Republic of North Macedonia

Ministry of Environment and Physical Planning

MACEDONIAN THIRD BIENNIAL UPDATE REPORT ON CLIMATE CHANGE

AUGUST 2020

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List of Experts

UNFCCC National Focal Point

Ministry of Environment and Physical Planning

Teodora Obradovic Grncarovska, Ph.D

UNFCCC Gender and Climate Change Focal Point

Ministry of Labour and Social Policy

Elena Grozdanova, M.Sc.

Project Team

Pavlina Zdraveva, B.Sc.

Trajancho Naumovski, B.Sc.

National Expert, Chief Technical Advisor

Natasa Markovska, Prof.

GHG INVENTORY TEAM

Research Center for Energy and Sustainable Development,

Macedonian Academy of Science and Arts (RCESD MASA) Team

Gligor Kanevce, Acad.

Verica Taseska-Gjorgievska, Ph.D

Aleksandar Dedinec, Ph.D

Aleksandra Dedinec, Assoc. Prof.

Vasil Bozhikaliev, M.Sc.

Emilija Mihajloska, B.Sc.

Lazar Aleksovski, B.Sc.

UKIM - Institute of Agriculture

Dusko Mukaetov, Prof.

Hristina Poposka, Ph.D

Dusko Nedelkovski, Ph.D

UKIM – Faculty of Agricultural Science and Food

Sretan Andonov, Prof.

Ordan Chukaliev, Prof.

Vjekoslav Tanaskovic, Prof.

UKIM – Faculty of Forestry

Ljupco Nestorovski, Prof.

Nikola Nikolov, Prof.

Ivan Mincev, Prof.

QA Expert

Elena Gavrilova, M.Sc.

QC Expert

Marjan Mihajlov, M.Sc.

Peer review, provided by the Global Support Programme

Carlos Lopez

NATIONAL ROAD TRANSPORT EMISSION INVENTORY

Advisent Consulting Skopje, Macedonia

Marko Dimitrovski, Ph.D.

MITIGATION TEAM

RCESD-MASA Team

Gligor Kanevce, Acad.

Aleksandar Dedinec, Ph.D.

Verica Taseska-Gjorgievska, Ph.D.

Aleksandra Dedinec, Assoc. Prof.

Emilija Mihajloska, B.Sc.

UKIM - Institute of Agriculture

Dusko Mukaetov, Prof.

Hristina Poposka, Ph.D.

Dusko Nedelkovski, Ph.D.

UKIM – Faculty of Agricultural Science and Food

Sretan Andonov, Prof.

Ordan Chukaliev, Prof.

Aleksandra Martinovska Stojcheska, Prof.

Vjekoslav Tanaskovik, Prof.

UKIM – Hans Em Faculty of Forest Sciences, Landscape Architecture and Environmental Engineering,

Ljupco Nestorovski, Prof.

Nikola Nikolov, Prof.

Ivan Mincev, Prof.

Peer review, provided by the Global Support Programme

Snezana Marstijepovic

Valeria Arroyave

Climate finance

Prof. Aleksandar Naumoski, Prof, UKIM - Faculty of Economics

Transfer of technology

Prof. Valentina Gecevska, Prof, UKIM - Faculty of Mechanical Engineering

Climate Change communication

Angelina Jovanovikj, B.Sc., Public relations Office, Ministry of Environment and Physical Planning

MONITORING, REPORTING AND VERIFICATION OF MITIGATION ACTIVITIES

Simona Getova, M.Sc.
Jasmina Pislevikj, M.Sc.
Petranka Boncheva, M.Sc.
Emsal Ajredini, LL.M
Nikola Gjorgjievski, M.Arch, M.LArch

Gender Consultant

Olgica Apostolova, M.Sc.

Implemented by the United Nations Development Programme

Anita Kodzoman, B.Sc.

Eva Huttova, M.Sc.

Damiano Borgogno, M.Sc.

Compiled by

Benjamin Bartle, M.Sc, PGDip. Sc., B.A..

Abbreviations & Units

AFOLU	Agriculture, Forestry and Other Land Use
BUR	Biennial Update Report on Climate Change
CBIT	Strengthening institutional and technical Macedonian capacities to enhance transparency in the framework of the Paris Agreement (CBIT project)
CC	Climate Change
CHPs	Combined Heat and Power Plants
CLC	CORINE Land Cover
CMC	Center for Management of Crises
CORINE	Coordination of Information on the Environment
CRF	Common Reporting Format
CS	Country Specific
CTA	Chief Technical Advisor
DF	Default Factor
DOC	Degradable Organic Carbon
EARM	Energy Agency of North Macedonia
EC	European Commission
EEA	European Environment Agency
EFDB	Emission Factor Database
EMI	Emission Monitoring in Industry
EnC	Energy Community
EO	Earth Observation
ERC	Energy Regulatory Commission of North Macedonia
EU	European Union
Eurostat	Statistical Office of the European Union
FAOStat	Food and Agriculture Organization of the United Nations Statistical Databases
FBUR	First Biennial Update Report
F-gas	Fluorinated gas
FNC	First National Communication
FOD	First Order Decay
FOLU	Forest and Other Land Use
GAP	Good agricultural practice
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GSP	Global Support Programme
GWP	Global Warming Potential
HPP	Hydro Power Plant
HEV	Hybrid Electric Vehicle
ICA	International Consultation and Analysis

