methodologies of the EU and EUROSTAT. In this report, the proposed policies and measures address six Sustainable Development Goals, with the relevant indicators fully aligned with European statistical frameworks (Table 2). In addition, the indicators form the basis of the monitoring, reporting and verification (MRV) system, without which consistent monitoring of the effects of policies and measures and the provision of credible analysis would not be possible.

Finally, integrating the SDG indicators into climate analyses enables a broader interpretation of the effects of climate policies, going beyond the narrow framework of emission reduction. This demonstrates that climate action delivers multidimensional benefits, including economic, social and environmental effects, positioning it as a key driver of sustainable development.

Table 2. Sustainable Development Goal indicators

Goal	Code	Indicator
	sdg_07_60 sdg_01_60	Population unable to keep home adequately warm by poverty status Population living in a dwelling with a leaking roof, damp walls, floors or foundation or rot in window frames of floor by poverty status
	sdg_02_60	Ammonia emissions from agriculture
	sdg_07_10 sdg_07_11 sdg_07_20 sdg_07_30 sdg_07_40 sdg_07_50 sdg_07_60 sdg_13_20	Primary energy consumption Final energy consumption Final energy consumption in households per capita Energy productivity Share of renewable energy in gross final energy consumption by sector Energy import dependency by products Population unable to keep home adequately warm by poverty status* Greenhouse gas emissions intensity of energy consumption
	sdg_09_50 sdg_09_60 sdg_12_30	Share of buses and trains in total passenger transport Share of rail and inland waterways in total freight transport Average CO ₂ emissions per km from new passenger cars
	sdg_11_60 sdg_09_50	Recycling rate of municipal waste Share of buses and trains in total passenger transport
	sdg_12_30 sdg_12_50 sdg_07_10 sdg_07_11 sdg_07_30 sdg_07_40	Average CO ₂ emissions per km from new passenger cars Generation of waste excluding major mineral waste by hazardousness Primary energy consumption Final energy consumption Energy productivity Share of renewable energy in gross final energy consumption by sector

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sdg_13_10
sdg_13_20
sdg_07_10
sdg_07_11
sdg_07_40

GHG emissions
Greenhouse gas emissions intensity of energy consumption
Primary energy consumption
Final energy consumption
Share of renewable energy in gross final energy consumption by sector



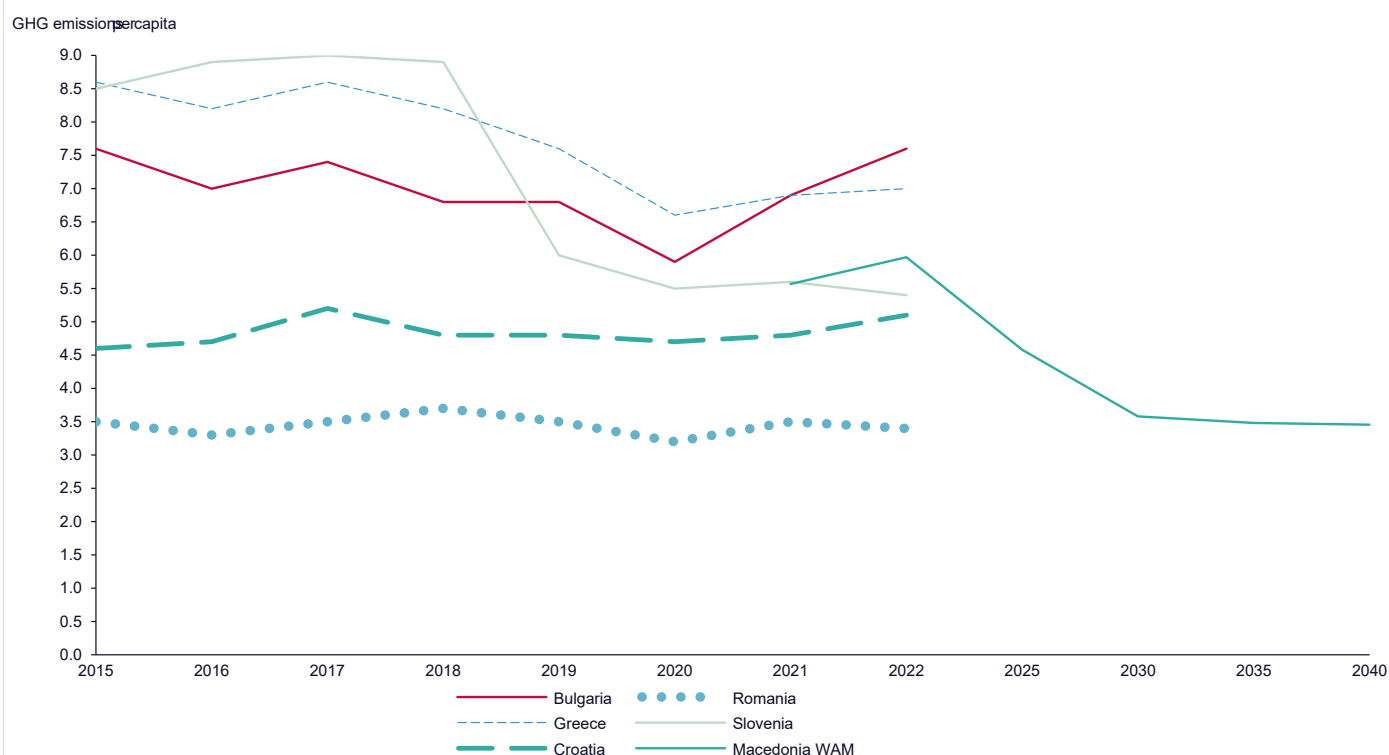
sdg_15_10

Share of forest area

Within this report, in order to provide a simpler and clearer picture of Macedonia's position relative to other countries, one representative indicator is presented: greenhouse gas emissions per capita (GHG per capita). This indicator is widely used in international analyses because it enables direct comparison between countries of different size and economic structure, while also providing a good picture of emission intensity relative to population. The analysis includes countries in the region that are part of the European Union, in order to assess Macedonia's relative position and its progress in the context of decarbonisation.

