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)”

Rapid Assessment of the Implementation of the Macedonian Enhanced Nationally Determined Contributions on Climate Change

Rapid Assessment of the Implementation of the Macedonian Enhanced Nationally Determined Contributions on Climate Change

Prepared for:	*UNDP*
Financial and technical support:	*Global Environment Fund* *United Nations Development Programme (UNDP)* Project manager: Jozhe Jovanovski
Prepared by:	***Prof. Natasa Markovska, PhD*** Support – Senior Research Associate Aleksandar Dedinec, PhD
Data:	May, 2025

Contents

List of tables

List of figures

Abbreviations

GEF	Global Environment Facility
GHG	Greenhouse Gas
SDGs	Sustainable Development Goals
SESP	Social and Environmental Screening Procedure
UNDP	United Nations Development Programme
ETF	Enhanced Transparency Framework
AFOLU	Agriculture, Forestry and Other Land Use
IPPU	Industrial Processes and Product Use
MPG	Modalities, Procedures, and Guidelines
INDC	Intended Nationally Determined Contribution
eNDC	Enhanced Nationally Determined Contribution
UNFCCC	United Nations Framework Convention on Climate Change
NECP	National Energy and Climate Plan
TBUR	Third Biennial Update Report
MRV	Measurement, Reporting, and Verification

Introduction

In the recent years, the global climate governance framework under the Paris Agreement has continued to evolve, with growing expectations for countries to submit increasingly ambitious and transparent Nationally Determined Contributions (NDCs). Central to these expectations are the Modalities, Procedures, and Guidelines (MPGs) adopted under the Enhanced Transparency Framework (ETF), which standardize how countries report their emissions, track progress toward targets, and communicate mitigation and adaptation efforts. These MPGs emphasize the importance of clarity, comparability, and methodological consistency, including the use of common reporting formats and robust data management systems. As countries prepare new or updated NDCs, alignment with these guidelines has become essential for ensuring credibility and enabling global stocktaking processes.

In this context, NDCs are also increasingly viewed as implementation tools, rather than aspirational statements. Countries are called upon to embed their NDCs within national development frameworks and to present credible roadmaps for delivery, including investment strategies, institutional arrangements, and monitoring mechanisms. The alignment of NDCs with Biennial Transparency Reports (BTRs), Long-Term Strategies (LTS), and National Adaptation Plans (NAPs) is becoming standard practice, enabling coherence across all Paris Agreement instruments and reinforcing national accountability.

The Republic of North Macedonia, a non-Annex I party to the United Nations Framework Convention on Climate Change (UNFCCC), prepared its first Nationally Determined Contribution (NDC) as an Intended **Nationally Determined Contribution (INDC) in 2015**, officially submitting it the same year as part of its commitment under the Paris Agreement. The Agreement was signed by North Macedonia in 2015 and subsequently ratified in January 2018, thereby formalizing the country's dedication to contributing to the global effort to mitigate climate change.

The 2015 NDC was primarily mitigation-oriented and focused almost exclusively **on carbon dioxide (CO_2) emissions from fossil fuel combustion in the energy sector**, which at the time accounted for approximately 80 percent of the country's total greenhouse gas (GHG) emissions. The scope of this initial contribution was limited, targeting emission reductions from energy supply, buildings, and transport, but without incorporating detailed or quantified policies for other major emitting sectors such as agriculture, land use, or waste management. Furthermore, it did not include other GHGs such as methane (CH_4) and nitrous oxide (N_2O), which are significant contributors in sectors like agriculture and waste.

Recognizing the need for a more comprehensive and ambitious approach aligned with evolving international standards and national development goals, the Government of the Republic of North Macedonia prepared its **Enhanced Nationally Determined Contribution (eNDC) in 2021.** The enhanced contribution marks a substantial advancement in both scope and methodology. It significantly broadens sectoral coverage to include mitigation measures in three key sectors: **energy (encompassing supply, residential, industrial, and transport subsectors),**

agriculture, forestry and other land use (AFOLU), and waste. These means that the eNDC presents a holistic and economy-wide approach to decarbonization.

In addition to expanding the range of covered sectors and GHGs, the eNDC introduces a set of cross-cutting enabling measures aimed at facilitating implementation. These include the establishment of robust financing mechanisms, enhanced institutional coordination frameworks, capacity-building initiatives, and public awareness and education campaigns. The eNDC is also supported by improved modeling methodologies, incorporation of social and gender dimensions, and alignment with national planning documents such as the Energy Development Strategy 2040, the National Energy and Climate Plan (NECP), and the Third Biennial Update Report (TBUR).

Table 1 presents a comparative overview of the key differences between the 2015 NDC and the 2021 eNDC in terms of sectoral coverage, gases included, and methodological framework.

TABLE 1. MAIN DIFFERENCES BETWEEN NDC AND ENDC

Aspect	2015 NDC	2021 eNDC
Sectors Covered	Energy only	Energy, AFOLU, Waste, Cross-sectoral
GHGs Covered	CO_2 only	CO_2, CH_4, N_2O, HFC
Scenario Approach	BAU vs. High Ambition	WOM vs. WAM (aligned with NECP, TBUR)
Modeling	MARAKAL - Energy only	Detailed emissions modelling for all sectors
Social/Gender Analysis	Not included	Included (green jobs, gender indicators)
Integration with strategies	Integration with not adopted energy strategy	Integrated with adopted NECP, Energy Strategy, TBUR

Objectives of the assessment

The primary objective of this assessment is to evaluate the progress made in implementing the eNDC) of the Republic of North Macedonia, as part of its commitments under the Paris Agreement. This includes a rapid review of the actions and measures outlined in the eNDC and the determination of the level of implementation, both overall and disaggregated by sector (e.g., energy, transport, buildings, agriculture, waste). By quantifying implementation progress and identifying sector-specific achievements and shortcomings, the assessment aims to provide a clear picture of the country's climate action trajectory.

An important objective is to identify and analyze the key barriers and challenges that have contributed to a lower implementation rate of the proposed measures. These may include institutional capacity constraints, coordination inefficiencies, lack of financial or human resources, and external factors such as political or economic developments.

In parallel, the assessment will also review the Financing Strategy for eNDC implementation. This includes evaluating the availability, mobilization, and allocation of financial resources from both

domestic and international sources, as well as examining the extent to which the Financing Strategy has been utilized by relevant institutions and stakeholders to secure funding for implementation.

Furthermore, the assessment will evaluate the level of awareness and understanding of the eNDC among key national institutions. This will help determine whether climate policies and NDC commitments are adequately mainstreamed into sectoral planning and decision-making processes.

Finally, the assessment will align the review with emerging global standards and expectations for the next round of NDCs (NDC 3.0). This includes identifying relevant international criteria and proposing ways to integrate them into North Macedonia's future NDC development process. Targeted recommendations to inform the design and formulation of NDC 3.0 and enhance its feasibility and ambition.

Methodology and data sources

To provide a robust and comprehensive assessment of the implementation of the eNDC, a dual-methodological approach has been developed. This approach combines top-down and bottom-up principles, ensuring that both strategic-level outcomes and measure-level implementation status are captured and analyzed effectively.

1. Top-Down approach: Indicator-based sectoral assessment

The first component of the methodology follows a top-down approach, grounded in the use of quantitative indicators that are linked to specific sectors and aligned with the relevant SDGs. Many of these indicators are explicitly defined within the eNDC and provide a structured basis for tracking progress in areas such as energy consumption, renewable energy share, greenhouse gas emissions, energy efficiency, transport performance, waste generation, and land use (Table 2). Where possible, these indicators are directly compared against projected values or targets for 2020, 2025 and 2030, allowing for a transparent assessment of whether current trends are aligned with national climate objectives.

This approach offers a macro-level perspective, enabling the identification of broader sectoral patterns and the overall direction of national climate efforts. It also allows for integration with the ETF under the Paris Agreement by establishing a data-driven foundation for regular reporting and evaluation.

TABLE 2. SDG 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 CO2 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 CO2 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
	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

2. Bottom-Up approach: Measure-level evaluation

Complementing the indicator-based analysis, the second component applies a bottom-up approach, focusing on the status and implementation stage of specific mitigation and adaptation measures outlined in the eNDC. Each measure is assessed according to its current phase, whether it is in the planning stage, under implementation, or already operational. This approach captures the practical realities of on-the-ground activities, enabling the identification of implementation bottlenecks, institutional or financial barriers, and areas where additional support or acceleration is needed.

By linking the status of individual measures to their expected contributions, this bottom-up analysis provides a micro-level view that complements the aggregated indicator trends. It also facilitates prioritization, highlighting measures that are lagging behind and those that could deliver early wins with targeted policy or financial intervention. To ensure consistency and transparency in evaluating

each measure, a graded scoring system has been adopted. The following six-point grading scale will be applied:

Grade	Definition
0	**No progress**: There is no visible implementation effort, and the measure remains absent or entirely ineffective.
1	**Very limited progress**: Actions largely remain at the planning or preparatory stage, or have been poorly executed, resulting in negligible or no tangible outcomes.
2	**Limited progress**: Implementation has begun but remains minimal. A few achievements may be noted, but major weaknesses hinder the overall effectiveness of the measure.
3	**Moderate progress**: The measure has been partially implemented, with some initial results visible. There is a balance of strengths and weaknesses, but several critical gaps limit its full impact.
4	**Good progress**: The measure has been substantially implemented and is delivering effective results. Key strengths are evident, although some moderate weaknesses or areas for further improvement remain.
5	**Excellent progress**: The measure is fully implemented, with significant and measurable outcomes already achieved. Strategic strengths clearly outweigh any minor weaknesses, and the measure is contributing effectively to national targets.

In addition, a traffic light rating system designed to complement or visually simplify the six-point grading scale in the bottom-up approach. This grading system provides a transparent and actionable way to monitor implementation, allowing policymakers to clearly identify which measures are advancing as planned, and which require redesign, capacity support, or resource mobilization. It also facilitates comparative analysis across sectors, enabling better prioritization of actions within the national climate strategy.

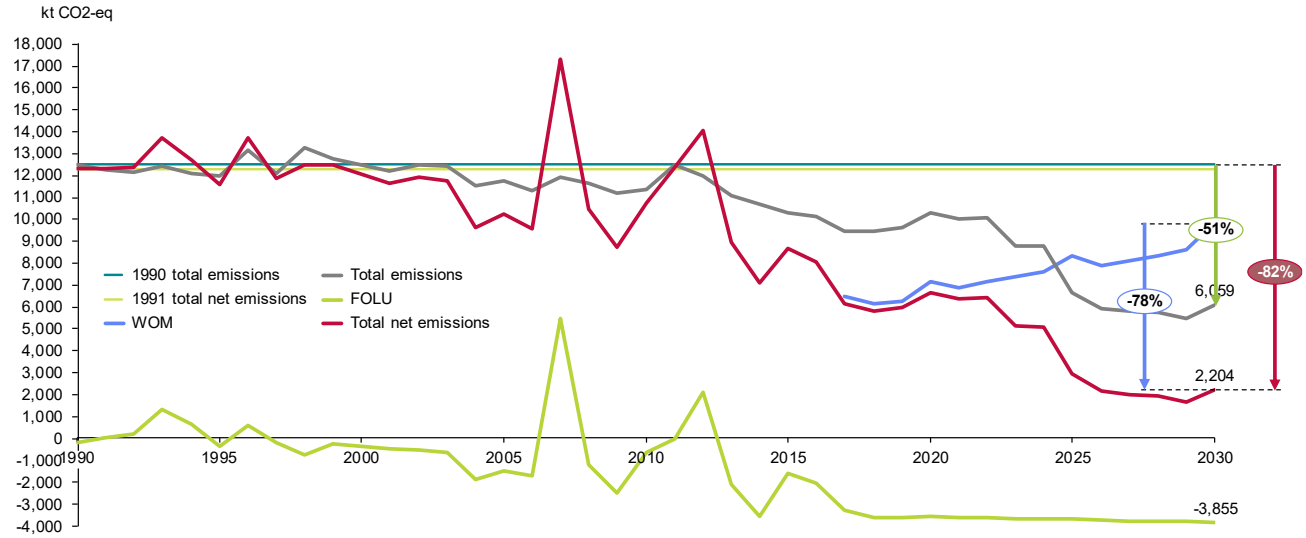
Together, these two methodological approaches form a holistic evaluation framework. The top-down analysis provides strategic oversight and alignment with SDGs and international obligations, while the bottom-up analysis offers detailed insights into implementation effectiveness and policy execution. This dual approach ensures that both outcomes and actions are monitored, making it possible to detect mismatches between policy ambition and practical progress, and to adjust strategies accordingly.