ICT	Information and Communication Technologies
IDT	Inventory Development Team
IE	Included elsewhere
IEA	International Energy Agency
INDC	Intended Nationally Determined Contributions
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
LU	Land Use
LUCF	Land-Use Change and Forestry
LULUCF	Land Use, Land-Use Change and Forestry
MAFWE	Ministry of Agriculture, Forestry and Water Economy
MAKSTAT	Database of the State Statistical Office of North Macedonia
MARKAL	MARKet Allocation (numeric model for the economic analysis of energy systems)
MASA	Macedonian Academy of Sciences and Arts
MEMO	National Electricity Market Operator
MCC	Macedonian Chambers of Commerce
MKD	Macedonian Denar
MMR	Monitoring Mechanism Regulation [European Union]
MNAV	Macedonian Navigation Agency
MOE	Ministry of Economy
MOEPP	Ministry of Environment and Physical Planning
MRV	Measurement, Reporting and Verification
NA	Not Applicable
NCCC	National Communication on Climate Change
NC	National Communication on Climate Change
NCSP	National Communications Support Programme
NCV	Net calorific value
NE	Not estimated
NGO	Non-Governmental Organization
NIR	National Inventory Report
NO	Not Occurring
ODS	Ozone-Depleting Substances
OECD	Organization for Economic Cooperation and Development
PV	Photovoltaic
PHEV	Plug-in Hybrid Electric Vehicle
QA	Quality Assurance
QAT	Quality Assurance Team
QC	Quality Control
RCESD	Research Center for Energy and Sustainable Development
REC	Regional Environmental Centre
RES	Renewable Energy Sources
RS	Remote Sensing

SAR	Second Assessment Report
SBUR	Second Biennial Update Report
SDGs	Sustainable Development Goals
SNC	Second National Communication
SOM	Soil Organic Matter
SSO	State Statistical Office
STUGRES	Study on Heating in the City of Skopje: Analysis of Policies and Measures
SWDS	Solid Waste Disposal Sites
T1	Tier 1
T2	Tier 2
TNC	Third National Communication
TMR	Total Mix Ration
TPP	Thermal Power Plant
TWG	Technical Working Group
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USA	United States of America
USAID	United States Agency for International Development
USD	United States Dollar
WAM	With Additional Measures
WB	World Bank
WEM	With Existing Measures
WEO	World Energy Outlook
WOM	Without Measures

Global warming potential values used in the preparation of the GHG Inventory (100-year time horizon)

Gas	CO_2 equivalent
CO_2	1
CH_4	25
N_2O	298

Gas	CO_2 equivalent
HFC-125	3,500
HFC-143a	4,470
HFC-134a	1,430
HFC-32	675
HFC-227ea	3,220
CF_4	7,390
C_2F_6	12,200

Source: IPCC Fourth Assessment Report (AR4), 2007

Chemical symbols

$CaCO_3$	Limestone
$CaMgCO_3$	Dolomite
CH_4	Methane
$CO(NH_2)_2$	Urea
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2-eq	Carbon Dioxide equivalents
$HCO3^-$	Bicarbonate
HFCs	Hydro Fluorocarbons
N	Nitrogen
N_2O	Nitrous Oxide
Na_2CO_3	Sodium carbonate
NH_3	Ammonia
NH_4^{+2}	Ammonium
NMVOC	Non-Methane Volatile Organic Compound,
NO_3^-	Nitrate
NOx	Nitrogen Oxides
OH^-	Hydroxyl ion
PFCs	Per Fluorocarbons
SF_6	Sulphur hexafluoride
SO_2	Sulphur Dioxide
SO_x	Sulphur Oxides

Units and Metric Symbols

UNIT	Name	Unit for		Metric Symbol	Prefix	Factor
g	gram	mass		P	peta	10^{15}
W	watt	power		T	tera	10^{12}
J	joule	energy		G	giga	10^{9}
m	meter	length		M	mega	10^{6}
Wh	watt hour	energy		k	kilo	10^{3}
toe	ton of oil equivalent	energy		h	hecto	10^{2}
				da	deca	10^{1}

Mass Unit Conversion						
				d	deci	10^{-1}
1g				c	centi	10^{-2}
1kg	= 1 000 g			m	milli	10^{-3}
1t	= 1 000 kg	= 1 Mg		μ	micro	10^{-6}
1kt	= 1 000 t	= 1 Gg		n	nano	10^{-9}
1Mt	= 1 000 000 t	= 1 Tg		p	pico	10^{-12}

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1 Executive Summary

1.1 National Circumstances

The Republic of North Macedonia is one of the smallest countries in the South-eastern Europe region, with around 2.077 million inhabitants (2018). In 2017, its gross domestic product (GDP) was EUR 10.7 billion and GDP per capita was EUR 5,153. As of 2019, the unemployment rate was 17.1%.[1] Compared to the other sectors, the Energy sector by far has the largest share in the GHG emissions in the country. This is because this sector is mainly based on fossil fuels, primarily coal, which accounts for over 80% of the total energy demand. In the last few years, a certain decreasing trend of the share of fossil fuels can be noted, primarily due to an increase in the electricity import, which additionally increases the import dependence of the country, estimated at 54%. There is also an increasing trend of the share of renewable energy in the gross final energy consumption, which from 17.7% in 2009 has increased to 19.6% in 2017. The efficiency of the Macedonian energy system (conversion from the total required energy into final energy) is about 71%. This value is almost at the same level as the member countries of the Organization for Economic Co-operation and Development (OECD) Europe, where it is about 70%.

As a result of the low GDP, the Republic of North Macedonia falls in the category of countries with high gross inland consumption and high final energy consumption per unit of GDP despite the low energy consumption per capita.

The Republic of North Macedonia is a party to the United Nation Framework Convention on Climate Change (UNFCCC) (Official Gazette of RM – 61/97) and its Doha Amendment (2019), ratified the Kyoto Protocol (Official Gazette of Republic of North Macedonia - 49/04), the Paris Agreement (Official Gazette of Republic of North Macedonia – 161/2017) and has associated itself with the Copenhagen Accord (2009). The country became the twenty-third in the world to submit its Nationally Determined Contributions for Climate Change (NDC) as per the Decision of the Government No. 42-17/91 of 28 July 2015. The Country has agreed to the following contribution to the global efforts for GHG emissions reduction (**Macedonian NDC**): "To reduce the CO_2 emissions from fossil fuels combustion for 30%, that is, for 36% at a higher level of ambition, by 2030 compared to the business as usual (BAU) scenario." The country is currently updating its NDC.