The results show that under the WAM scenario Macedonia records a significant reduction in emissions per capita, particularly after 2025, with values falling to around 3.5 t CO₂eq per capita in 2030 year and are stabilise of similar level to 2040 (Figure 69). This represents significantly improvement in relation of the historical values and it positions the country below the level of some countries of the region, as which are Bulgaria and Greece, and in certain years and close to the values of Croatia. At the same time, emissions per capita remain higher than those in Romania, but move within a similar range to some South-East European countries. These trends indicate that, with implementation of the WAM scenario measures, North Macedonia significantly improves its position relative to the EU and the region, moving towards a more sustainable development model.

Figure 69. Greenhouse gas emissions per capita



10 Annex I – Public opinion on waste management (Sentiment analysis and topic modelling)

10.1 Introduction

At a time when climate change is recognised as one of the greatest global challenges, waste management is becoming increasingly important, particularly because of its contribution to greenhouse gas emissions. The waste sector is among the fastest-growing sources of emissions in developing countries and economies in transition, including the Republic of North Macedonia.

Despite the adoption of a range of regulations, their implementation has not always delivered the intended environmental and social transformation. It is therefore increasingly clear that the success of policies depends not only on their technical design and legal framework, but also on public perception and support. In this context, understanding how the public in Macedonia perceives waste-management issues is essential.

Recognising the importance of public opinion for the adoption, implementation and acceptance of policies and measures, the National Waste Management Plan for 2021–2031 identifies research into citizens' perceptions as a key element.

Against this background, several studies have recently been conducted using data from social media and online news sources. Sentiment analysis and topic modelling were used to examine citizens' attitudes towards waste management in Macedonia and to identify the key concepts, emotions and discussions that characterise the public debate. The findings provide an additional evidence base for the design and implementation of public policies.

10.2 Methodology

The studies presented in this document use natural language processing (NLP) techniques to conduct a structured analysis of large textual datasets. The analyses cover the period from 2021 to 2025.

For the sentiment analysis of more than 13,000 tweets related to waste, several models were used, including VADER, RoBERTa and BERTweet. As suitable Macedonian-language models were not available, the tweets were machine-translated into English and the quality of the translation was checked manually. Multilingual BERT was also used for the study comparing waste-related discussions in North Macedonia and Spain. In addition, BERTopic was applied to identify the most frequent topics and discussions in public posts. The research also covered more than 9,500 media items on renewable energy sources collected through the Time.mk aggregator, thereby extending the analysis to wider public communication on climate action.

10.3 Results

10.3.1 Public reaction to regulations

The analysis indicates predominantly negative public sentiment towards waste management in North Macedonia. It also shows that changes in sentiment are influenced by specific events related to the implementation of waste-management policies and measures.

The public-opinion analysis covering October 2021 to March 2022 showed that discussion of plastic-bag use intensified in December 2021, when the ban on single-use plastic bags entered into force. During this period, Figure 70 shows a sharp increase in negative sentiment.

Figure 70. Trend in tweet sentiment

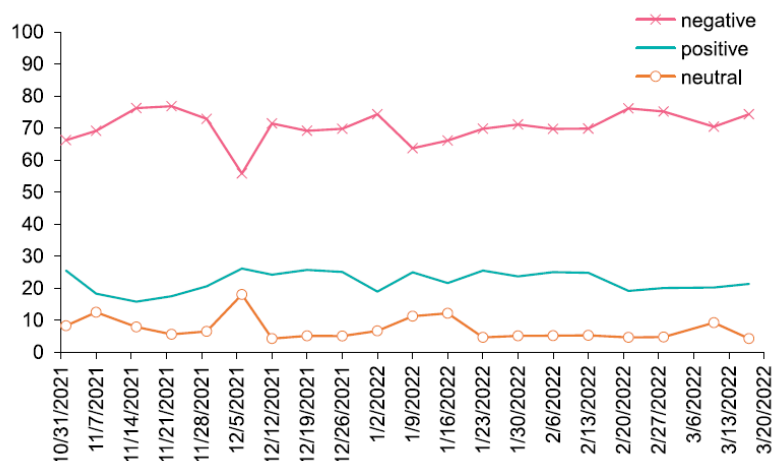
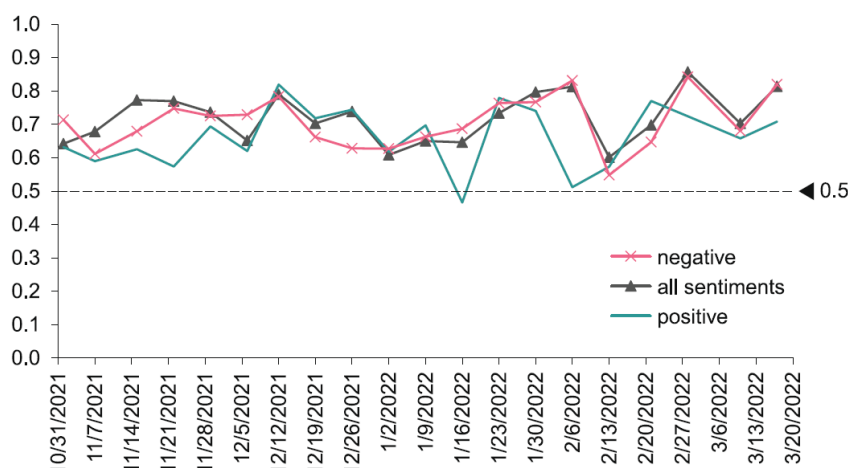


Figure 71 indicates a strong correlation between the sentiment expressed in online news and that expressed in tweets, suggesting that developments in waste-management policy are reflected in public discussion. Citizens' emotional and attitudinal responses to regulatory changes indicate a high level of awareness of and concern about waste-management issues.