Both the top-down and bottom-up approaches in this methodology rely on official and verified statistical data to ensure accuracy, consistency, and transparency in assessing the implementation of North Macedonia's eNDC. Data are derived from data sources such as the State Statistical Office, EUROSTAT, the Energy Regulatory Commission, Ministry of Energy, Mining and Mineral Resources, Ministry of Environment and Physical Planning etc. These sources provide essential data on energy consumption, renewable energy shares, GHG emissions, energy import dependency, waste generation, transport performance, and land use, all of which are used to track alignment with SDG-linked indicators defined in the eNDC.

Overview of the eNDC

The eNDC of the Republic of North Macedonia (2021) reflects a substantial step forward in the country's climate ambition and policy coherence. Compared to the initial NDC submitted in 2015, the eNDC sets significantly more ambitious greenhouse gas (GHG) emission reduction targets. By 2030, the country commits to reducing total GHG emissions by 51% and achieving a reduction in net emissions of 82%, relative to 1990 levels. These targets incorporate both emission reductions and the enhancement of carbon sinks, particularly through measures in the forestry and land use sectors.

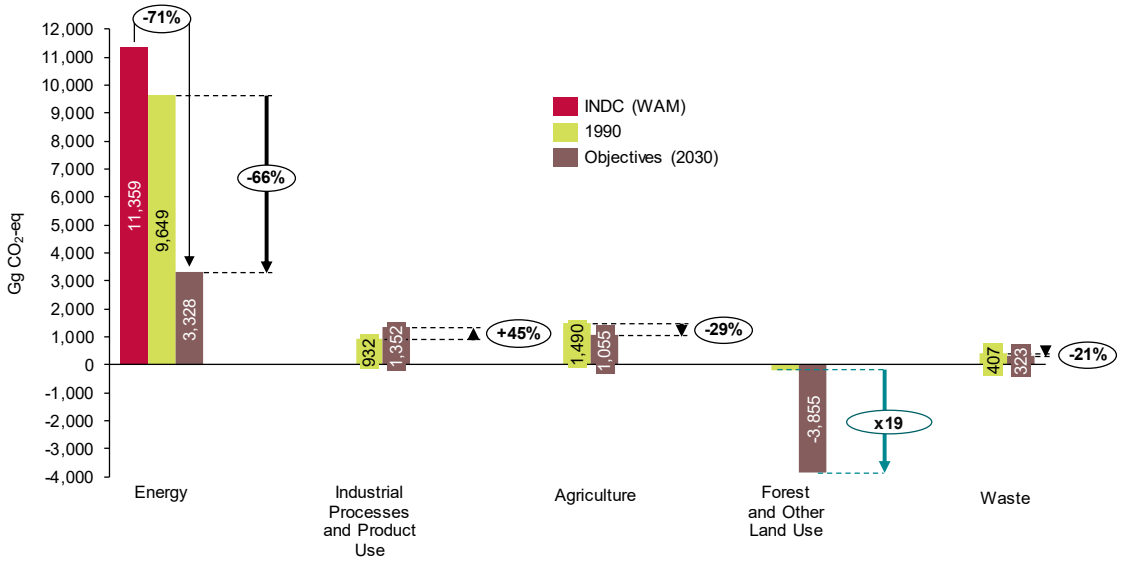
FIGURE 1. TRAJECTORY OF GHG EMISSIONS (IN GG CO_2-EQ) AND INDICATIVE REDUCTION TARGETS (IN %)



Source: eNDC Technical Report

Sector-specific targets form the backbone of this enhanced ambition. The energy sector, which is historically the dominant source of emissions in North Macedonia, is expected to achieve a 66% reduction in emissions by 2030. Agriculture is projected to contribute with a 29% reduction, while the waste sector is expected to deliver a 21% cut in emissions. Meanwhile, the land use and forestry sector is projected to increase its capacity for greenhouse gas removals nearly 18-fold compared to 1990 (Figure 2). When benchmarked against a scenario without measures (WOM), the projected economy-wide reduction reaches an impressive 78% by 2030.

FIGURE 2. SECTORAL OBJECTIVES FOR 2030 RELATIVE TO 1990 LEVEL, AND COMPARISON WITH INDC TARGET



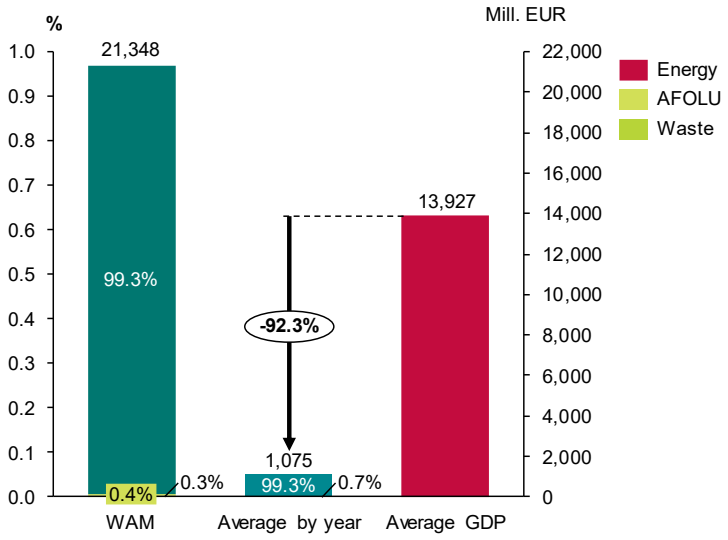
Source: eNDC Technical Report

The eNDC covers a broad range of thematic areas and goes beyond traditional energy sector interventions. A total of 63 mitigation measures are elaborated, including 32 measures in the energy sector, 11 in agriculture, forestry, and other land use (AFOLU), and 4 in the waste sector. These are complemented by 16 cross-sectoral and enabling policies and measures (PAMs) that serve to create the institutional, technical, and financial conditions for implementation. These measures are not only assessed in terms of emission reduction potential, but also through their socio-economic and gender dimensions. The eNDC introduces innovative approaches by quantifying the expected number of green jobs created, with projections of up to 9,895 new jobs by 2035, 77% of which are linked to energy efficiency. Furthermore, gender equality and youth inclusion are integrated into the policy design process, with specific indicators and consultations held to ensure their meaningful involvement.

The eNDC also adopts a regional and equitable approach to implementation, prioritizing measures according to the developmental needs of different regions in the country. For example, just transition programs are targeted at the coal-dependent Pelagonia region, while renewable energy expansion and energy efficiency improvements are tailored to specific geographic and socio-economic contexts.

Financing the eNDC represents a major challenge and opportunity. The estimated total investment needed for implementation by 2030 exceeds €20 billion (Figure 3). The majority of this amount—approximately 99%—is expected to be directed toward the energy sector, which is both the most emission-intensive and most capital-intensive sector. The roadmap outlines a multi-source financing approach, including public funds, private investments, international donor support, and consumer contributions. While only around €925 million is expected to come directly from state sources, the rest is envisaged through mixed and external financing mechanisms, reflecting the country's limited fiscal space but strong reliance on leveraging partnerships and innovative instruments.

FIGURE 3. INVESTMENTS IN WAM AND ANNUAL INVESTMENTS COMPARED TO AVERAGE GDP



Source: eNDC Technical Report

The eNDC is part of an interconnected policy and planning ecosystem in North Macedonia. It builds on a series of national documents developed over recent years, including the Second and Third Biennial Update Reports on Climate Change (SBUR and TBUR), the Strategy for Energy Development until 2040, the draft National Energy and Climate Plan (NECP), and the draft Long-Term Climate Strategy (Figure 4). These documents provide the analytical foundation and scenario assumptions upon which the eNDC is based. They ensure consistency in the modeling of mitigation pathways and establish a unified framework for policy development. The eNDC harmonizes scenario definitions used across different documents, especially regarding the baseline scenario (WOM) and the mitigation scenario with additional measures (WAM).

FIGURE 4. DOCUMENTS PREPARED AFTER THE ADOPTION OF INTENDED NATIONALLY DETERMINED CONTRIBUTION

Source: eNDC Technical Report

Assessment of Implementation of the eNDC

Top-down approach

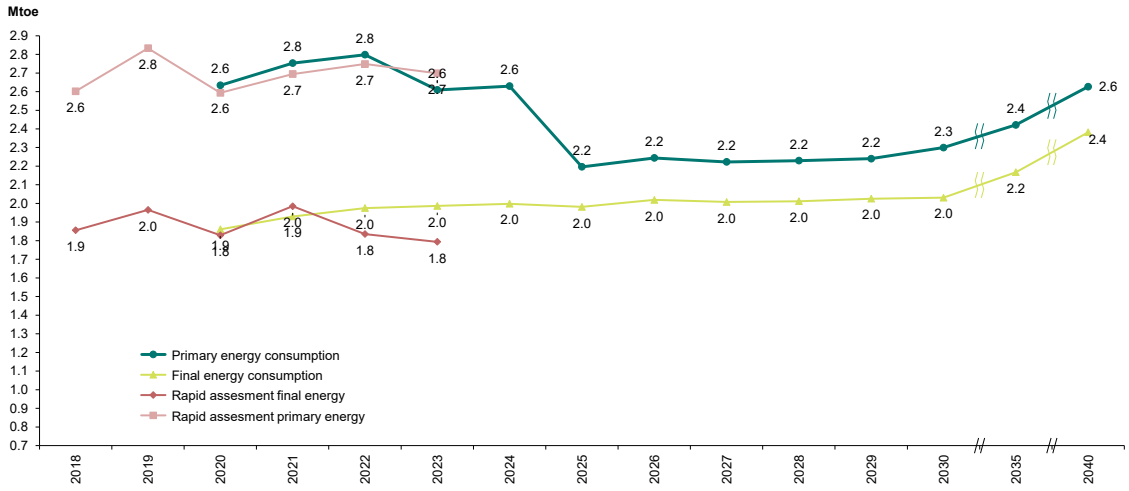
One of the key steps in tracking the progress of North Macedonia's eNDC is the regular monitoring of well-defined indicators. The NDC framework includes a comprehensive list of indicators, many of which are directly linked to the Sustainable Development Goals (SDGs). These indicators serve as a foundation for understanding the country's trajectory in implementing its climate and energy commitments and provide a structured approach for evaluating outcomes across sectors such as energy, transport, waste, agriculture, and forestry.

Although data for some indicators are still not available—particularly those related to housing quality by poverty status or certain transport and waste management metrics—the majority of the indicators do have accessible data for North Macedonia, either from national statistical systems or international sources. This Rapid Assessment focuses on the indicators where data is available, offering an evidence-based overview of the direction the country is taking. These include metrics such as primary and final energy consumption, energy productivity, the share of renewables, energy import dependency, GHG emissions, and sector-specific CO_2 intensities, among others. Together, these indicators will help assess whether the current trends align with the targets outlined in the NDC and identify areas where further effort and policy intervention are needed.

Since most of the GHG emissions are coming from the energy sector, the indicators for primary and final energy consumption are the first to be analyzed in the Rapid Assessment report, providing an initial snapshot of the country's energy efficiency trends. Primary and final energy consumption in North Macedonia remained consistently lower in the Rapid Assessment (real data) compared to the official projections used in the energy balance. For primary energy, actual consumption ranged from 2.60 Mtoe in 2018 to 2.70 Mtoe in 2023, while projected values reached as high as 2.80 Mtoe in 2022. Similarly, final energy consumption stayed below expectations, ending at 1.79 Mtoe in 2023, compared to the projected 1.99 Mtoe.