The Ministry of Environment and Physical Planning (MOEPP) has been designated as the National Focal Point to the UNFCCC and the National Authority for the implementation of the Kyoto Protocol. The UNFCCC Gender and Climate Change Focal point has been nominated from the Ministry of Labour and Social Policy. Other ministries responsible for relevant climate change policymaking are: Ministry of Economy, Ministry of Agriculture, Forestry and Water Economy, Ministry of Transport and Communications, Ministry of Health, and Ministry of Finance. The Office of the Deputy Prime Minister for Economic Affairs is responsible for the achievement of the Sustainable Development Goals, and it is also a National Designated Entity for the Green Climate Fund. The National Climate Change Committee (NCCC), established by the Government, provides high-level support and guidance for the overall climate change policies in the country. It comprises of key stakeholders representatives from national institutions, academic institutions, the private sector and civil society and the climate change coordinators appointed by ministries. The National Council for Sustainable Development also participate in this this process as well as other key stakeholders in government and in civil society.

[1] Statistical data from Republic of North Macedonia, State Statistical Office. See: http://www.stat.gov.mk/KlucniIndikatori_en.aspx. Site accessed 20/04/2020

The process for producing National Communications and Biennial Reports for the UNFCCC is led by MOEPP, which is the institution responsible for climate change policies and national point of contact for UNFCCC. The National Climate Change Committee (NCCC) and the Technical Group at the National Sustainable Development Council also participate in this this process as well as other key stakeholders in government and in civil society. So far, **three National Communications on Climate Change (NCCC)** and **two Biennial Update Reports (BURs),** first (FBUR) and second (SBUR) have been submitted to the UNFCCC. All these documents, particularly the latest, SBUR, are based on the robust analytical work and consultations with the relevant ministries and other relevant stakeholders International institutions and donors, specifically the Global Environmental Facility (GEF) and the United Nations Development Programme (UNDP), have provided financial and technical support for this reporting process. In absence of Strategy of Climate Action, the NCs, the BURs and the NDC served as main strategic climate change documents in the country.

However, the country is in the process of converting to a legislative and regulatory framework that will be informed by the 2030 Climate and Energy Framework of the European Union. It will need to adopt a **Long-term Climate Action Strategy** and **a Law on Climate Action.** This initiative is being funded by a project entitled “Preparation of the Long term strategy and Law on Climate Action”, which has been programmed under the EU Instrument for Pre-Accession Assistance (IPA II) funding mechanism. Work on the Long-term Strategy on Climate Action started in March 2019 and the drafting of the Law on Climate Action (including transposition of EU Monitoring Mechanism Regulation 525/2013) is ongoing. Moreover, UNDP is supporting development of a GCF project proposal for National Climate Change Adaptation Plan.

Meanwhile, **the National Strategy for Energy Development up to 2040** (Energy Strategy) was adopted in December 2019. The Energy Strategy depicts three scenarios - Reference, Moderate Transition and Green which reflect different dynamics of energy transition and enable flexibility into Macedonian response to relevant EU policies and governance for modern, competitive and climate-neutral economy by 2050.

The most ambitious scenario of the TBUR, e-WAM, is selected to be the basis of the new **National Energy and Climate Action Plan (NECP)**. The process of Macedonian NECP development started in 2018, with the establishment of the Working Group consisting of representatives of key stakeholders in the country. The Ministry of Economy and the Ministry of Environment and Physical Planning lead the NECP development process, as institutions with the ultimate responsibility for implementing the NECP. A draft version of its NECP was prepared in May 2020. The process is still ongoing until the Government adopts the final version of the document.

1.2 National GHG Inventory

The Republic of North Macedonia, as a Non-Annex I Party to the UNFCCC, has been developing Inventory of the anthropogenic emissions by sources and removals by sinks of GHGs emitted to or removed from the atmosphere since 2000 as a part of its National Communications on Climate Change and Biennial Update Reports.

In the First Biennial Report, the series was updated to consider the period 2010 – 2012 and additionally, the entire previous series of data from 1990 to 2009 were revised according to the requirements of the IPCC Inventory Software and IPCC 2006 Guidelines. The same approach was used in the Second Biennial Update Report (SBUR) and the emission trend was expanded by developing the GHG inventory for 2013 and 2014.

The inventory activities under the Third Biennial Update Report (3rd BUR) continue the work done in the previous BURs and include developing the GHG inventory for 2015 and 2016 in line with the IPCC 2006 Guidelines. The latest version of IPCC Inventory Software (version 2.54 – from July 6, 2017, available when the 3rd BUR activities started) is used in this process.

The inventory covers four main sectors: Energy, Industrial Processes and Product Use (IPPU), Agriculture, Forestry and Other Land Use (AFOLU) and Waste, disaggregated by categories and subcategories. It includes a database for the following GHGs: CO_2, CH_4, N2O, PFCs and HFCs, as well as precursors and indirect emissions from: CO, NO_x, NMVOC, SO_2 and NH_3. The emission of SF_6 is not estimated for the country due to unavailability of activity data.

The preparation of the national GHG inventory is project based, supported by Global Environment Facility (GEF) and United Nations Development Programme (UNDP). However, significant efforts have been invested in the TBUR to enhance the sustainability of the GHG inventory development in the country (Figure 3-1), by completely institutionalizing the process in the academia sector (Macedonian Academy of Sciences and Arts, Institut of Ariculture, Faculty of Agricultural Science and Food, Hans Em Faculty of Forest Sciences, Landscape Architecture and Environmental Engineering).

The estimated emissions in the inventory are publicly available within the national climate change platform www.klimatskipromeni.mk, open data portal (data.gov.mk) and UNFCCC web site.

1.2.1 Emissions and removals by sector and gas

The aggregate GHG emissions and removals (net emissions) in 2016 are estimated at 8,020 Gg CO_2-eq (including the FOLU sector) (Table 1-1). Figure 1-1 shows the time–series of emissions and removals, (in tonnes CO_2-eq), from 1990 to 2016 (summary information tables of inventories for previous submission years can be found in Annex 1). There are significant fluctuations in the net emissions in 2000, 2007 and 2012, where increased emissions can be noticed in the FOLU sector (instead of removals) as a result of intensified forest fires / wildfires over that period. GHG emissions in 2016 are reduced by 34.6% compared to 1990 levels. The reduction is mainly result of reduced electricity production from lignite, fuels switch (residual fuel oil for electricity and heat production is replaced with natural gas), and lower industrial production, which has been decreasing since 2012.