Figure 71. Similarity of sentiment between tweets and news items



Topic analysis identified the following as the most frequently discussed issues during the period analysed:

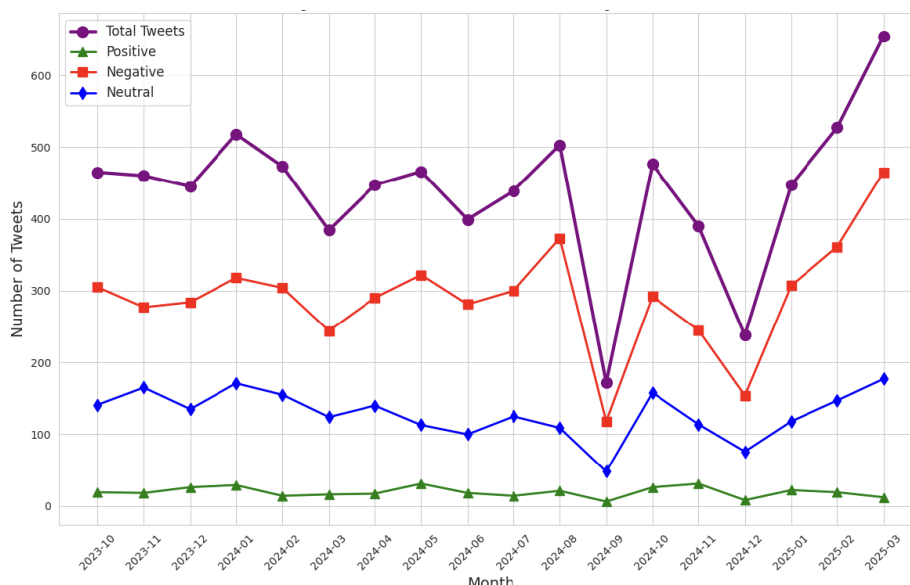
- improper waste disposal
- plastic bags
- nuclear waste from nuclear power plants
- medical waste and its management by municipalities
- the burning of wood and other materials for heating
- the disposal of electronic waste, including lithium batteries
- biowaste composting
- vehicle recycling

All identified topics appeared with a similar frequency, except for plastic bags, which became particularly prominent following the introduction of the single-use plastic bag ban in December 2021.

10.3.2 Sentiment analysis of tweets on waste and landfills

This analysis covers an 18-month period, from October 2023 to March 2025. A total of 13,287 tweets related to waste were collected, more than 80% of which expressed negative sentiment, including concern, frustration, criticism and anger regarding institutional passivity or ineffectiveness (Figure 72).

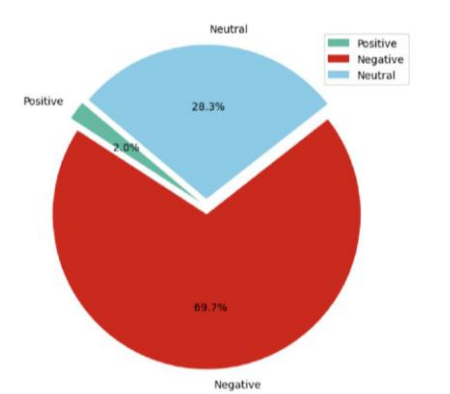
Figure 72. Trend in tweet sentiment on a monthly basis



Topic modelling identified several consistently recurring clusters in posts on X (formerly Twitter), including distrust of institutions, a lack of public education, an insufficient number of waste containers and inadequate recycling services. Other frequently discussed issues included poor landfill management, pollution in surrounding areas, the burning of waste for heating, and the improper disposal of medical and electronic waste.

For a more detailed examination of discussions concerning landfills, a subset of 1,278 tweets was analysed, of which 69.7% were classified as negative (Figure 73). The main concerns related to pollution, foul odours, institutional passivity, insufficient oversight and a lack of action by the relevant authorities.

Figure 73. Distribution of tweets related to the topic of landfills



The visualisations in Figure 74 show the words that had the greatest influence on the negative classification of the tweets.

Figure 74. Words most frequently mentioned in tweets in the context of landfills

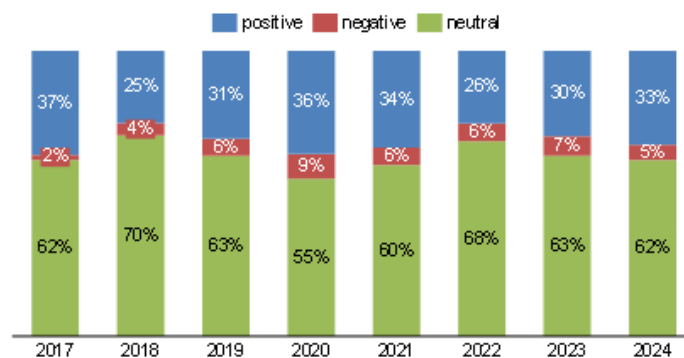


10.3.3 Media analysis of renewable energy sources

The media analysis covered 9,500 news items published between January 2017 and December 2024 and collected through the Time.mk aggregator.