This consistent gap between projections and real data can be interpreted positively. It indicates that energy use has been more efficient than anticipated, and that demand-side measures, structural changes in the economy, or behavioral shifts may be reducing overall energy intensity. Importantly, lower actual consumption is not necessarily a negative sign. If economic activity has remained stable or grown while energy consumption has stayed flat or declined, this implies a decoupling of energy use from economic growth, which is a key objective of sustainable energy policy. In North Macedonia's case, the data trend is generally encouraging, suggesting that the country is on a more efficient energy path than originally forecasted.

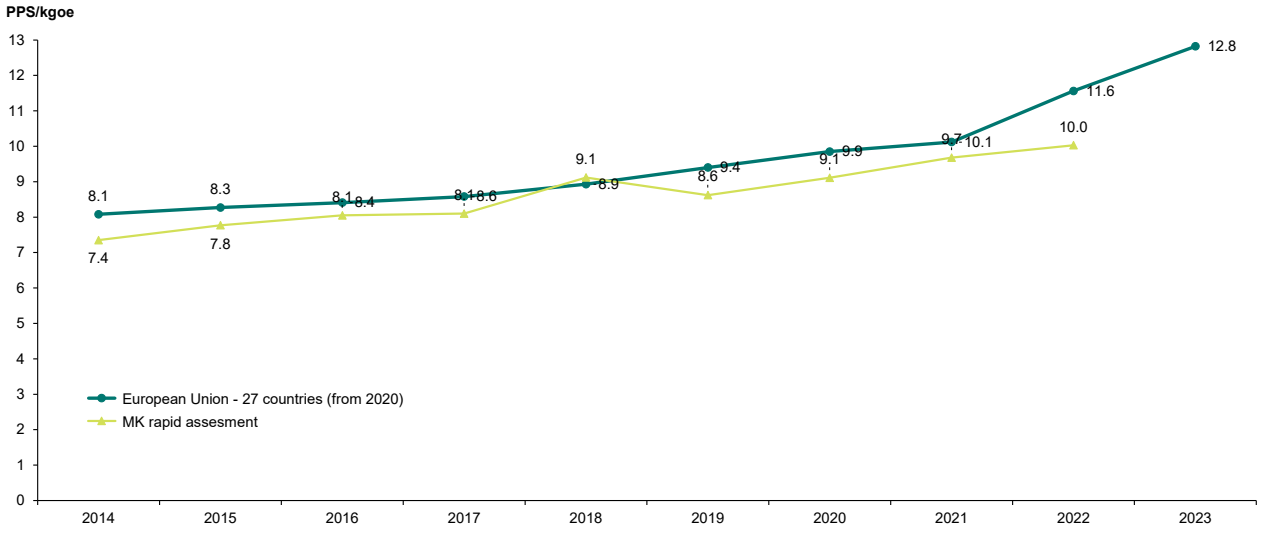
FIGURE 5. PRIMARY AND FINAL ENERGY CONSUMPTION



To support the statement on improved energy efficiency and decoupling of energy use from economic growth, energy productivity data (measured in PPS/kgoe) provides clear empirical evidence. In the case of North Macedonia, energy productivity has steadily improved over the past decade, rising from 7.35 in 2014 to 10.03 in 2022, as shown in the Rapid Assessment (Figure 6). This trend indicates that the country is generating more economic output per unit of energy consumed, reflecting increased efficiency and more sustainable patterns of energy use.

While still slightly below the EU-27 average, which rose from 8.08 in 2014 to 12.82 in 2023, the gap has narrowed over time, especially since 2018. Notably, despite lower final and primary energy consumption than projected, North Macedonia has maintained an upward trajectory in energy productivity. This supports the interpretation that lower-than-expected energy use is not a sign of underperformance, but rather a positive outcome of structural changes, demand-side policies, and improved energy management. It also signals gradual convergence with EU standards and reflects progress toward a more resilient and efficient energy system.

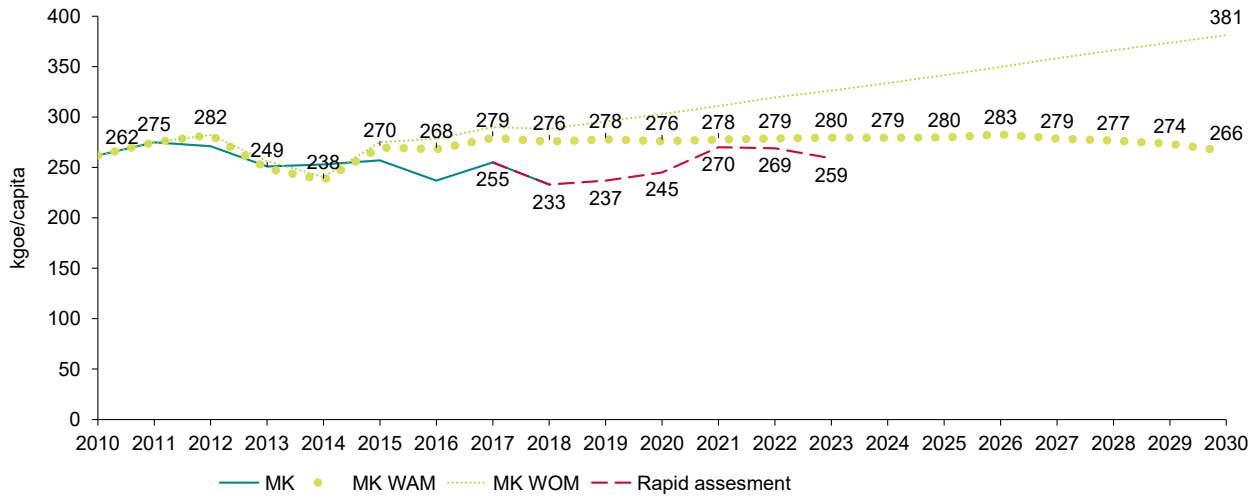
FIGURE 6. ENERGY PRODUCTIVITY (PPS/KGOE)



Other indicator about the implementation of energy efficiency measures and support the final energy consumption trend is energy consumption in households per capita. Between 2018 and 2023, the final energy consumption in households per capita in North Macedonia remained consistently lower than projected, which is a positive indicator of improved energy efficiency. According to real data (Rapid Assessment), household consumption was 233 kgoe/capita in 2018, rose slightly to 237 in 2019 and 245 in 2020, peaked at 270 in 2021, and then slightly decreased to 269 in 2022 and 259 in 2023 (Figure 7). Despite fluctuations, actual consumption remained below both NDC scenario projections throughout the period.

The WAM scenario projected household consumption reaching 279.6 kgoe/capita by 2023, while the WOM scenario anticipated a much higher 326.3 kgoe/capita. The fact that real consumption stayed well below both projections suggests that households have become more energy-efficient than expected—possibly due to better insulation, more efficient appliances, behavioral changes, market change and broader adoption of energy-saving practices. This is a favorable development, showing that demand-side measures and public awareness may already be having a meaningful impact, and that households are contributing to climate and energy goals even beyond what the models had assumed.

FIGURE 7. FINAL ENERGY CONSUMPTION IN HOUSEHOLDS PER CAPITA (KGOE/CAPITA)



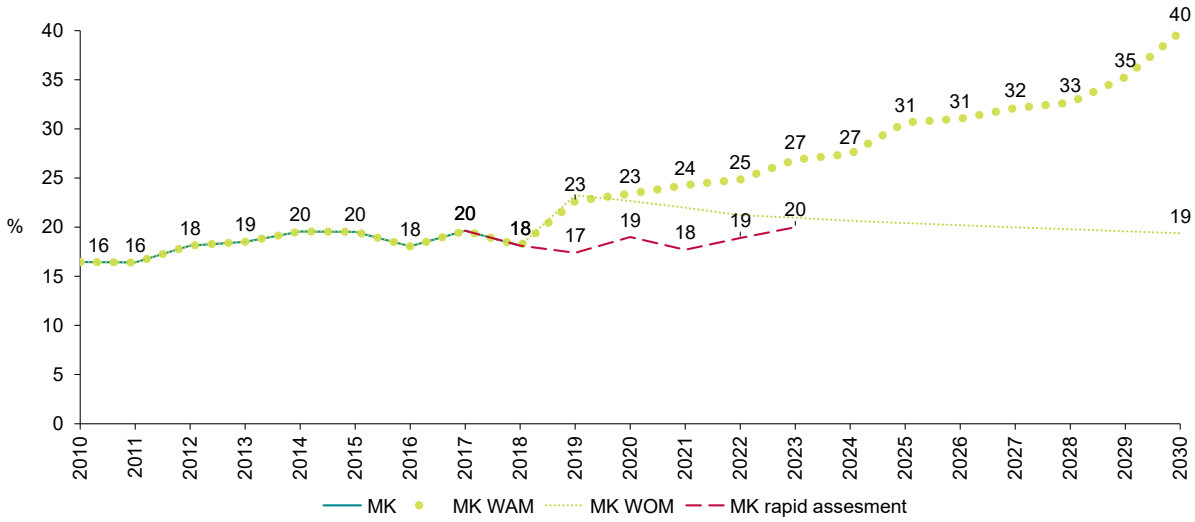
Between 2018 and 2023, the Rapid Assessment, which reflects official statistical data (Figure 8), shows that the share of renewables in North Macedonia's gross final energy consumption remained largely stagnant, starting at 20% in 2018, dropping to 17.4% in 2019, and recovering slowly to reach 20% again in 2023. At first look, this trend suggests limited progress. However, the statistical data significantly underrepresents the actual renewable energy uptake, primarily because key technologies are not yet captured in the national reporting system.

One major exception is heat pumps, which are recognized under Eurostat methodology as renewable energy sources when extracting ambient heat for space and water heating. In the WAM scenario, which represents a modeled policy pathway from the eNDC, heat pumps are included starting in 2019, resulting in a marked jump in the projected renewable share, from 18% in 2018 to 22.66% in 2019. This creates a 5 percentage points gap in that year between WAM and Rapid Assessment values, entirely due to methodological differences, not actual implementation failure.

In addition to heat pumps, rooftop solar photovoltaic (PV) systems, especially those installed on residential buildings, and solar thermal collectors used in the commercial and service sectors, are not fully captured in the official statistics. This is primarily due to a lack of comprehensive reporting mechanisms and insufficient data collection at the decentralized level. These unreported sources contribute renewable energy at the point of use, often outside the purview of energy utilities and therefore escape standard data tracking.

In summary, the apparent gap between the Rapid Assessment (real data) and the WAM scenario projections is primarily methodological, rather than evidence of policy underperformance. The exclusion of heat pumps, rooftop solar PV, and commercial-sector solar thermal systems from current national statistics results in a systematic underestimation of renewable energy shares. As these technologies continue to expand, updating the statistical framework to align with EU and international practices will be essential to accurately reflect North Macedonia's actual progress toward its renewable energy and climate goals. However, it should be mentioned that some percentage point in not achieving the target is camming from the transport sector in which the biofuels are not introduced, and in the first years there are still small percentage of electric cars.

FIGURE 8. RENEWABLE ENERGY SHARE IN THE GROSS FINAL ENERGY CONSUMPTION (IN %)



Between 2018 and 2023, the share of renewables in gross final electricity consumption in North Macedonia shows diverging paths across actual statistical data (Rapid Assessment) and the NDC projections under the WAM and WOM scenarios.