Table 1-1: GHG emissions and removals by sector (in Gg CO_2-eq)

Sector	1990	2000	2005	2014	2015	2016
Energy	9,648.9	9,757.9	9,251.1	8,051.3	7,701.3	7,449.3
Industrial Processes and Product Use	932.2	888.4	861.7	886.2	790.5	858.0
Agriculture (without FOLU)	1,490.4	1,249.6	1,204.1	1,131.5	1,159.4	1,193.2
FOLU	-207.0[2]	10,441.4	-1,522.1	-3597.4	-1,625.4	-2,090.1
Waste	406.7	412.7	435.2	574.3	596.7	610.2
Total (incl. FOLU) – Net emissions	**12,271.2**	**22,749.9**	**10,230.0**	**7,045.9**	**8,622.6**	**8,020.6**
Total (excl. FOLU)	**12,478.2**	**12,308.6**	**11,752.1**	**10,643.3**	**10,247.9**	**10,110.8**

The **GHG inventory in the Energy sector** accounts for the emissions released as a result of fuel combustion activities, as well as the fugitive emissions from extraction of solid and transmission and distribution of liquid and gaseous fuels. In this report, the emissions have been calculated by two methods: Reference approach (top-down) - using the apparent fuel consumption to account for the carbon flows into and out of the country and Sectoral approach - accounting for the fuel

[2] The value for 1990 does not include the emissions/sinks from land use changes that are reported in the AFOLU chapter.

consumption by sectors. The estimated CO_2 emissions with the Reference approach are 7,396 Gg CO_2 in 2015 and 7,175 Gg CO_2 in 2016.

The emissions in the Sectoral approach are separated in the following categories: Energy Industries, Manufacturing Industries and Construction, Transport, Other sectors (Commercial/Institutional, Residential and Agriculture/Forestry/Fishing) and Non-Specified. In addition, the Fugitive emissions from extraction of lignite, oil refining and transmission of natural gas have been calculated. Therefore, the overall GHG emissions in Energy sector are 7,701 Gg CO_2-eq in 2015 and 7,449 Gg CO_2-eq in 2016. Most of the GHG emissions in 2016 occur in the category Energy Industries (51.0%), followed by Transport (28.1%) and Manufacturing Industries and Construction (13.9%). The other two categories together account for 5% of the total emissions in 2016 and the remaining around 2% are Fugitive emissions. Almost all of the GHG emissions in 2016 are CO_2 emissions (96.4%), and CH_4 and N_2O emissions amount to only 2.8% and 0.8%, respectively.

The **GHG emissions in the sector Industrial Processes and Product Use (IPPU)** in the country come either from the manufacturing industries or the usage of ozone-depleting substances (ODS) substitutes for refrigeration and air-conditioning. Until 2000, the metal industry was prevailing source of the emissions, mostly from the ferroalloy production. After 2000, when ODS substitutes usage in the country have started to increase, the share of the GHG emissions from the Metal industry in total emissions from IPPU sector have decreased considerably (from 64% in 1990 to 19% in 2016), while the emissions from the Mineral industry have been fluctuating over the inventory period. In the last three reporting years the product uses as substitutes for ODS had grown for around 50%, resulting with share of almost 37% of the IPPU emissions in 2016. However, the dominant share in 2016 had the Mineral industry with 44%, while the share of the Metal industry was reduced to 19%. Emissions from the other categories, like Chemical industry, Non-Energy Products from Fuels and Solvent Use, Electronics Industry and Other Product Manufacture and Use do not occur in the country.

The level of the overall greenhouse emissions from this sector is consistent throughout the entire period of 1990 – 2016. The overall emission in 2016 achieved 850 Gg CO_2-eq, which is 3.2% lower compared to 2014 or 8% less compared to 1990.

The **GHG emissions from the Agriculture Forestry and Other Land Uses (AFOLU) sector** include emissions associated with Livestock, Forestry and Land Use. Activities related to **Livestock production** emit CH_4 and N_2O. The CH_4 emission is caused by enteric fermentation during herbal digestion in ruminants but also N_2O emission occurs during the metabolic processes. Additionally, N_2O is emitted as a result of manure storage and processing (management). The total emissions due to livestock activity in 2015 were 821.5 Gg CO_2-eq, while in 2016, 833.5 Gg CO_2-eq. This increase of about 4-5% compared to 2014 (792.7 Gg CO2-eq) is due to increase in number of heads in cattle (for about 5%) and swine (for 34%), but decrease in sheep, horses and poultry.

On the other hand, greenhouse gas emissions from **crop production** are a consequence of several major sources, such as inadequate and excessive fertilization with mineral fertilizers, which in the long term causes a serious reduction in organic matter in soils and significant CO_2 emissions, rare and inadequate application of manure, conversion to land use from extensive to an intensive plant production system, inadequate management of arable land and improper management when fertilizing.

Forestry sector is the main GHG sink in the country, within the Land subsector of AFOLU, with exception of several years when the amount of forest fires (burned areas) were significantly above the annual average. The area of forestland, the species composition (conifers, broadleaved, mixed), as well as the annual increment and removals from the forests are relatively stable. The estimated GHG sinks in this sector for 2015 is estimated on 1,608.3 and in 2016 2,120.6 Gg CO2 eq.

The other land use like **Cropland, Grassland, Settlements and Other land**, participate in the emission of CO_2, and in some years can be considered as a significant source of emissions of this GHG. This emission is mainly result to the conversion of one to another category of land use, when significant amounts of above and below ground biomass is rapidly removed and is considered as a direct loss. For the other areas, which remains under same category of land use, gains and losses, are in balance (Tier 1) and are considered as carbon neutral.