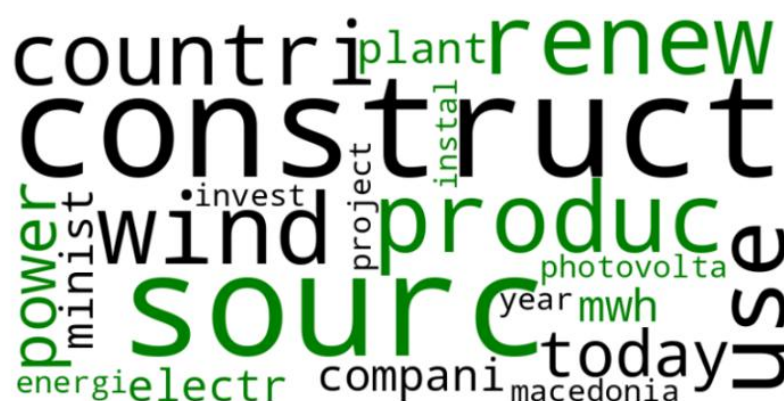
The results presented in Figure 75 reveal a different pattern, dominated by neutral sentiment, reflecting the predominantly informative nature of news reporting. Nevertheless, positive sentiment increased after 2020. This increase appears to correspond with developments in renewable-energy policies and investments during the same period.

Figure 75. Distribution of positive, neutral and negative news items, by year



Over time, media coverage shifted from discussions of decentralisation towards topics related to technology, public support and institutional integration (Figure 76). These results suggest that the media can play an important role in informing the public about the benefits of policies and measures, raising awareness and encouraging participation in activities that support their effective implementation.

Figure 76. Words most frequently mentioned in news items on renewable energy sources



10.3.4 Tweet sentiment in Macedonia and Spain: same waste, different worlds

To compare public discussions of waste management in Macedonia with those in an EU Member State, Spain was selected as a reference case. In recent years, the two countries have recorded similar levels of waste generated per capita, providing a relevant basis for comparison.

The dynamics of public discussion, however, are markedly different. The comparative analysis shows that tweets related to waste management in Spain display predominantly positive sentiment (76%). Citizens frequently praise recycling initiatives, circular-economy practices and visible cooperation between the public and private sectors.

By contrast, Figure 77 and Figure 78 show that negative sentiment predominates in North Macedonia (83%), with a tone indicating disappointment and apathy. Approximately 11% of the tweets were positive and primarily focused on calls for action.

Figure 77. Distribution of Macedonian tweets related to waste management

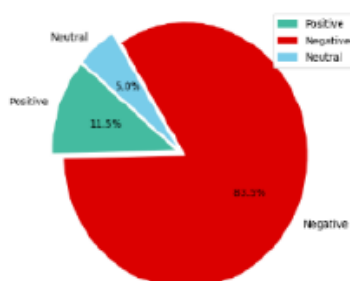
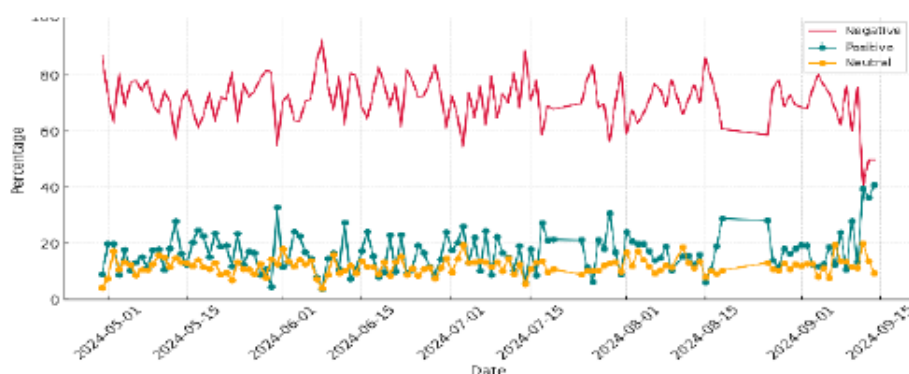


Figure 78. Trend in sentiment of Macedonian tweets related to waste management



The analysis identified several main topics, including pollution, improper waste management, inadequate landfills and institutional ineffectiveness. The same broad themes appeared in both countries, including institutional accountability, calls for action, support for recycling and public awareness. However, they were discussed from markedly different perspectives. In Spain, these themes were generally associated with recognition of successful practices, whereas in Macedonia they predominantly reflected frustration with inadequate or ineffective implementation. Nevertheless, the Macedonian tweets also expressed a strong desire for improvement and more effective implementation of the relevant policies and measures.

10.4 Discussion

The analyses show that public sentiment is not merely a passive reflection of policy outcomes, but also a valuable source of feedback that can guide institutional action. In Macedonia, the predominance of negative sentiment should not be interpreted solely as resistance, but also as evidence of potential for public mobilisation. Citizens frequently call for accountability, concrete solutions and improved performance; institutions should therefore respond to these messages and incorporate them into policymaking.

The comparison with Spain indicates that trust in institutions, economic stability and transparent communication play an important role in shaping positive sentiment. In Spain, policy implementation is more frequently perceived as supportive and effective, whereas in Macedonia it is often viewed as inadequate or obstructive.

The recurrence of topics such as plastic bags, illegal landfills and inadequate waste management also points to systemic weaknesses that cannot be addressed through one-off measures, but require long-term, structured interventions.

These findings point to several directions for developing more effective policies. Sentiment analysis can be used as a supplementary near-real-time monitoring tool, providing early indications or warnings of possible resistance to new measures. Topic modelling can help identify the issues of greatest concern to citizens and provide an evidence base for the design and implementation of regulations. Positive media sentiment also indicates that institutions can use media channels to strengthen communication and build public support. The media should therefore play a central role in informing the public about policies and measures, explaining their implementation and encouraging active participation. Where levels of distrust are higher, measures should be adapted to local circumstances in order to improve institutional transparency and public participation.