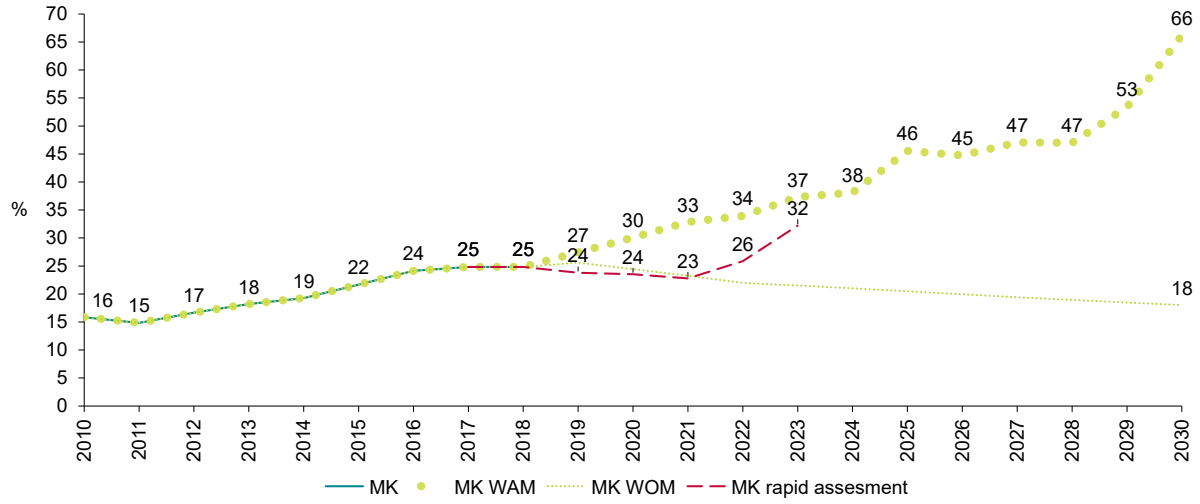
According to the Rapid Assessment, the renewable share remained stable at 25% in 2018 and 2019, decreased slightly to 24% in 2020 and 2021, then increased to 26% in 2022, and reached a notable 32% in 2023 (Figure 9). This recent acceleration reflects increased deployment of renewable electricity, particularly solar and wind. However, a significant portion of this growth is still not fully captured in the official statistics, mainly due to the lack of systematic reporting of rooftop solar photovoltaic (PV) systems, particularly in the residential and commercial sectors. Many of these systems are either off-grid or installed without integration into the centralized data collection framework.

The WAM scenario, representing the enhanced NDC's policy-driven projections, assumes full implementation of planned investments and support schemes. It projects a steady increase in renewable electricity, from 25% in 2018 to 37.3% in 2023. It also assumes comprehensive data coverage, including decentralized and prosumer generation.

By 2023, the Rapid Assessment (32%) outperforms the WOM projection (21.5%), and significantly narrows the gap with the WAM target (37.3%), indicating real-world progress in renewable electricity deployment. The difference that remains can be attributed to statistical underreporting, especially of distributed and rooftop generation.

Looking ahead, 2024 is expected to mark a major jump. The production of solar electricity has already surpassed 800 GWh (according to the annual report of the Energy Regulatory Commission[1]), which is an increase of nearly 500 GWh compared to 2023. Preliminary estimates suggest that the share of renewables in gross final electricity consumption could exceed 37% in 2024, potentially even surpassing the WAM projection. This would represent a milestone achievement for North Macedonia.

FIGURE 9. ELECTRICITY GENERATED FROM RENEWABLE ENERGY SOURCES (IN %)



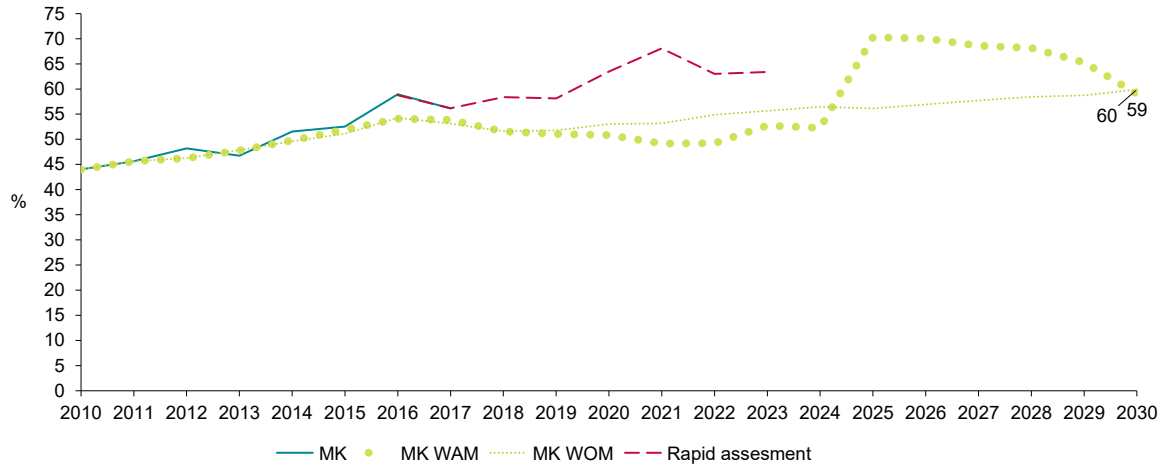
Between 2018 and 2023, North Macedonia's energy import dependency increased sharply, conflicting from both WAM and WOM scenario projections. Real data show an increase from 56% in 2018 to 58% in 2019, peaking at 68% in 2021, and then stabilizing at 63% in 2022 and 2023 (Figure 10). This rise is largely attributed to reduced electricity generation from domestic lignite power plants, caused by aging infrastructure and limited fuel availability. As a result, electricity imports rose significantly, alongside increased imports of lignite, heavy fuel oil, and natural gas, especially during the 2021–2022 energy crisis, when global prices and supply risks prompted emergency fuel diversification.

Looking ahead, projections for 2024 indicate a reversal of this trend. With improved domestic generation, particularly from solar, closing of the Negotino Power Plant and stabilized lignite supply through imports, the country is expected to reduce its reliance on foreign energy. Preliminary

[1] 2025.04.29 - RKE GI 2024-final.pdf

estimates suggest that import dependency in 2024 will realign with the NDC projections, falling closer to the levels foreseen in the WAM scenario.

FIGURE 10. ENERGY DEPENDENCE (IN %)

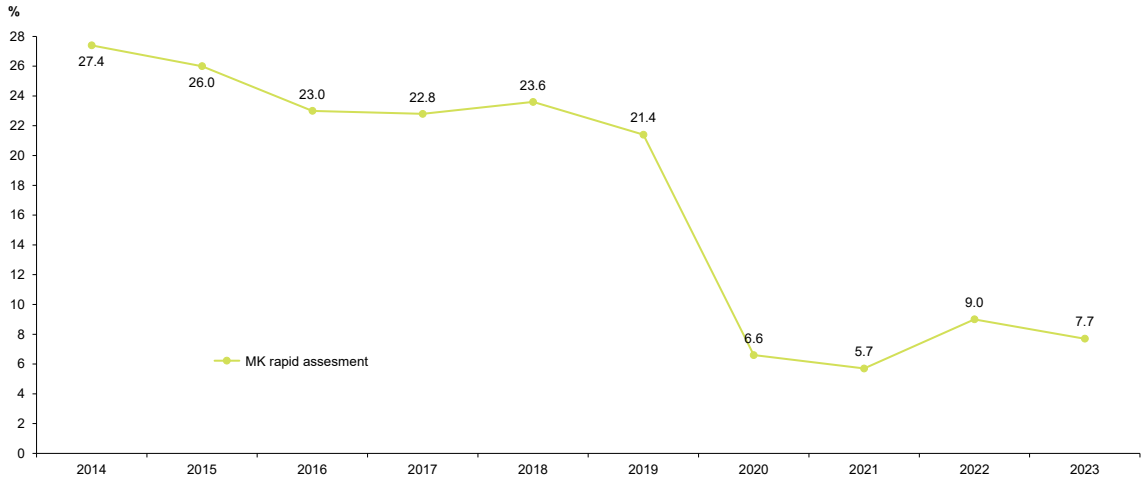


All of the previously discussed indicators are directly linked to **SDG 7: Affordable and Clean Energy**, highlighting progress in areas such as energy consumption, efficiency, and renewable energy uptake.

The following indicator, however, fall under SDG 9: Industry, Innovation, and Infrastructure, and SDG 11 Sustainable cities and communities specifically addressing the **transport sector**. Although the eNDC does not provide specific numerical targets or projections for these transport-related indicator, the available trend data clearly suggests that planned measures in the areas of public and rail transport have not been effectively implemented.

The share of buses and trains in total passenger transport in North Macedonia has seen a significant and consistent decline over the past decade, based on Rapid Assessment data (official statistical data). From a relatively high level of 27.4% in 2014, the share gradually dropped to 21.4% in 2019, followed by a dramatic fall to 6.6% in 2020 and 5.7% in 2021 (Figure 11), largely due to the COVID-19 pandemic's impact on public transport usage. Although there was a partial recovery to 9% in 2022 and 8% in 2023, the figures remain far below pre-pandemic levels. This trend indicates a shift away from public transport toward private vehicle use, raising concerns regarding transport sector emissions, congestion, and energy efficiency. It highlights the urgent need for strategic investments and policy measures to restore and enhance the attractiveness and accessibility of public transport, in line with sustainable mobility and climate targets. The number of rail passengers declined significantly, from 1.4 million in 2011 to just 0.28 million in 2023.

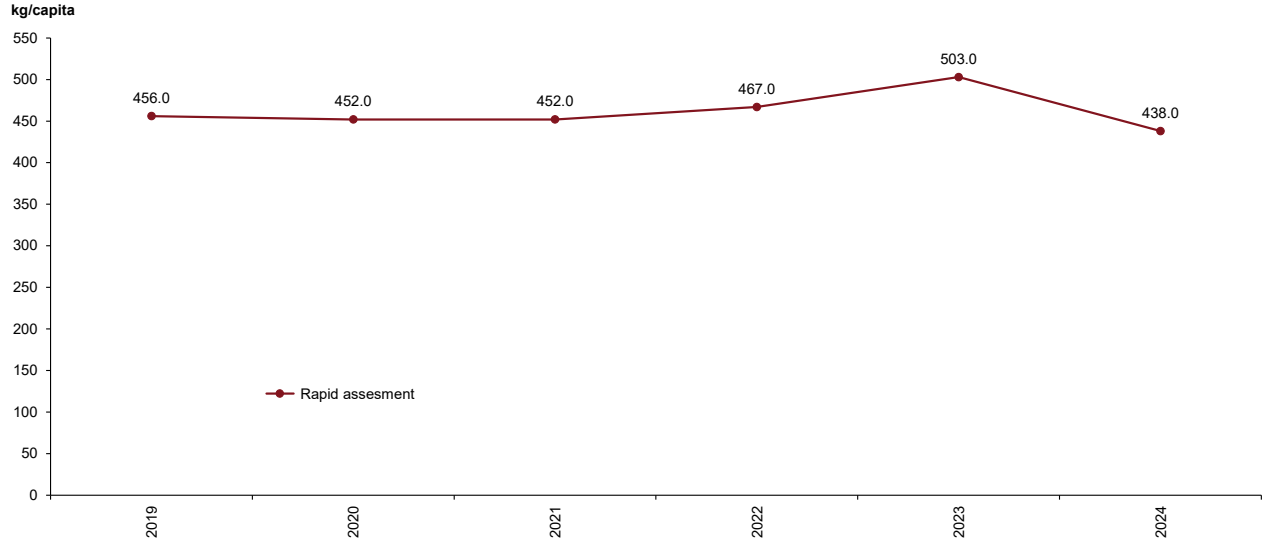
FIGURE 11. SHARE OF BUSES AND TRAINS IN TOTAL PASSENGER TRANSPORT



In the **waste sector**, the data on waste generated per capita from the eNDC cannot be directly compared to the real data from the Rapid Assessment. This is primarily due to the population adjustment following the 2021 census, which has changed the baseline population figures used for calculating per capita values. As a result, new projections are needed to ensure consistency and comparability of waste-related indicators.