For the **non-CO_2 sources of GHG**, it can be concluded that there are numerous management practices and inputs resulting in a significant amount of GHG emissions, which when summed up, differ in a small range of 313.1 Gg CO_2-eq in the year 2000 up to 382.3 Gg CO_2-eq, in 1990. The managed soils are a major source of non-CO_2 emissions, which in 1990 contribute with 55.4% in the total emissions, and up to 62.4 % in 2016.

The categories reported under **Waste sector** are Solid Waste Disposal, Biological Treatment of Solid Waste, Incineration and Open Burning of Waste and Wastewater Treatment and Discharge. The data categorization format is consistent with previous years in order to preserve the existing time series, except in sectors where data was introduced for the first time.

The GHG emissions from the Waste sector demonstrate an increasing trend achieving 610 Gg CO_2-eq in 2016, which is double compared to 1990 or 6.3% more compared to 2014. Out of all the sectors, the emission from Solid Waste Disposal category are most significant with 77.5% in the total GHG emission in 2016. Second category with significant amount of GHG emissions is Wastewater Treatment and Discharge with around 19% in 2016. Incineration and open burning of waste category contribute with around 4% in the last three reported years. The CH_4 and N_2O emissions from the Biological Treatment of Solid Waste category do not contribute largely to the overall emissions due to the small amount of reported composted waste. Around 92% of the GHG emissions in the last three years of the reporting period are CH_4, while N_2O and CO_2 participates with 7.2%, 1% respectively. Considering the fact that most of the emissions are from Solid Waste Disposal Sides, as well as the forecasts for their growth as a result of the increased amount of waste that citizens are increasingly creating, special attention should be paid to this sector.

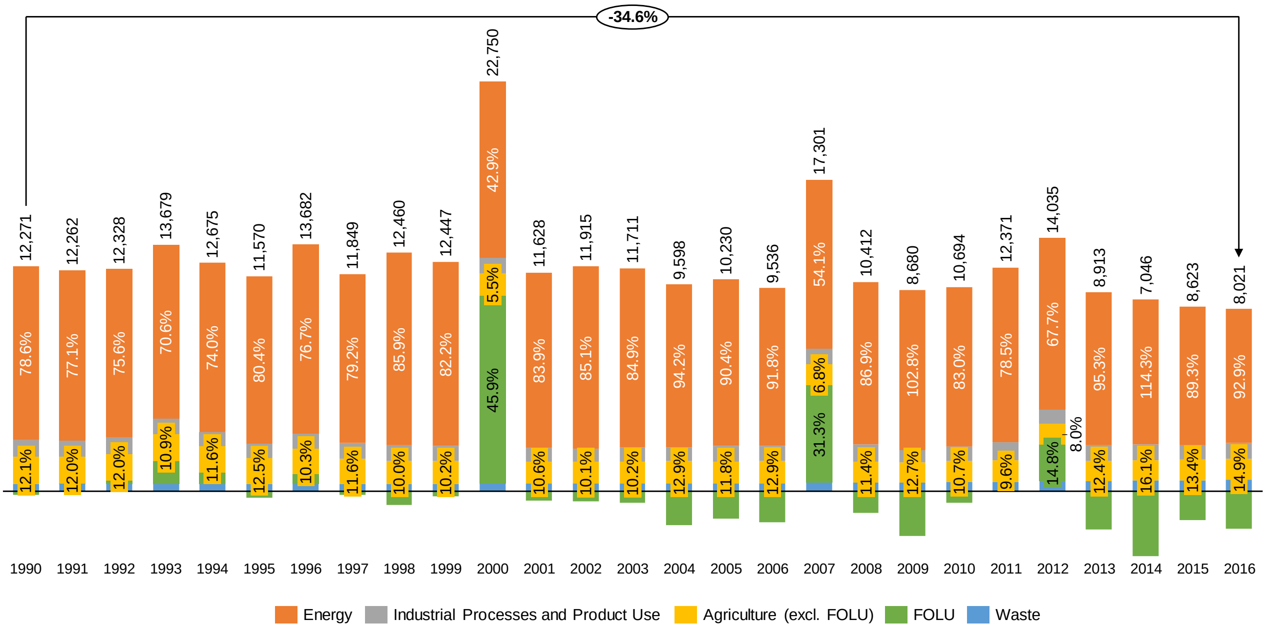

Figure 1-1: GHG emissions and removals by sector (in Gg CO2-eq)

If the removals from FOLU sector are not accounted for, then the total GHG emissions in 2016 were 10,111 Gg CO_2-eq (Figure 1-2). The greatest share of emissions is from the Energy sector, accounting for 73.7% in 2016, followed by the Agriculture (excluding FOLU) with 11.8% and IPPU sector with 8.5% and Waste sector with 6% share. The dominant share of emissions for the Energy sector is evident throughout the whole time series. Excluding FOLU, the emissions in 2016 were reduced by 19% compared to 1990 levels.