10.5 General conclusions

Public opinion is an essential element in the successful implementation of waste-management policies. The research shows that public concern and criticism are widespread in Macedonia and, if properly channelled, can become a driver of improvement. Technical solutions must therefore be accompanied by effective communication, transparency and civic-participation strategies.

Positive sentiment may indicate greater public trust in institutions and greater continuity in policy implementation. This transformative potential should be used effectively, and public opinion should be recognised as a legitimate source of evidence and a driver of change. Institutions should therefore adopt a hybrid approach in which technical assessments of policy effectiveness are complemented by analyses of citizens' perceptions, attitudes and expressed concerns, with the aim of achieving sustainable and inclusive waste management.

11 Annex II – Policies and regulations of the European Union (EU)

11.1 Energy efficiency

1. Revised Energy Efficiency Directive (EED) – Directive (EU) 2023/1791

Status: Adopted in September 2023.

a. Key provisions:

- i. Sets a binding EU-level target to reduce final energy consumption by **11.7% by 2030** compared with the projections in the 2020 Reference Scenario, which is a fundamental change from the previous indicative target. .
- ii. The “**Energy efficiency first principle**” is given a legally binding basis and must be considered in sectoral policies, planning and major energy-related investment decisions.
- iii. **Higher annual energy savings:** The annual end-use energy-savings obligation rises to 1.3% in 2025, 1.5% in 2026 and 2027, and 1.9% from 2028 to 2030.

b. New Specific Obligations Introduced in 2023:

- i. **The public sector** must reduce the combined final energy consumption of public bodies by at least **1.9% each year**, and renovate at least **3% of the total floor area** of buildings owned by public bodies annually.
- ii. **Protection of vulnerable consumers:** The Directive places particular emphasis on addressing energy poverty and requires Member States to prioritise energy-efficiency measures for vulnerable customers, people affected by energy poverty and, where applicable, people living in social housing.

2. Revised Energy Performance of Buildings Directive (EPBD) – Directive (EU) 2024/1275 (recast)

Status: Adopted in May 2024.

a. Key provisions:

- i. **Vision 2030:** Sets a clear goal for all buildings in the EU to be **Zero-Emission Buildings (ZEB) by 2030**.
- ii. **New buildings:** New buildings owned by public bodies must be zero-emission buildings from 2028, and all new buildings from 2030.
- iii. **Minimum energy performance standards (MEPS):** Requires Member States to establish standards and renovation trajectories that prioritise the worst-performing parts of the existing building stock.
- iv. **Fossil-fuel phase-out:** Phasing out subsidies for fossil fuel boilers and mandatory installation of solar panels on new buildings.

11.2 Renewable energy sources

1. Revised Renewable Energy Directive (RED III) – Directive (EU) 2023/2413

Status: Adopted in October 2023.

- **Main objective:** Raises the binding EU target for the share of renewable energy in gross final energy consumption to at least 42.5% by 2030, with a collective ambition to reach 45%.
- Key policies and measures:
 - Acceleration and simplification of permitting procedures:
 - Renewable-energy projects are presumed to be in the overriding public interest for specified legal balancing tests, subject to the applicable environmental safeguards.
 - Member States must designate renewables acceleration areas with shorter permitting deadlines: generally no more than 12 months within such areas and two years outside them.
 - Permitting procedures for the repowering of existing renewable-energy plants can be shortened to a maximum of six months in renewables acceleration areas.
 - Sector-specific targets by 2030:
 - **Industry:** An obligation for an average annual increase in the use of renewable energy of 1.6% and a mandatory target for 42% of hydrogen to be renewable (RFNBO).
 - **Transport:** Member States may choose between a 29% renewable-energy share and a 14.5% reduction in greenhouse-gas intensity by 2030. A combined sub-target of 5.5% applies to advanced biofuels and RFNBOs.
 - **Buildings:** Sets an indicative target of at least a 49% renewable-energy share.
 - **Heating and cooling:** Requires an annual increase in the renewable-energy share of 0.8% until 2025 and 1.1% for 2026–2030.
 - **Strengthened bioenergy sustainability criteria:** Introduces the cascading-use principle for woody biomass and tighter restrictions on financial support for certain uses of primary woody biomass.
 - **Innovative technologies and consumer rights:** Strengthens the framework for RFNBOs and reinforces the rights of prosumers and renewable-energy communities.
 - **Implications:** Requires faster reform of administrative procedures, strategic spatial planning, stronger markets for emerging technologies and greater attention in industry and buildings.

11.3 Electricity market and risk preparedness

1. Electricity market design reform - Directive (EU) 2019/944 and Regulation (EU) 2019/943, amended in May 2024

- **Main objective:** Creating a more integrated and flexible market with a focus on consumer rights and removing barriers to cross-border trade.
- New elements:
 - **Long-term stability:** Emphasis on long-term contracts (Contracts for Difference - CfDs) as a mandatory model for public support of new investments in clean energy and power purchase agreements (PPAs) with state guarantees to reduce risk.
 - **Consumer protection:** Strengthened rights, including the right to fixed-price contracts and protection against exclusion for vulnerable categories.

2. Regulation (EU) 2019/941 on risk-preparedness in the electricity sector, as amended in May 2024

- **Main objective:** Establishes a common framework for cooperation between Member States to prevent, prepare for and manage electricity crises.
- New elements:
 - **Electricity price crisis:** Introducing the possibility to declare a regional or pan-European crisis caused by extremely high prices, even when there is physically sufficient electricity.
 - **New crisis management tools:** Possibility to apply emergency measures such as direct price support and redistribution of extra-profits from producers.
 - **Strengthened role of the Council of the EU:** The European Commission can propose, and the Council of the EU can declare, an official crisis.
 - **Cybersecurity:** Greater emphasis on the risks of cyberattacks on energy infrastructure.