According to the latest data from the State Statistical Office, 2024 shows a notable decrease in the amount of waste generated per capita, reaching 438 kg per capita per year — the lowest level recorded in the past five years. In comparison, the value in 2023 was 503 kg, 467 kg in 2022, and 452 kg in both 2020 and 2021 (Figure 12). The highest level was observed in 2023, indicating a short-term peak followed by a strong reversal in 2024. This decline may reflect improvements in waste prevention, recycling practices, or reporting accuracy, and signals a potential positive trend toward more sustainable waste management practices. However, a more detailed analysis is needed to determine whether this reduction is driven by policy measures or by external factors such as economic shifts or population behavior changes.

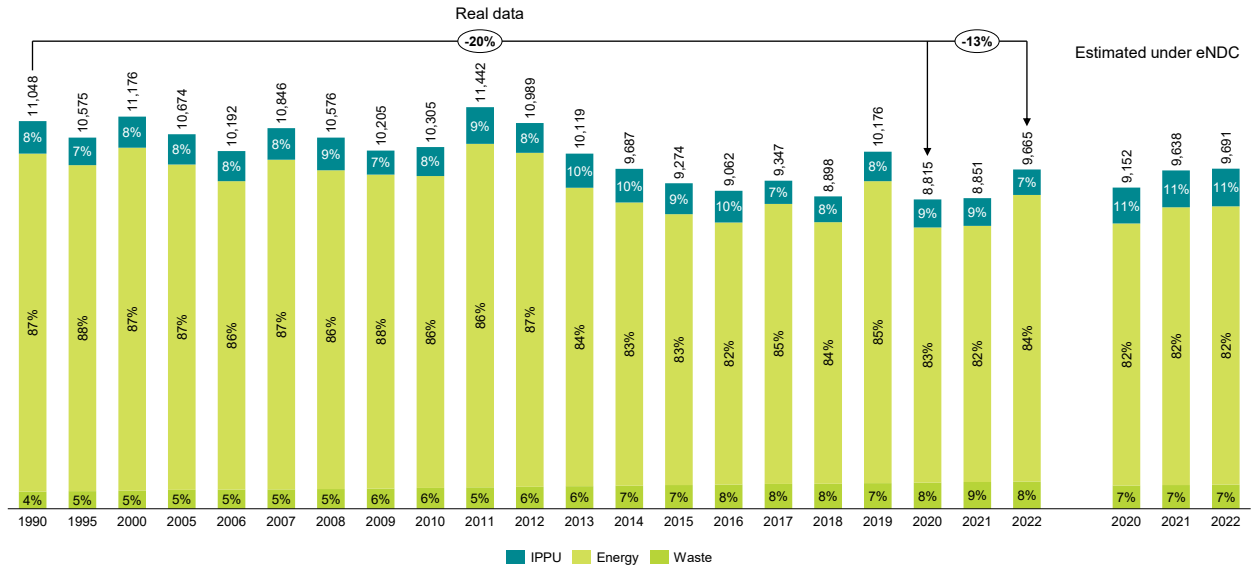
FIGURE 12. WASTE PER CAPITA



Since the national GHG inventory is still not finalized, the assessment relies on the sectoral data presented by the Macedonian Academy of Sciences and Arts (MANU), which covers the sectors of Energy, Waste, and Industrial Processes and Product Use (IPPU). Based on this data, it is evident that there has been a change in GHG emissions trends in recent years. In 2020 and 2021, emissions decreased compared to 2019, primarily as a result of reduced economic activity during the COVID-19 pandemic and temporary declines in energy demand. However, in 2022, emissions began to rise again. This increase was largely driven by the energy crisis, which led to a greater reliance on coal-fired electricity generation, and by a significant increase in the consumption of petroleum products in the transport sector.

These developments indicate a temporary reversal of the downward emission trend, underscoring the sensitivity of **GHG emissions** to both external shocks and structural energy choices. It also highlights the urgent need for accelerated decarbonization measures in the energy and transport sectors to maintain progress toward North Macedonia's NDC targets and long-term climate commitments. However, when comparing the real data with the estimates provided in the eNDC for the period 2020–2022, it becomes clear that by 2022, the values are nearly identical. This alignment indicates that, in these sectors, progress is generally on track, suggesting that implementation is proceeding in line with expectations. Such consistency between projected and actual data enhances confidence in the reliability of the modeling approaches used in the eNDC and suggests that the assumptions made for this period were largely accurate.

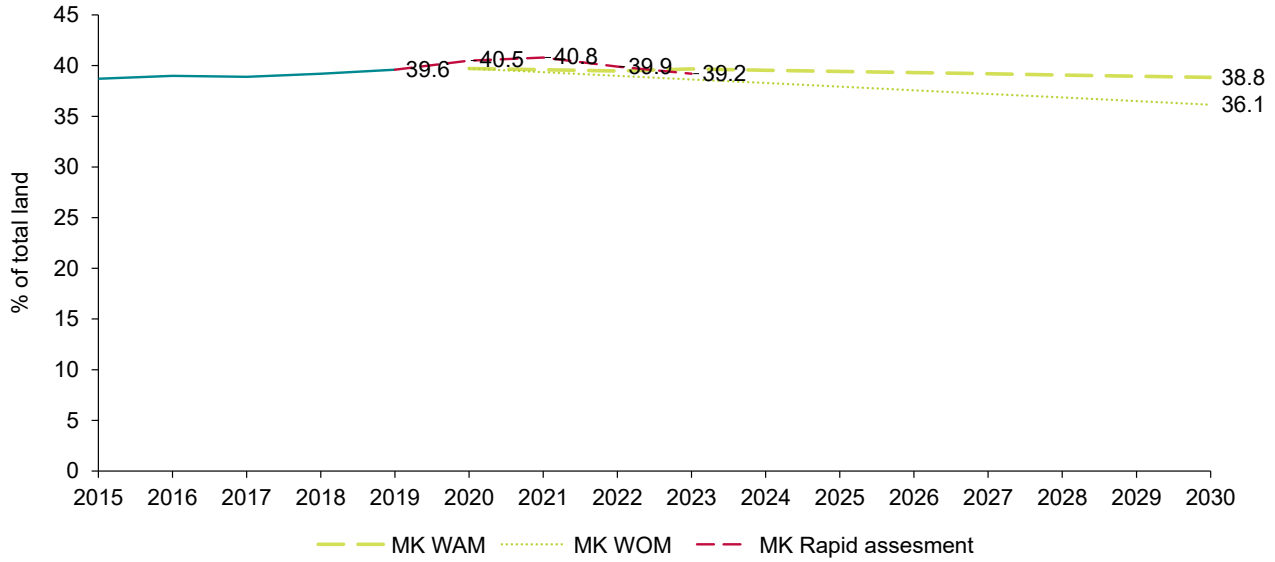
FIGURE 13. GHG EMISSIONS (CO2-EQ)



The **AFOLU sector** in the national GHG inventory in May 2025 is in the preparatory phase, with the full dataset and methodological framework still under development. Nevertheless, several key indicators have already been compiled and analyzed, offering preliminary insights into the sector's dynamics and potential impact on emissions trends. One of the key indicators used to assess progress under **SDG 15: Life on Land** is the Share of forest area as a percentage of total land area. This indicator provides valuable insight into a country's commitment to protecting terrestrial ecosystems, managing forests sustainably, and preserving biodiversity. The share of forest land in North Macedonia, expressed as a percentage of total land area, has remained relatively stable over

recent years, showing only slight fluctuations across both real data and scenario projections. According to the Rapid Assessment (real data), forest cover was 40% in 2019, rose briefly to 41% in 2020 and 2021, and then declined to 40% in 2022 and 39% in 2023 (Figure 14), indicating limited net change in forest area during this period.

FIGURE 14. FOREST LAND (% FROM TOTAL LAND)



Although there are currently no formal indicators defined for the agriculture sector within the eNDC monitoring framework, a comparison has been made between real data available up to 2024 and the projected values for 2025 and 2030 for key livestock categories. This comparison serves to identify potential discrepancies that may influence emission estimates and mitigation targets for 2030.

As shown in Table 3, the number of horses and cows in the actual data is significantly lower than what was projected, indicating that these livestock categories may have been overestimated in the eNDS scenarios. This overestimation is particularly important in the case of cows, given their substantial contribution to methane emissions, which could distort projections and the effectiveness of planned measures in the sector. On the other hand, the number of goats in 2024 is nearly three times higher than the projected figures, suggesting an underestimation of smaller ruminant populations. These mismatches highlight the need to update the agricultural scenario and ensure that future emissions projections and mitigation actions are grounded in accurate and current data, which is essential for realistic planning and effective implementation of climate policies in the agricultural sector.

TABLE 3. STATISTICAL (2016-2024) AND FORESEEN DATA ON THE NUMBER OF DOMESTIC ANIMALS

	Real data										Projected	
	2016	2017	2018	2019	2020	2021	2022	2023	2024		2025	2030
Horses	19263	17951	10041	8952	9154	11140	10659	10104	7815		19,926	19,931
Cows	254768	255036	256181	217790	222202	177622	164751	148693	143953		232,939	227,699
Pigs	202758	202197	195538	135770	164074	186146	182604	193412	179682		168,000	170,000
Sheep	723295	724555	726990	684558	630634	633281	646488	587073	517128		577,913	554,953

Goats	101669	107466	117447	87581	95008	75753	80186	85528	97918		36,559	28,655
Poultry	1865769	1840173	1828287	1562089	1643462	1484025	1561933	1746029	1573294		1,910,712	2,005,922

Bottom-up approach

The bottom-up approach in this assessment focuses on evaluating the implementation status of specific mitigation measures defined in North Macedonia's eNDC. These measures represent concrete actions planned across key sectors such as energy, transport, industry, agriculture, waste, and forestry. By assessing each measure individually, this approach provides detailed insight into how far implementation has progressed in practice. This allows for the identification of both successful areas and those where further efforts or corrective actions are needed, helping to strengthen the overall effectiveness of NDC implementation. The grades are for the period by 2024, not covering 2025.

For certain measures outlined in the eNDC, tracking progress is not straightforward, as it requires more detailed and disaggregated data than is currently available. This is particularly the case for measures such as the retrofitting of buildings, where implementation is often fragmented across various municipalities, public institutions, and private actors. Unlike centralized infrastructure projects, building renovations can vary widely in scope, depth (e.g., light vs. deep renovation), and energy savings achieved, making it difficult to capture consistent progress through standard indicators alone.

Furthermore, private-sector renovations, which form a significant part of the overall potential impact, are often underreported or entirely untracked. To address these challenges, there is a clear need for more systematic data collection, standardized reporting methodologies, and monitoring frameworks, particularly at the local level. Without these improvements, it will remain difficult to fully assess the contribution of building retrofits to national climate targets.

The tables presented below define the implementation progress of measures in the energy and waste sectors, as well as additional cross-sectoral measures. Measures from the agriculture and forestry sectors have not been analyzed due to a lack of reliable data, as these measures are highly sector-specific and often dependent on localized practices, biological processes, and long-term monitoring. Furthermore, several planned actions in these sectors are still in the early conceptual or preparatory stages, making it difficult to evaluate their actual implementation status or impact at this stage.