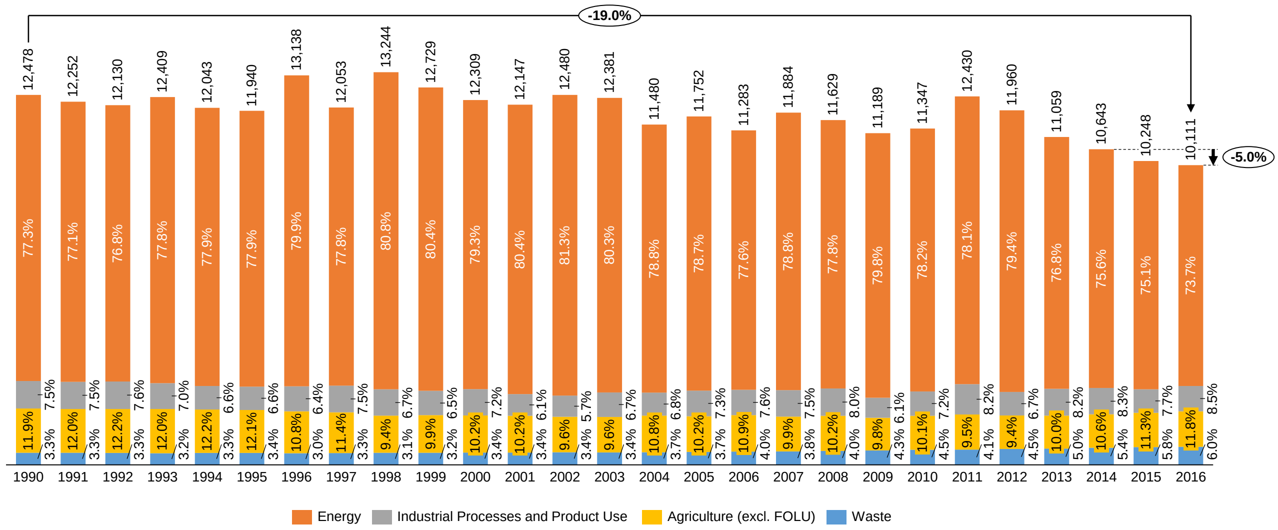

Figure 1-2: Total GHG emissions by sector, excluding FOLU sector (in Gg CO_2-eq)

Analysing the **GHG emissions by gas** (excluding FOLU sector), it is evident that across the series the most dominant are CO_2 emissions (Table 1-2 and Figure 1-3). CO_2 emissions account for 76.5% of overall emissions in 2016, followed by the CH_4 emissions with 15.7%, then N_2O emissions with 4.7% and all F-gases with 3.1%.

Table 1-2: GHG emissions by gas (in CO_2-eq)

Gas	1990	2000	2005	2014	2015	2016
CO_2 (incl. FOLU)	9978.1	20697.0	8171.2	4825.0	6355.9	5641.0
CO_2 (excl. FOLU)	10185.1	10255.6	9693.3	8422.3	7981.3	7731.1
CH_4	1740.3	1571.1	1509.4	1563.3	1595.2	1588.3
N_2O	461.1	414.2	446.2	451.0	452.4	475.6
HFCs	0.0	4.8	102.8	206.6	219.1	315.7
PFCs	91.7	62.9	0.3	0.0	0.0	0.0
SF_6	0.0	0.0	0.0	0.0	0.0	0.0
Total (incl. FOLU) - Net emissions	**12271.2**	**22749.9**	**10230.0**	**7045.9**	**8622.6**	**8020.6**
Total (excl. FOLU)	**12478.2**	**12308.6**	**11752.1**	**10643.3**	**10247.9**	**10110.8**

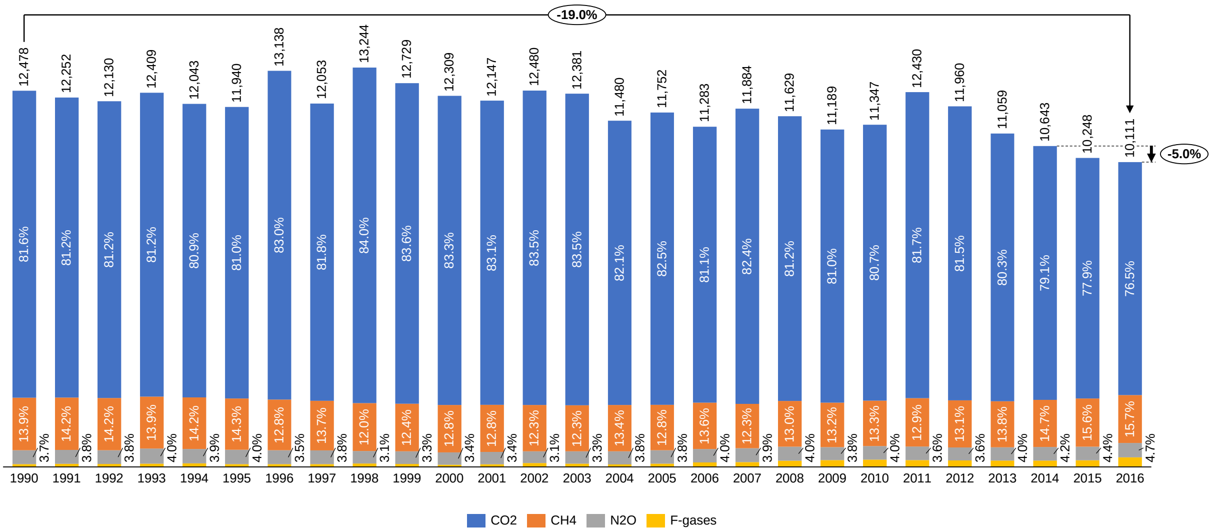

Figure 1-3: Total GHG emissions by gas, excluding FOLU (in Gg CO_2-eq)

In spite of the small share of the F-gases in the total emissions, only HFCs and PFCs are reported in the inventory (Figure 1-4). SF_6 gas is not estimated for the Republic of North Macedonia due to unavailability of activity data. As can be seen in Figure 1-4, the emissions of HFCs start in the year 2000 with some fluctuations over the time-series, depending on the activities in the IPPU sector achieving 316 Gg CO_2-eq in 2016, while the emissions of the PFCs considerably decrease after 2003. The significant growth in import of gases (blends) used for refrigeration and air-conditioning has resulted in an increase of HFCs emissions in 2016 compared to 2015.