11.4 Governance of energy and climate policies

1. Governance Regulation – Regulation (EU) 2018/1999 (amended)

- **Main objective:** Establishes an integrated framework for planning, reporting and monitoring through National Energy and Climate Plans (NECPs).
 - New elements:
 - **Higher targets:** Member States must incorporate the new, higher targets from RED III (42.5% RES) and the new EED (11.7% consumption reduction) into their National Energy and Climate Plans (NECPs).
 - **REPowerEU Chapter:** Updated NECPs must include a separate chapter with measures to achieve the REPowerEU objectives (energy independence).

11.5 Decarbonisation mechanisms and infrastructure

1. "Fit for 55" package

- Reform of the EU Emissions Trading System (EU ETS):
 - **Key legislation:** Key regulation: Directive (EU) 2023/959 amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Union and Decision (EU) 2015/1814 establishing and operating a market stability reserve for the Union greenhouse gas emissions trading scheme, adopted in May 2023.
 - **Policy:** Reduction of the total number of emission allowances, with the aim of reducing emissions from the sectors covered by the ETS by 62% by 2030 (compared to 2005).
 - **Measures:** Phasing out free allowances (in particular for sectors covered by CBAM and aviation by 2026), inclusion of maritime transport, reinforced innovation and modernisation funds.
- New emissions trading system for buildings and road transport (ETS 2)
 - **Key regulation:** Directive (EU) 2023/959 amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Union and Decision (EU) 2015/1814 establishing and operating a market stability reserve for the Union greenhouse gas emissions trading scheme, adopted in May 2023.

- **Policy:** Establish a carbon price for fuels used for heating in buildings and in road transport, starting from 2027.
 - **Measure:** The obligation to purchase allowances lies with fuel distributors, not households or drivers.
- Social Climate Fund:
 - **Key legislation:** Regulation (EU) 2023/955 establishing the Social Climate Fund, adopted in May 2023.
 - **Policy:** Ensuring a socially just transition and preventing energy and transport poverty.
 - **Measure:** A fund worth over €65 billion for the period 2026-2032, financed by ETS 2 revenues, intended to directly support vulnerable households and finance long-term investments.
- Effort Sharing Regulation (ESR)
 - **Key legislation:** Regulation (EU) 2023/857 amending Regulation (EU) 2018/842 on binding annual greenhouse-gas emission reductions by Member States.
 - **Policy:** Setting binding national targets for reducing emissions from non-ETS sectors (road transport, buildings, agriculture, waste and small industry), which account for around 60% of total emissions.
 - **Measure:** An overall EU target of a 40% reduction in emissions from these sectors by 2030 (compared with 2005).
- Land Use, Land-Use Change and Forestry Regulation (LULUCF)
 - **Key legislation:** Regulation (EU) 2023/839 amending Regulation (EU) 2018/841 as regards greenhouse-gas emissions and removals from land use, land-use change and forestry in the 2030 climate and energy framework, and amending Regulation (EU) 2018/1999, adopted in April 2023.
 - **Policy:** Transforming the sector from a source of emissions into a net carbon sink.
 - **Measure:** A new, binding EU target for the removal of 310 million tonnes of CO₂ equivalent from the atmosphere by 2030 through improved management of forests, cropland and wetlands.
- Methane Regulation
 - **Key legislation:** Regulation (EU) 2024/1787 on the reduction of methane emissions in the energy sector and amending Regulation (EU) 2019/942, which entered into force in August 2024.
 - **Policy:** Reducing methane emissions from the energy sector (oil, gas and coal).
 - **Measure:** Strict obligations for the measurement, reporting and verification of emissions, mandatory leak detection and repair (LDAR), and transparency regarding emissions from imported fossil fuels.
- Carbon Border Adjustment Mechanism (CBAM)
 - **Key legislation:** Regulation (EU) 2023/956 establishing a Carbon Border Adjustment Mechanism, adopted in May 2023. The transitional reporting period began in October 2023.
 - **Key points:** It introduces a levy on imports of certain goods (iron, steel, aluminium, cement, fertilisers, electricity, hydrogen) from countries outside the EU, unless the producer has paid a carbon price similar to that in the EU (through the EU ETS). This directly affects trading partners, including contracting parties to the Energy Community.
- CO₂ emission standards for road vehicles
 - **Key legislation:** Regulation (EU) 2023/851 amending Regulation (EU) 2019/631 as regards strengthening CO₂ emission performance standards for new passenger cars and new light commercial vehicles.
- Deployment of alternative fuels infrastructure
 - **Key legislation:** Regulation (EU) 2023/1804 on the deployment of alternative fuels infrastructure (AFIR), adopted in September 2023.
 - Binding targets (based on the Trans-European Transport Network – TEN-T):
 - **Recharging for light-duty vehicles:** Electric charging for light vehicles: Every 60 km along the core TEN-T network by the end of 2025, with a capacity of at least 400 kW (with at least one 150 kW charger).
 - **Recharging for heavy-duty vehicles:** Electric charging for heavy-duty vehicles: Every 60 km along the core TEN-T network by 2025, with a capacity of 1400 kW (up to 3500 kW by 2027).

- **Hydrogen infrastructure:** Every 200 km along the core TEN-T network by the end of 2030, with a capacity of at least 1 tonne of hydrogen per day.
- **Port and airport infrastructure:** Ports and airports in the TEN-T network must provide shore-side electricity supply for ships and electricity supply for stationary aircraft by 2030, i.e. 2025/2030.
- **User-experience measures:** Provides for straightforward ad-hoc payment (card/QR), price transparency and access to real-time data.
- **Implications for the Republic of North Macedonia:** As part of the TEN-T network and the EU accession process, North Macedonia will need to align its planning and legislation with AFIR requirements and ensure sufficient electricity-grid capacity.