TABLE 4. MEASURES/POLICIES INCLUDED IN THE MITIGATION SCENARIO OF THE ENERGY SECTOR

#	Policy/measure	Competent entity for realization	Budget (mil. €)	Source of finance	Comments	Progress assessment
1	Reduction of network losses	► Electricity distribution companies ► Heat distribution companies ► Energy Agency, Ministry of Economy	170	Distribution and transmission companies		Good progress 4
2	Large hydropower plants	► JSC ESM ► Ministry of Environment and Physical Planning ► Ministry of Economy, Energy Agency	1716.2	JSC ESM, Public Private Partnership, Independent power producers	It was planned for part of the hydropower plants in the Vardar Valley to be constructed by 2030, and for Čebren to be completed by 2029. However, due to the failed tender process for Čebren, it is no longer realistic to expect its construction to be completed by 2030, and as for the Vardar Valley projects, no activities have been initiated at all.	Very limited progress 1
3	Incentives Feed-in tariff	► Government of the Republic of North Macedonia ► Energy Regulatory Commission ► Ministry of Environment and Physical Planning ► Ministry of Economy, Energy Agency ► Private investors	356.9	Independent power producers Consumers of electricity through bills		Excellent progress 5
4	Incentives feed-in premium	► Government of the Republic of North Macedonia ► Energy Regulatory Commission ► Ministry of Economy ► Private investors	240.6	Independent power producers, incentives from the central government budget		Excellent progress 5
5	Biomass power plants (CHP optional)	► Government of the Republic of North Macedonia ► Energy Regulatory Commission ► Ministry of Environment and Physical Planning ► Ministry of Economy, Energy Agency ► Private investors	24.3	Independent power producers Consumers of electricity through bills	Only one biomass power plant with a capacity of 0.6 MW has been put into operation. Additional analyses are needed to understand why investors are not showing interest in these types of plants. Furthermore, the state-owned utility company ESM could also be considered as a potential actor in exploring the construction of a biomass power plant.	Very limited progress 1
6	*Solar rooftop power plants*	► *Government of the Republic of North Macedonia* ► *Energy Regulatory Commission* ► *Ministry of Economy, Energy Agency* ► *Elektrodistribucija Skopje*	*263.4*	*Independent power producers, donors, subsidies from national and local budget, EE fund*		Excellent progress 5

		► *Suppliers of electricity* ► *End-users of electricity*				
	RES without incentives	► Government of the Republic of North Macedonia ► Energy Regulatory Commission ► Ministry of Economy, Energy Agency ► JSC Macedonian Power Plants (ESM AD) ► Private investors	1325.4	Public private partnership, Independent power producers, ESM		Excellent progress 5
	Development of the biofuels market	► Government of the Republic of North Macedonia ► Ministry of economy ► Companies that sell oil products	n/a	Central government budget, consumers	Only draft version of the Law on biofuel was developed	Very limited progress 1
	Energy efficiency obligation schemes	► Ministry of economy ► Distribution system operators ► Suppliers and traders of electricity and gas	182	Consumers through their bills	No direct implementation has taken place yet. However, certain already completed measures may fall under this obligation, provided that a proper methodological framework is established to account for them	Very limited progress 1
	Solar thermal collectors	► Ministry of Economy, Energy Agency ► End-users	70	Private, EE fund, incentives from the central government budget, donors		Excellent progress 5
11	Labeling of electric appliances and equipment	► Ministry of Economy, Energy Agency ► Producers and suppliers of electrical equipment and household appliances ► End-users	71	Private, EE fund		Good progress 4
12	Increased use of heat pumps	► Ministry of Economy, Energy Agency ► End-users	474.4	Private, EE fund, incentives from the central and local government budget, donors		Excellent progress 5
13 14 15	Public awareness campaigns and network of EE info centers	► Ministry of Economy, Energy Agency ► Energy suppliers ► End-users	712	Private sector, donors, central and local governments		Moderate progress 3
	Retrofitting of existing residential buildings	► Ministry of Economy, Energy Agency ► Donors and financial institutions ► Households	1708.2	Private, donors through commercial EE loans, EE fund		Good progress 4
	Retrofitting of existing central government buildings	► Ministry of Economy, Energy Agency ► Ministry of Finance	170	Central government budget, donors		Moderate progress 3

		► Local self-government ► Municipal public enterprises ► Donors and financial institutions				
16	Retrofitting of existing local self-government buildings	► Ministry of Economy, Energy Agency ► Ministry of Finance ► Local self-government ► Municipal public enterprises ► Donors and financial institutions	150	Local self-government budget, donors		Moderate progress 3
17 18 19	Retrofitting of existing commercial buildings	► Ministry of Economy, Energy Agency ► Ministry of Finance ► Commercial buildings owners	530	Private, donors through commercial EE loans, EE fund		Good progress 4
	Construction of new buildings	► Ministry of Economy, Energy Agency ► Donors and financial institutions ► Investors (households)	282.7	Private, donors through commercial EE loans, EE fund		Good progress 4
	Construction of passive buildings	► Ministry of Economy, Energy Agency ► Donors and financial institutions ► Investors (households)	1068	Private, donors through commercial EE loans, EE fund		Moderate progress 3
20 21	Phasing out of incandescent lights	► Government of the Republic of North Macedonia ► Ministry of Economy, Energy Agency End-users	558	Central government budget, private	Although the measure banning incandescent light bulbs has not yet been officially adopted, the majority of citizens are already choosing to purchase LED bulbs. This indicates a positive shift in consumer behavior toward more energy-efficient lighting, even in the absence of formal regulation.	Good progress 4
	Improvement of the street lighting in the municipalities	► Government of the Republic of North Macedonia ► Energy Regulatory Commission ► Ministry of Environment and Physical Planning ► Ministry of Economy, Energy Agency ► Local self-government	25.3	Central and local government budget, ESCO		Good progress 4
22	Green procurements	► Ministry of Economy, Energy Agency ► Public Procurement Bureau ► Local self-government	24	Central and local government budget		Moderate progress 3

23 24 25	Increased use of central heating systems	► Ministry of Economy, Energy Agency ► Balkan energy Dooel Skopje ► JSC Skopje Sever ► "Energetika" –Skopje, subsidiary to JSC Macedonian Power Plants (ESM AD) ► Private investors	3.2	Private, EE fund, incentives from the central and local government budget		Moderate progress 3 
26 27	Energy management in manufacturing industries	Ministry of Economy, Energy Agency Private companies	n/a	Private, donors through commercial EE loans		Moderate progress 3 
	Introduction of efficient electric motors	Private companies Ministry of Economy, Energy Agency	113	Private, donors through commercial EE loans		Moderate progress 3 
	Introduction of more advanced technologies	Government of the Republic of North Macedonia Ministry of Environment and Physical Planning Ministry of Economy, Energy Agency Private investors	438.6	Private, donors through commercial EE loans, EE fund		Moderate progress 3 
	Increased use of the railway	Government of the RM Ministry of Transport Ministry of Economy, Energy Agency JSC Makedonski zeleznici End-users Private companies	180.6	Central government budget		No progress 1 
28	Renewing of the national car fleet	Government of the RM Ministry of Transport Ministry of Economy, Energy Agency End-users	2167.7	Private, EE fund, incentives from the central government budget	More electrical vehicles are need	Moderate progress 3 
29	Renewing of other national road fleet (busses, heavy goods vehicles)	Government of the Republic of North Macedonia Ministry of Transport Ministry of Interior Affairs Ministry of Economy, Energy Agency Private companies	2300	Private sector	More electrical vehicles and need	Moderate progress 3 
30	Advanced mobility	Ministry of Economy, Energy Agency Local self-government End-users	n/a	Private, EE fund, incentives from the central and local government budget, donors		Good progress 4 
31	*Construction of the railway to the Republic of Bulgaria*	*Government of the Republic of North Macedonia* *Ministry of Transport* *Ministry of Economy, Energy Agency*	*720*	*Central government budget*		Moderate progress 3 

32	Electrification of the transport	Government of the Republic of North Macedonia Ministry of Transport Ministry of economy	8292.3	Private, EE fund, incentives from the central government budget	More electrical vehicles are need	Moderate progress 3 
		Total	24,571.8			

Note: As of 2024, the newly established Ministry of Energy, Mining, and Mineral Resources has taken over the responsibilities previously held by the Ministry of Economy and the Energy Agency.

TABLE 5. MEASURES/POLICIES INCLUDED IN THE MITIGATION SCENARIO OF THE WASTE SECTOR

#	Policy/ measure	Competent entity for realization	Budget (mil. €)	Source of finance	Comments	Progress assessment
1	Landfill gas flaring	► Ministry of Environment and Physical Planning ► Public municipal enterprises for waste management ► State Environmental Inspectorate ► Inter-Municipal Waste Management Board ► Authorized Inspectors of Environment (Municipalities)	20.5	Local self-government through Public Utilities, Public Private Partnership, Grants from the EU	Only mentioned in the document	Very limited progress 1 
2	Mechanical and biological treatment (MBT) in new landfills with composting	► Ministry of environment and physical planning ► Public utilities for waste management ► State Environmental Inspectorate ► Inter-municipal board for waste	36.1	Local self-government through Public Utilities, Public Private Partnership, Grants from the EU		Moderate progress 3 

		management ▶ Authorized Inspectors of Environment (Municipalities)				
3	Selection of waste - paper	▶ Ministry of environment and physical planning ▶ Public utilities for waste management ▶ State Environmental Inspectorate ▶ Inter-municipal board for waste management ▶ Authorized Inspectors of Environment (Municipalities)	2	Local self-government through Public Utilities, Public Private Partnership, Grants from the EU		Good progress 4
4	Improved waste and materials management at industrial facilities	▶ Ministry of Environment and Physical Planning ▶ Public utilities for waste management ▶ State Environmental Inspectorate ▶ Inter-Municipal Waste Management Board ▶ Authorized Inspectors of Environment (Municipalities)	0	Ministry of Environment and Physical Planning Municipalities and city of Skopje Industrial facilities		Moderate progress 3
		Total	58.6			

Note: As of 2024, the newly established Ministry of Energy, Mining, and Mineral Resources has taken over the responsibilities previously held by the Ministry of Economy and the Energy Agency.

TABLE 6. ADDITIONAL MEASURES/POLICIES INCLUDED IN THE MITIGATION SCENARIO

#	Policy/ measure	Competent entity for realization	Budget (mil. €)	Source of finance	Comments	Progress assessment
1	Introduction of CO_2 tax	► Government of the Republic of North Macedonia ► Ministry of Environment and Physical Planning ► Ministry of Economy, Energy Agency Ministry of Finance	n/a	n/a	Only preparatory studies have been completed so far, but the corresponding law has not yet been adopted. As a result, the implementation of the measure cannot proceed until a clear legal framework is established, which continues to delay progress.	Limited progress 2
2	Program for just transition	Government of the Republic of North Macedonia Ministry of Economy JSC Macedonian Power Plants (ESM AD) Ministry of labor and social policy	n/a	JSC ESM, state budget, donors		Good progress 4
3	Identification of the proper location for solar and wind power plants	Government of the Republic of North Macedonia Ministry of Economy JSC Macedonian Power Plants (ESM AD) Ministry of labor and social policy Donors	n/a	State budget, donors		Good progress 4
4	Smart communities	Universities (or high schools)	n/a	Donors Horizon 2020 and other research programs		Good progress 4
5	Construction of 400 kV electricity transmission interconnection Macedonia-Albania (Bitola-Elbasan)	MEPSO	34	EBRD (17.2 Mil. €), Grand from Western Balkan Investment Fund (16.9 Mil. €)	MEPSO terminated the contract with the contractor, and a new contractor will need to be selected, which will further delay the implementation timeline.	Limited progress 2
6	Develop natural gas cross-border infrastructure to diversify supply routes and increase market competitiveness	National Energy Resources of Macedonia	n/a	Grant – 10 Mil. €, Central government budget	A contractor has been selected to construct the gas interconnector with Greece, marking a significant step forward in the project's implementation. This development paves the way for the commencement of construction activities in line with the planned schedule	Moderate progress 3

7	Develop gas transmission network	National Energy Resources of Macedonia	200	State budget		Moderate progress 3 
8	Develop a gas distribution network	Ministry of economy, National Energy Resources of Macedonia, Local self-government	n/a	Grant, Central governmental budget, Local self-government budgets	A construction company has not yet been selected, which continues to delay the start of implementation. The absence of a designated contractor poses a significant barrier to initiating the planned activities within the expected timeline.	Very limited progress 1 
9	Pursue regional electricity market integration	National electricity market operator (MEMO), GAMA	n/a	National electricity market operator (MEMO), GAMA		Moderate progress 3 
10	Develop further distribution system network to integrate more RES, including prosumers and more electric vehicles (EVs), as well as continuously improve network reliability	EVN Energy Regulatory Commission	n/a	EVN, consumers through their electricity bills		Moderate progress 3 
11	Price signal demand response	Electricity suppliers/traders Consumers	n/a	Electricity suppliers/traders Consumers	Macedonia still maintains a two-tier electricity pricing system with low and high tariffs, which represents a preliminary step toward implementing price signal-based demand response. However, no further progress has been made in advancing or improving this mechanism to effectively influence consumer behavior or optimize energy use	Very limited progress 1 
12	Adoption of annual program for vulnerable consumers	Ministry of economy Suppliers of electricity, gas and heat	n/a	Budget and potential donors		Excellent progress 5 
13	Participation in development of energy transition technologies and measures	Ministry of Education and Science Fund for Innovation and Technology Development Chamber of Commerce	n/a	Fund for Innovation and Technology Development Horizon 2020 Donors		Limited progress 2 

14	*Increased level of education of sustainable energy needs*	*Universities, High and Primary schools*	n/a			Moderate progress 3
15	Inter-sectoral and geographical mobility of researchers	Universities Industry companies	n/a	Industry companies Donors		Moderate progress 3
16	Increase the role of SME sector in energy transition	SMEs	n/a	Grants Private investments		Moderate progress 3

Note: As of 2024, the newly established Ministry of Energy, Mining, and Mineral Resources has taken over the responsibilities previously held by the Ministry of Economy and the Energy Agency.