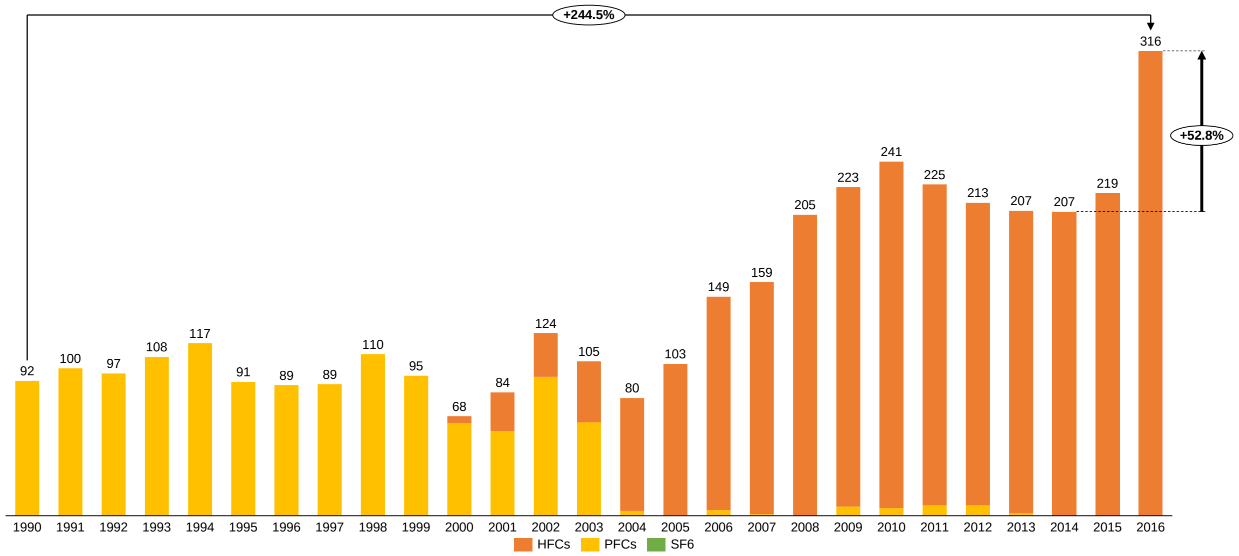

Figure 1-4: Emissions of F-gasses (in Gg CO2-eq)

The Precursors and indirect emissions have been estimated in line with the EMEP/EEA Emission Inventory Guidebook, in a consistent, complete and comparable manner for the entire inventory period 1990 – 2016 (Figure 1-5). The results for precursors and indirect emissions show that they are reduced by 18.5% and 10.5% in 2016 compared to 1990 and 2014 respectively

(Figure 4). At average the emissions are around 200 Gg/year, but there are peaks in 2000, 2007, 2008, 2011 and 2012 mainly as a results of forest fires. The highest numbers are estimated for 2000, 357 Gg. SO2 participates with around 50% over the entry reporting period, but in the last five years it shares is below 40%, as a result of reduction in electricity production from lignite, as well as fuel change (oil for heat production is replaced with natural gas). CO is the second contributor, with around 30%, with peak in the years with more forest fires. NH_3 as a new gas that is introduced in this inventory, participate with around 8% during the reporting period.

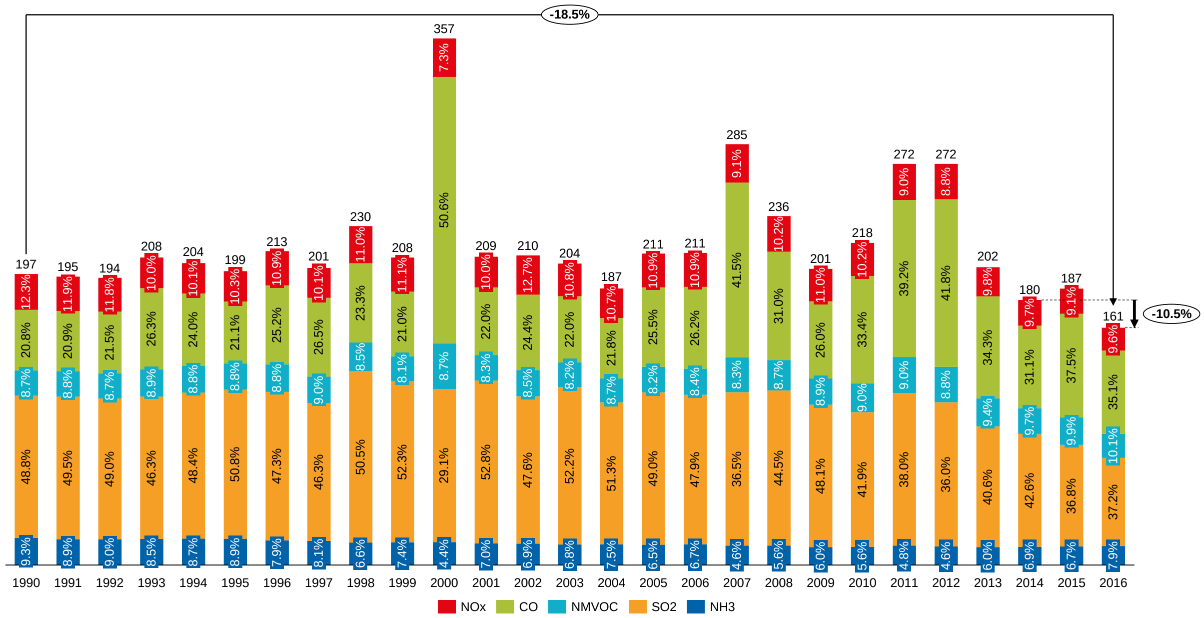

Figure 1-5: Emissions of NOx, CO, NMVOC, SO_2 and NH_3 in the period 1990 – 2014 (in Gg)

1.2.2 Key category analysis

The analysis of key categories that contribute the most to the absolute level of national emissions and removals (level assessment) and to the trend of emissions and removals (trend assessment), is conducted using the Approach 1. According to this approach, key categories are identified using a pre-determined cumulative emissions threshold. Key categories are those that, when summed together in descending order of magnitude, add up to 95% of the total level/trend.

The level assessment is performed for 2016, as the latest analyzed year. The top five categories with the highest values of both emissions and removals (sinks) represented in Gg CO_2-eq are: Energy Industries – Solid Fuels (27.4%) (Energy sector), Forest Land Remaining Forest Land (17.5%) (AFOLU sector), Road Transportation (16.6%) (Energy sector), Enteric Fermentation from Livestock (5.3%) (AFOLU sector) and Manufacturing Industries and Construction – Solid Fuels (4.1%) (Energy sector). The Forest land category is relevant for sinks, while the other categories for GHG emissions.