2. Renewable gas and hydrogen market package

- **Key legislation:** Directive (EU) 2024/1788 concerning common rules for the internal markets in renewable gas, natural gas and hydrogen, amending Directive (EU) 2023/1791 and repealing Directive 2009/73/EC and Regulation (EU) 2024/1789 concerning the internal markets in renewable gas, natural gas and hydrogen, amending Regulations (EU) No 1227/2011, (EU) 2017/1938, (EU) 2019/942 and (EU) 2022/869 and Decision (EU) 2017/684 and repealing Regulation (EC) No 715/2009, entered into force in August 2024.
- **Key points:** Creates rules for an integrated market for renewable and low-carbon gases (including hydrogen), rules on network access, tariffs and certification, and strengthens cooperation on security of gas supply.

11.6 EU strategic frameworks and plans

1. REPowerEU Plan

Status: Adopted in May 2022.

- **Objective:** To reduce dependence on Russian fossil fuels rapidly and accelerate the clean-energy transition.
- **Main pillars:**
 - **Energy savings:** Raising the mandatory energy efficiency target to 11.7% by 2030, including through intensified campaigns and regulations to reduce gas demand.
 - **Supply diversification:** Establishing an energy platform for joint procurement at EU level, new international partnerships, accelerating infrastructure construction (LNG terminals, gas interconnectors) and increasing biomethane production (35 billion cubic meters per year by 2030).
 - **Accelerating renewable energy:** Higher RES target (42.5% by 2030), massive acceleration of permit granting procedures, European Solar Strategy (600 GW by 2030), development of hydrogen economy and doubling of heat pump installation.
 - **Financing:** Mobilising €330 billion in investments by 2027 through the Recovery and Resilience Facility (RRF), cohesion funding and support from the European Investment Bank (EIB).
 - **Activities (2023-2024):** Finalization of the National Recovery and Resilience Plans (NRRPs), completion of legislative alignment, activation of the joint gas procurement platform (AggregateEU) and strategic documents for the industry (Net-Zero Industry Act, Critical Raw Materials Act).

2. Electricity market design reform

Status: adopted in May 2024.

- **Objective:** To make electricity prices less dependent on short-term fluctuations in fossil-fuel prices by strengthening long-term contracts.

11.7 Energy Community policies and regulations

1. Transposition of the Clean Energy Package (CEP)

Status: Part of the EU Clean Energy legislative package was adopted in adapted form by Decision No. D/2021/14/MC-EnC and D/2022/03/MC-EnC of the Ministerial Council of the Energy Community. The European Commission Implementing Regulation (EU) 2022/2299 on National Energy and Climate Plans (NECPs) was adopted in adapted form by Decision No. 2024/01/PHLG-EnC.

- **Transposition obligation:** Each Contracting Party was required to transpose the legal acts of the adapted CEP into its national legislation by 31 December 2023 at the latest.
- **Adoption of 2030 energy and climate targets (December 2022) Status:** Decision No. 2022/02/MC-EnC of the Ministerial Council of the Energy Community adopted the targets for each Contracting Party.
- **Key targets for 2030:** Reducing greenhouse gas emissions, increasing the share of renewable energy and improving energy efficiency.
- **Transposition obligation:** Each Contracting Party is required to integrate these targets into its National Energy and Climate Plans (NECPs).

2. Recommendations and guidance related to the crisis (2022–2023)

- The Secretariat issued recommendations and guidance on measures to address high energy prices, strengthen security of supply and accelerate investment in renewable energy and energy efficiency, in line with the objectives of REPowerEU.

Ministerial Council decisions on binding targets

- Ministerial Council Decision 2022/02/MC-EnC established national net greenhouse-gas emission targets for 2030. For the Republic of North Macedonia, the target is an 82% reduction compared with 1990, corresponding to an absolute limit of 2.20 Mt CO₂-eq in 2030. The target covers several sectors, including LULUCF and waste.

LULUCF

- LULUCF is included directly in the 2030 target under Decision 2022/02/MC-EnC.
- The Energy Community has not adopted an adapted version of Regulation (EU) 2018/841 on LULUCF, but Contracting Parties must include emissions and removals from the sector in their economy-wide net target.
- North Macedonia must report LULUCF categories in accordance with UNFCCC and IPCC methodologies.

Waste

- Within the EU, waste is covered by the ESR (2018/842).
- The Energy Community has not adopted an adapted version of the ESR, but waste is included in North Macedonia's economy-wide net emissions target of an 82% reduction by 2030.
- Monitoring, reporting and verification (MRV)

Under the Governance Regulation as adapted by the Energy Community:

- **Annual greenhouse-gas inventories:**
 - By 15 January each year (from 2025) – preliminary inventory data;
 - By 15 March – final inventory data plus the full National Inventory Report;
 - By 31 July – an approximated greenhouse-gas inventory for year X–1.

If a Contracting Party does not submit the required information on time, the Secretariat may compile an approximated inventory and prepare estimates to fill data gaps.

The Secretariat maintains the Energy Community inventory system, including QA/QC, and carries out comprehensive reviews of inventories, (especially in 2027 and 2032 for the 2025–2030 period).

- **Systems for policies and measures and projections:**

The Republic of North Macedonia must establish national systems for policies and measures and for projections of emissions and removals covering all sectors, and report through progress reports on the implementation of its NECP.

- **Progress reporting and the powers of the Secretariat:**

The Energy Community Secretariat reviews progress and may propose measures where progress is insufficient. The deadline under Article 29(5) for reporting on the achievement of targets was moved to 31 October 2025.

- **Monitoring compliance with climate-reporting obligations:**

The Energy Community Secretariat's 2024 Implementation Report explicitly called on the Republic of North Macedonia to comply with its climate-reporting obligations, confirming that MRV remains an active compliance issue.