Based on the overall progress ratings presented in the policy and measures tables, the implementation of mitigation measures under Macedonia's eNDC shows **moderate advancement** across key sectors:

- In the energy sector, which comprises the largest number of actions and contributes the highest share of greenhouse gas emissions, the average implementation progress is estimated at approximately 65%. This indicates steady movement, particularly in measures related to renewable energy development, such as rooftop solar PV and solar thermal collectors, both of which have received the highest implementation scores. Energy efficiency initiatives in public and residential buildings are also progressing moderately, though some critical infrastructure projects, like biomass power plants or large-scale hydropower projects, face delays due to financial, technical, or permitting obstacles.
- In the waste sector, the implementation progress stands at around 55%, reflecting a combination of solid early-stage planning and slow materialization on the ground. Several measures, such as opening of new and closure of non-compliant landfills, are in the planning but lack full-scale roll-out. Legal and institutional hurdles, limited municipal capacity, and the need for clearer financing strategies have all contributed to the slower-than-expected pace in this sector. In addition, resistance from local communities, particularly regarding the siting of regional landfills and waste treatment facilities, has emerged as a significant barrier, delaying several planned investments and triggering public opposition in multiple municipalities.
- For additional and cross-cutting measures, including those related to awareness raising, legislation, and research and development, the average progress rate is just under 60%. This suggests a fair level of engagement but also highlights the need for more systemic support mechanisms and stronger policy enforcement. One notable example of slow implementation is the 400 kV transmission line to Albania, which received the lowest implementation score (grade 1). Although this project is strategically important for enhancing regional electricity connectivity and enabling renewable energy integration, its realization has been significantly delayed due to administrative, procurement, and coordination issues. The contract with the selected contractor has been terminated, and the process of identifying a new contractor is ongoing, further postponing the start of construction and jeopardizing alignment with regional interconnection goals.

Overall, while the progress made so far reflects a positive trajectory toward achieving the eNDC targets, the current pace will need to accelerate to ensure full implementation by 2030. Enhanced

inter-institutional coordination, regulatory certainty, and targeted financing will be essential to close the remaining implementation gaps and strengthen cross-sectoral alignment.

Assessment of the eNDC Roadmap

The Roadmap for the implementation of Macedonia's eNDC was developed to serve as a strategic guide for operationalizing the country's climate commitments. It outlines priority measures, institutional responsibilities, indicative timelines, and financing needs. While the existence of this document marks a significant step toward implementation planning, several limitations affect its practical utility and uptake by stakeholders.

1. **Structure and strategic relevance**

The roadmap successfully identified and detailed the 63 mitigation measures under the eNDC, including timelines, responsible institutions, indicative budgets, and sources of finance. It also highlighted interlinkages with sectoral and cross-sectoral strategies. However, while the strategic vision of the roadmap is sound, its operational depth is limited. The roadmap lacks detailed implementation pathways for complex measures, especially those requiring inter-agency cooperation, legislative changes, or market transformation (e.g., development of the biofuels market, large-scale electrification of transport). There are no concrete timelines, milestones, or performance indicators to guide or assess progress on a quarterly or annual basis.

2. **Utilization by stakeholders**

In practice, the roadmap has had greater influence in the energy sector, where key measures such as solar PV deployment, energy efficiency in public buildings, and feed-in tariff reforms have been implemented with good to excellent progress. These reflect both policy continuity and institutional familiarity with renewable energy and energy efficiency programs. In contrast, roadmap guidance has had less traction in sectors such as transport and agriculture, where implementation remains limited or moderate despite clear actions being outlined.

For instance, measures like the construction of the railway to Bulgaria, national car fleet renewal, and biofuels market development remain behind schedule or stalled due to lack of institutional ownership, regulatory delays, or inadequate financing strategies. This gap underscores the need for stronger integration of the roadmap into the operational frameworks of all line ministries, with explicit mandates, budget linkages, and monitoring obligations.

Private sector actors and civil society are also largely unaware of the Roadmap, despite their important roles in deploying renewables, industrial energy efficiency, and public engagement campaigns. This lack of visibility limits potential synergies and innovation, and weakens ownership across society.

3. **Integration with monitoring and reporting systems**

The roadmap lacks a clear accountability and progress-tracking mechanism. While the ETF under the Paris Agreement recommends regular tracking of NDC implementation, there is no formal monitoring framework linked to the roadmap itself. As a result, institutional follow-up on measure-

by-measure implementation is ad hoc, relying on donor-driven reporting or sporadic updates rather than a consistent national system.

Moreover, the absence of a **central coordination body** to oversee the roadmap's delivery has limited the ability to address cross-sectoral bottlenecks and ensure implementation coherence. This is particularly visible in the delayed execution of key infrastructure projects such as the 400 kV transmission line to Albania and the gas distribution network, which require multi-institutional cooperation.

In addition, measures such as feed-in premiums for renewables, solar rooftop PV, and heat pump deployment are progressing well (grades 5), but their actual contributions to emission reductions are not tracked in real-time through a central system. This undermines transparency and makes it difficult to evaluate cost-effectiveness or scale-up potential.

4. Responsiveness to changing contexts

The eNDC Roadmap, though comprehensive at the time of its development, has not been adequately updated to reflect major contextual changes that have occurred since its adoption. The COVID-19 pandemic disrupted institutional capacities and delayed the implementation of several planned measures, while shifting national priorities toward health and economic recovery. More significantly, the global energy crisis, worsened by the war in Ukraine, increased short-term reliance on coal, and led to emergency interventions such as the reactivation of the Negotino thermal power plant. These developments were not anticipated in the original roadmap but have had direct implications for the trajectory of emissions and the alignment of energy security with climate policy.

In addition to these shocks, inflationary pressures and global supply chain disruptions have increased the costs of renewable energy technologies, building materials, and transport infrastructure, further complicating the implementation of energy transition measures. Despite these shifts, the roadmap remains static and lacks mechanisms for adaptive revision. This reduces its practical value as an operational tool for guiding implementation. A more dynamic and regularly updated roadmap, one that incorporates feedback loops, risk assessments, and response strategies to external shocks, would enable North Macedonia to remain on track with its climate commitments, even in the face of changing economic and geopolitical conditions.

Assessment of the eNDC Financing Strategy

The Financing Strategy accompanying North Macedonia's eNDC was developed to outline the financial framework required for the implementation of mitigation measures by 2030. It presents an ambitious investment agenda of over €21.3 billion (if all measures are implemented), with a strong focus on the energy sector, which accounts for approximately 99% of the estimated investment needs. The strategy emphasizes a multi-source financing model, combining domestic public funds, private sector investment, international donor support, and consumer contributions through regulated tariffs and incentive schemes.

Although the Financing Strategy offers a broad and inclusive vision, its operationalization remains limited. One of the key shortcomings is the absence of a detailed financing pipeline linked to specific projects and implementation timelines. Although high-level investment needs are outlined, including indicative costs per sector and measure, the strategy lacks clear mechanisms for financial tracking, disbursement scheduling, and coordination across funding sources. Moreover, institutional capacity for leveraging international climate finance and public-private partnerships remains underdeveloped, creating a bottleneck for scaling up investments.

Access to financing at the local level is also constrained. Municipalities, which play a critical role in implementing building retrofits, waste management, and local transport measures, often lack the solvency, co-financing capacity, or technical expertise to independently secure funds. While donor-supported programs have helped launch some local initiatives, there is no structured mechanism in the strategy to facilitate subnational access to climate finance, such as through guarantee schemes, dedicated municipal climate funds, or capacity-building facilities.

Private sector participation is acknowledged as a cornerstone of the financing approach, yet targeted financial instruments such as risk-sharing facilities, concessional loans, or tax incentives are not clearly defined or implemented. This has contributed to low investor interest in specific segments, such as biomass power plants or passive buildings, where high upfront costs and regulatory uncertainties persist.

Overall, while the eNDC Financing Strategy lays a strong conceptual foundation, it requires significant refinement to become an actionable and results-oriented tool. A more granular financing framework, with dedicated instruments for high-impact sectors, mechanisms to attract private capital, and inclusive access for local governments, will be essential for scaling up implementation.

Awareness and institutional engagement

Effective implementation of the eNDC requires besides technical measures and financing mechanisms, requires a high level of institutional awareness, stakeholder engagement, and coordination. While some progress has been made in mainstreaming climate policy into national planning, the overall awareness and institutional ownership of the eNDC remain uneven across sectors and levels of government.

1. **Awareness among national institutions**

At the national level, key ministries such as the Ministry of Energy, Mining and Mineral Resources and Ministry of Environment and Physical Planning demonstrate relatively strong engagement with the eNDC framework. These institutions were actively involved in the development of the eNDC and other documents that are related to eNDC like Energy strategy and NECP and several have integrated mitigation-related objectives into their strategic and operational planning. For example, the Energy, Mining and Mineral Resources has supported the rollout of feed-in premiums, solar rooftop programs, and other measures, contributing to the high implementation scores (grades 4 and 5) for these measures.

However, beyond these core institutions, awareness of the eNDC's targets and implementation roadmap declines significantly. Ministries such as Transport, Agriculture, and Finance often treat climate-related measures as parallel rather than integral components of their sectoral policies. For instance, transport-related measures, including railway modernization, have seen very limited progress (grades 1), in part due to insufficient prioritization and lack of ownership by the responsible institutions.

2. **Local government involvement**

Engagement at the local level is even more fragmented. Municipalities/City of Skopje play a crucial role in implementing measures related to building retrofits, street lighting upgrades, waste management, and green procurement, yet their participation is hindered by limited technical capacity and budgetary constraints. Although measures like improvement of municipal lighting systems and retrofitting of local government buildings are showing moderate progress (grades 3–4), many municipalities/City of Skopje lack a clear understanding of their responsibilities under the eNDC and often rely on external donor-driven projects rather than proactive planning.

Moreover, the absence of formal communication channels between the national and municipal levels leads to missed opportunities for knowledge sharing, replication of good practices, and scaling of successful interventions. For example, only a handful of municipalities are in the phase of developing Sustainable Energy and Climate Action Plans (SECAPs).

3. **Role of Non-State actors and the private sector**

Engagement with the private sector and non-state actors has been inconsistent. On one hand, the uptake of solar PV systems without incentives and the rise in LED lighting adoption indicate

that private actors are responding to market signals and making climate-positive investments. On the other hand, critical measures such as biomass energy deployment, green procurement, and energy efficiency in industries show limited progress due to lack of targeted outreach, weak business case clarity, and limited public-private dialogue.

The private sector often views the eNDC as a government obligation rather than a strategic framework that opens investment opportunities and offers long-term economic benefits. To overcome this, there is a need for active communication campaigns, policy certainty, and structured partnerships that align corporate interests with national climate goals.

4. Public awareness and behavior change

Public awareness is gradually improving, especially in areas with direct consumer engagement such as lighting efficiency and household energy use. The shift toward LED lighting, despite the absence of a formal ban on incandescent bulbs, illustrates that behaviour change is possible when consumers are informed and have access to affordable alternatives. However, this transition is not driven by consumer awareness alone, it is also strongly influenced by market and producer dynamics. Advances in technology, increased availability, and falling prices of LED products, combined with reduced production and import of incandescent bulbs, have played a significant role in shaping consumer choices. This underscores the importance of aligning public awareness campaigns with market trends and supply-side measures to accelerate the adoption of energy-efficient technologies.

Nevertheless, more needs to be done to enhance understanding of the broader climate policy framework, particularly regarding the co-benefits of mitigation measures (e.g., job creation, improved health, and lower energy bills). Furthermore, vulnerable groups such as low-income households, rural populations, and youth remain underrepresented in climate dialogues. Strengthening the role of civil society organizations, schools, and media in climate education could play a transformative role in expanding the reach and effectiveness of the eNDC.

Identification of implementation gaps

Despite notable advancements in several priority areas, significant implementation gaps persist that may hinder the full realization of North Macedonia's eNDC targets. These gaps are primarily the result of systemic challenges across institutional, financial, and regulatory dimensions:

1. Institutional and human resource constraints

Implementation of measures is often delayed or fragmented due to limited administrative and technical capacities, particularly at the local level. For example, the retrofitting of municipal and central government buildings (grades 3 and 4, respectively) is progressing moderately but lacks unified coordination and standardization across municipalities. Energy management in manufacturing industries (grade 3) similarly suffers from a lack of dedicated energy managers of implementation of ISO 50001 standard and sector-specific guidance, especially among small and medium enterprises (SMEs).

Moreover, green procurement policies (grade 3) remain underutilized due to weak enforcement mechanisms and limited institutional knowledge on sustainable criteria among procurement officers. Measures like building retrofitting and sustainable transport require cross-sectoral coordination that is currently underdeveloped.

2. Financial barriers and budget limitations

If all measures are implemented the estimated €21.3 billion are needed to implement the eNDC measures by 2040 highlights the financing gap. A major example is the electrification of the transport sector (grade 3), which requires over €8.2 billion, but has seen only modest progress due to the absence of robust incentive programs for electric vehicles (EVs), insufficient EV charging infrastructure, and minimal public procurement of EVs in the government fleet.

Similarly, the construction of passive buildings (grade 3), though vital for energy savings, is hampered by high upfront costs, limited access to concessional financing, and low consumer awareness. The biomass power plant program (grade 1) is another example, where only one 0.6 MW plant has been constructed, signaling a failure to attract investor interest, likely due to unclear market signals and insufficient risk mitigation instruments.

3. Policy and regulatory gaps

It is important to note that the broader legal and institutional framework for climate action is still incomplete, most notably, the Law on Climate Action has not yet been adopted by the Parliament. The absence of this overarching legislation continues to limit cross-sectoral coordination and the formal integration of climate objectives into all relevant policy domains, as well as one of the most important measure, carbon tax. Additionally, the full enforcement of the Law on Energy Efficiency and other sectoral laws remains essential to provide the regulatory certainty needed for scaling up investments and guiding institutional efforts. However, more than three years after the adoption

of the Law on Energy Efficiency, the necessary secondary legislation (bylaws) has still not been adopted. This delay significantly undermines the operationalization of the law, leaving many of its provisions unenforceable in practice. Without clearly defined rules, procedures, and institutional responsibilities outlined in the bylaws, key mechanisms, such as energy performance standards, obligation schemes, and monitoring frameworks, cannot be effectively implemented. Accelerating the adoption of the bylaws is therefore critical to unlocking the full impact of the Energy Efficiency Law. These legislative processes should be treated as a priority to enable a more coherent, enforceable, and effective climate policy framework in the upcoming NDC cycle.

In addition, several key policy instruments have not yet been fully adopted or implemented. The development of the biofuels market (grade 1) remains stopped due to delays in finalizing the Biofuels Law, resulting in no practical uptake of biofuels in the transport sector. Similarly, the measure to phase out incandescent bulbs (grade 4) has not been officially enacted as a regulation, even though market trends suggest consumers are transitioning to LEDs voluntarily.

Moreover, the national car fleet renewal (grade 3) show limited effectiveness in the absence of binding standards for fuel economy or fleet electrification.

4. Data and monitoring deficiencies

A lack of granular and disaggregated data hampers the ability to track progress effectively. For example, the retrofitting of residential buildings (grade 4) is difficult to monitor due to the absence of a centralized registry of renovations, especially for privately financed and executed upgrades. Similarly, rooftop solar PV systems are not systematically reported in national statistics, leading to underestimation of renewable electricity contributions despite excellent implementation progress (grade 5).

The transport sector presents another data gap. Indicators such as modal split, vehicle-kilometers, or emissions per mode are either missing or outdated, which makes it difficult to quantify the impact of measures in this sector and to see the real effect.

5. Cross-cutting challenges

Public awareness and stakeholder engagement remain unbalanced. Although public awareness campaigns and EE information centers (grade 3) have been launched, their reach and impact are not sufficient to shift consumer behaviour at scale. This is evident in the limited uptake of solar thermal collectors (despite excellent implementation, grade 5) and heat pumps, where technical knowledge among installers and end-users remains a barrier.

Addressing these gaps will require immediate action to strengthen institutional frameworks, unlock financing through blended mechanisms, finalize and enforce climate-relevant legislation, and improve data systems. These improvements will be critical not only to ensure implementation of the current eNDC but also to enhance the credibility and ambition of North Macedonia’s future NDC 3.0.

Recommendations for NDC 3.0 Development

To ensure that North Macedonia's NDC 3.0 is both ambitious and feasible, it is important to build upon lessons learned from the implementation of the eNDC. Strengthening institutional coordination is a top priority, with the creation of a **centralized oversight body** essential for guiding implementation across sectors. Equally important is the **integration of climate goals into the mandates and budgets** of all line ministries and the empowerment of local authorities through funding, technical support, and training.

The updated NDC must also address existing gaps in the current roadmap and financing framework. The **roadmap should be transformed into a flexible tool,** regularly revised to account for emerging risks such as energy price volatility and geopolitical instability. Clear timelines, indicators, and milestones should be attached to every mitigation measure to ensure accountability. The **financing strategy**, in turn, needs to become more detailed and actionable, defining specific project pipelines, funding mechanisms, and approaches to attract private investment. Special focus is needed on financial instruments that support municipal-level projects and reduce investment risks in sectors like biomass, electric transport, and energy-efficient construction.

One of the key lessons from the implementation of the enhanced NDC is the urgent need to improve both the formulation and practical usability of indicators. While the eNDC includes a set of indicators at both the overall and measure-specific level, many of them remain either too general or insufficiently linked to the actions they are meant to track. This has created challenges in assessing real progress, especially when it comes to distinguishing between planned activities, partial implementation, and measurable results. In some cases, indicators are framed in a way that is conceptually sound but difficult to operationalize due to gaps in data availability or inconsistencies in how different institutions collect and report information.

For NDC 3.0, it is strongly recommended that each mitigation and adaptation measure be paired with clearly defined, measurable, and time-bound. These indicators should enable regular tracking and evaluation of progress and support adaptive management, allowing adjustments when targets are not met or when external circumstances change. To make this possible, improvements are needed not only in indicator design but also in the statistical systems that underpin them. This is especially critical for indicators that overlap with the SDGs, where official data is incomplete, or updated infrequently. Therefore, enhancing the capacity of the national statistical system, including the State Statistical Office and sectoral data providers, is essential to make the indicators in NDC 3.0 truly actionable. Without timely, disaggregated, and reliable data, even the best-designed indicators risk becoming symbolic rather than functional tools for guiding climate action.

In that direction, although some initial trends in livestock numbers and forest cover have been explored, the AFOLU sector remains largely underrepresented in emissions tracking and mitigation analysis. The current data is often fragmented, outdated, or inconsistent across

institutions. This makes it difficult to understand the full climate impact of land use and agricultural practices. As a result, the sector's true mitigation potential is not fully captured in national climate planning.

To address this, strengthening the AFOLU data foundation should be a key priority in the development of NDC 3.0. Improved spatial mapping of land use changes and accurate emissions baselines are urgently needed. These efforts must be supported by stronger institutional cooperation, particularly between ministries, state statistical office, research institutions, and the cadastre office. In addition, clear and measurable indicators should be developed for key AFOLU mitigation actions, such as afforestation, agroforestry, and sustainable soil practices, so that progress can be tracked over time. Better data and monitoring systems will also improve access to international climate finance and carbon market mechanisms. Without a stronger analytical foundation, the AFOLU sector will continue to lag behind. Building that foundation is essential for delivering a more balanced and credible NDC.

To boost transparency and strengthen the credibility of climate commitments, North Macedonia should operationalise and upgrade a robust Measurement, Reporting, and Verification (MRV) system aligned with the ETF of the Paris Agreement. This system must monitor GHG emissions, the status of mitigation and adaptation efforts and the flow of financial support. A comprehensive MRV framework would enable consistent, comparable reporting while identifying progress and gaps in implementation. Such transparency is critical for building trust among stakeholders and international partners.

An urgent priority for enabling effective cross-sectoral implementation of the NDC is the adoption of the Law on Climate Action, which remains pending. The absence of a legally binding and overarching climate framework creates a significant policy vacuum, particularly for sectors that currently lack sector-specific climate regulations or institutional mandates, such as transport, agriculture, forestry and waste management. These sectors face considerable implementation challenges due to enforceable obligations related to mitigation and adaptation.

The Law on Climate Action is expected to provide the legal basis for establishing a national system for climate governance, including mechanisms for mainstreaming climate objectives across sectoral policies, defining institutional roles, and ensuring compliance with mitigation targets. It would also enable the formalization of the Measurement, Reporting, and Verification (MRV) system, facilitate the alignment with the Enhanced Transparency Framework under the Paris Agreement, and support the long-term development of the carbon pricing instruments and climate finance mechanisms.

Without this legal foundation, the implementation of the NDC remains highly dependent on voluntary measures, project-based initiatives, or donor support, which limits continuity, scalability, and accountability. Therefore, the swift adoption and operationalization of the Law on Climate Action should be seen not merely as a technical requirement, but as a strategic enabler of the country's climate ambition. Its inclusion as a high-priority action under NDC 3.0 is essential to ensure policy coherence, regulatory certainty, and effective implementation across all sectors.

Additionally, **climate-related financial tracking** should be embedded within national budgeting processes. Applying UNFCCC-recommended methodologies will help the country monitor both

domestic climate expenditures and international support. This approach will improve the efficiency of resource allocation and enhance access to global climate finance.

Conclusions

The implementation of North Macedonia's eNDC has demonstrated **moderate progress** across several key sectors, particularly in energy efficiency, renewable energy deployment, and selected enabling measures. The top-down analysis shows improvements in energy productivity, a downward trend in per capita energy consumption, and gradual increases in the renewable electricity share, highlighting tangible progress toward decarbonization targets. At the same time, the bottom-up evaluation reveals that while many measures have been initiated and several show excellent progress (e.g., rooftop solar PV, feed-in tariffs), others, particularly in transport, biofuels, biomass energy, and waste infrastructure, lag behind expectations.

The implementation of the eNDC remains hindered by systemic barriers, including **weak inter-institutional coordination, financing constraints, regulatory gaps, and insufficient local government capacity**. External shocks such as the COVID-19 pandemic and the global energy crisis, exacerbated by the war in Ukraine, further complicated implementation, forcing a short-term return to fossil fuels and delaying critical infrastructure investments. While the roadmap and financing strategy provide an essential framework for action, they require greater operational detail, dynamic updating, and integration into sectoral decision-making to serve as truly effective planning and implementation tools.

Looking ahead to the NDC 3.0 cycle, it is imperative to address these implementation bottlenecks, improve monitoring and data systems, and reinforce stakeholder engagement to accelerate climate action. **Strengthening institutional capacity, expanding private sector participation, and enhancing transparency** will be essential for increasing ambition and ensuring that North Macedonia delivers on its long-term climate commitments.