11.8 OECD and World Bank reports and recommendations for the Western Balkans, with a focus on the Republic of North Macedonia

11.8.1 Policies to Improve the Environmental Performance of Road Vehicles in the Western Balkans (World Bank)

1. Key problems in the Western Balkans region

- **Ageing vehicle fleet:** The average vehicle age is approximately 17 years (19 years in North Macedonia).
- **Large-scale imports of older, high-emitting vehicles:** The Western Balkans receives substantial numbers of used diesel vehicles (Euro 3, Euro 4 and Euro 5 standards).
- **Predominance of diesel vehicles:** Diesel vehicles are a major source of nitrogen oxides and PM emissions.
- **Inadequate roadworthiness testing:** Existing systems are often ineffective in identifying excessively polluting vehicles.
- Fiscal policies do not consistently incentivise lower-emission vehicle choices.

2. Recommended policies and measures for the Western Balkans region

- **Strengthening technical inspection programs:** Introduce NO_x emission measurements, stricter checks for removed or tampered diesel particulate filters (DPFs) and exhaust-gas recirculation (EGR) systems, and digitalise the inspection process.
- **Aligning vehicle standards with EU requirements:** Restrict the registration of imported used vehicles below at least the Euro 5 standard, establish a pathway towards Euro 6, and consider low-emission zones (LEZs).
- **Introducing emission-based fiscal measures:** Reform registration taxes and annual vehicle charges so that they reflect CO₂ emissions and Euro emission standards, apply the polluter-pays principle, and consider vehicle-scrappage schemes.

3. Specific recommendations for the Republic of North Macedonia

- **Reforming vehicle taxation:** Replace the current approach with a system in which import and first-registration charges directly reflect Euro emission standards and CO₂ emissions.
- **Tightening import and registration requirements:** Raise the minimum emission standard for imported used vehicles and first registration from Euro 4 to at least Euro 5, with a medium-term pathway towards Euro 6.
- **Modernising roadworthiness testing centres:** Introduce mandatory NO_x measurements, DPF integrity checks, full digitalisation and video monitoring.
- **Introducing a vehicle-scrappage scheme:** Establish a public support mechanism using vouchers or subsidies to replace the oldest vehicles with newer, cleaner vehicles.

11.9 Energy prices and subsidies in the Western Balkans: Reforms for a fair and green future (OECD, 2025)

1. Key findings for the Western Balkans region

- **Scale of public support:** The region provided EUR 5.8 billion in direct financial support and EUR 19.1 billion in induced support through below-market prices during 2018–2023.
- **Predominance of fossil-fuel support:** More than 70% of direct support was allocated to fossil fuels.
- **Electricity prices are artificially low:** Average electricity prices were 62.5% below the EU average.
- **Subsidies are unfair:** Higher-income households received a disproportionately share of the subsidies.
- **Persistent energy poverty.**

2. Main recommended policies and measures for the Western Balkans region

- Gradually introduce market-based pricing.
- Phase out direct fiscal subsidies for fossil fuels.
- Strengthen governance in state-owned energy companies.
- Reform social-protection systems and provide targeted financial assistance.
- Support renewable energy and energy efficiency.

3. Specific findings and recommendations for the Republic of North Macedonia

- **Dependence on fossil fuels and imports:** 71% of the total energy mix in 2023.

- **Scale of support:** EUR 1.4 billion in induced support during 2018–2023 and EUR 574 million in direct financial support during 2021–2023.
- **Cross-subsidisation:** An estimated EUR 190 million in cross-subsidisation during 2018–2023.
- **Energy poverty:** A significant share of the population is at risk, particularly women, rural communities and Roma communities.
- **Recommended policies:** Align prices more closely with market conditions; protect vulnerable consumers through targeted assistance; expand renewable-energy capacity; strengthen grid infrastructure; enable the participation of prosumers and energy communities; and develop the skills required for the energy transition.

11.10 Western Balkans 6 Country Climate and Development Report (CCDR), World Bank, 2024

1. Key challenges for the Western Balkans

- **Adaptation challenge:** The region is warming faster than the global average and faces increasing economic losses from droughts, floods and heatwaves.
- **Decarbonisation challenge (Mitigation):** The region's energy-intensive economies remain heavily dependent on coal, increasing their exposure to the CBAM.
- **Economic consequences:** Significant losses in GDP by 2030 if no measures are taken.
- **Investment need:** uge investments (3-5% of GDP per year) are needed, bringing multiple benefits.
- **Just transition:** Need for social plans and retraining programs for coal-dependent regions.

2. Vulnerability profile of the Republic of North Macedonia

- **Dependence on coal:** The power sector remains heavily dependent on domestic lignite, particularly REK Bitola, and includes ageing, inefficient and high-emitting capacity.
- **Water-resource vulnerability:** The country faces a high risk of water stress as precipitation patterns change, affecting agriculture and hydropower generation.
- **Air pollution:** Coal-based power generation, an ageing vehicle fleet and household biomass heating all contribute to high levels of air pollution.

3. Recommended policies and measures for the Republic of North Macedonia

- **Managed and just energy transition:** Establish a clear pathway for phasing out coal, accompanied by worker-reskilling programmes, new investment and social support for affected communities.
- **Large-scale investment in renewable energy and networks:** Simplify administrative procedures for solar and wind projects, modernise transmission and distribution networks, and expand energy-storage capacity.
- **Adaptation in water management and agriculture:** Treat water as a strategic resource, modernise irrigation systems and promote drought-resistant crops.
- **Introducing carbon pricing:** Develop an appropriate carbon-pricing instrument, such as a carbon tax or a national emissions trading system, and use the revenues strategically to support the green transition.