The trend assessment of source categories is also executed, taking 1990 as base year and 2016 as latest inventory year. The purpose of this trend assessment is to emphasize the categories whose trend is significantly different from the trend of the overall inventory, regardless whether the category trend is increasing or decreasing, or is a sink or source. The results in percentages (up to 95%) show that Forest Land Remaining Forest Land category participates with 27.4% (AFOLU sector) , followed by Road Transportation with 22.8% (Energy sector), Energy Industries-solid fuels with 5% (Energy sector), Manufacturing Industries and Construction – Liquid Fuels (Energy sector) with 4.8% and Refrigeration and Air Conditioning with 4.6% (IPPU sector).

1.2.3 Uncertainty and QA/QC

The uncertainty analysis is again conducted using both methods, Approach 1 (Error Propagation method) and Approach 2 (which is actually an implementation of the Monte Carlo method), for each sector of the inventory for 2014, 2015 and 2016. IPCC software was used for the first approach, while for the second one, the MATLAB model developed in SBUR was applied.

The Macedonian approach towards **QA/QC activities** in the national GHG inventory process is based on the in-depth analyses of the current practices of the inventory compilation in the country and the relevant international best practices. The resulting **QA/QC plan** was presented within the FBUR. It is applied in the same manner over the Inventory process of the SBUR, with an extension of QA activities within the energy sector. This QA/QC plan has proved effective in achieving QA/QC objectives, and as such is planned to be implemented for the inventory processes under forthcoming National Communications on Climate Change and Biennial Update Reports.

1.3 Climate change mitigation and action plan

To assess the mitigation potential of certain measures and policies, all sectors recognized by the Intergovernmental Panel on Climate Change (IPCC) methodology (Energy, Industrial Processes and Product Use, Agriculture, Forestry and Other Land Use and Waste) have been modelled in the TBUR. The good practices and the established detailed and robust methodology developed in SBUR have also been implemented in this BUR.

To evaluate the impact of each mitigation policy and measure, Scenario Without Measure is created (WOM). This scenario assumes no major changes in technology, economics, or policies so that normal circumstances can be expected to continue unchanged. This scenario has no likelihood of occurrence because it implies, for instance, that the efficiencies of devices used in households in 2040 would be the same as the efficiencies of the devices used in 2017. Nevertheless, such a scenario is of crucial importance because it allows all policies and measures to be compared to a referent option ("no action" case) and identify their performance (energy, emissions and financial savings).

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

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

Taking into consideration all national strategic and planning documents, 47 mitigation measures were recognized out of which, 32 measures in the Energy sector, 11 measures in Agriculture, Forestry and Other Land Use (AFOLU) and 4 measures in the Waste sector. Each of these measures is represented with a separate table containing the all necessary information, progress of implementation (timeframe, expected results and costs, implementing entity), progress indicators as well as direct and indirect contribution to the SDG goals. In the Energy sector, some measures are defined three different paths of implementation that correspond to a different scenario.

To see which measures and policies should be prioritized, the economic effectiveness or specific cost (in €/t CO2-eq), as well as the environmental effectiveness or mitigation potential (in t CO2-eq) for each measure and policy is calculated. It can be concluded that in the WAM scenario:

- the total reduction from the proposed measures are estimated to around 5.6 Tg CO_2-eq,
- 70% can be achieved with a “win-win” policies and measures, which means that these measures are reducing the emissions by negative specific costs,
- additional 20% of the reductions are realized by measures with specific costs in a range from 0-5 €/t CO_2-eq.

It is very important to underline that this is not the total amount of GHG emission reduction, because there is one more measure which is very important, but its independent contribution cannot the estimated. This measure is the Introduction of CO_2 tax, which depends to a high extent on the other measures (such as the measures for RES, energy efficiency, fuel switch etc.) which are needed to replace the CO_2 emitters, and therefore cannot be modelled on its own.

Furthermore, additional benefits of the measures/policies are also analyzed in light of their potential for job creation (green jobs). The maximal number in the WEM scenario is in 2030 with 5,309 green jobs, from which 61% are from the energy efficiency and the remaining are from RES. In the WAM scenarios the maximal number is achieved in 2030 (7,035), while in the e-WAM scenario in 2035 (9,895). Moreover, the number of green jobs in 2035 in the e-WAM scenario is almost doubled compared to the WEM scenario. Based on the types of jobs, very basic analyses are done concerning the gender issue. It is found that at least around 27% of the maximum number of job positions in 2035 can be assigned to women

In SBUR, there were two mitigation scenarios (With Existing Measures - WEM and With Additional Measures - WAM), but the very fact that the Energy strategy now defines three scenarios necessitated TBUR defining another additional mitigation scenario (Extended Mitigation - e-WAM). Accordingly, the Reference Scenario of the Energy strategy corresponds to the WEM scenario, the Moderate Transition Scenario in TBUR is a WAM scenario, while for the Green Scenario in TBUR it is presented through the e-WAM scenario. The proposed measures in the AFOLU and Waste sector are included in each scenario. The difference in the scenarios is made by the measures from the energy sector.

Since for Macedonia the base year is not yet defined, in this report 1990 and 2005 are used. Regarding the comparison of the results relative to a base year, it can be concluded that for Macedonia 1990 is a more suitable year, as there are more GHG emissions in that year compared to 2005, and therefore the reductions will be higher. The highest reduction of the GHG emissions that can be reached in 2030 is 82% compared to the 1990 level and it is accomplished by implementing the e-WAM scenario (Figure 1-6). It is projected that the emissions from the Energy sector, Agriculture and waste will be reduced by 66%, 29% and 21%, respectively compared to 1990. Besides, the sinks from the Forestry will be increased by 18 times compared to 1990. Because, there are no measures in the IPPU sector, GHG emission from this sector will increase by 45% compared to the 1990 level.

Although this reduction of emissions of 82% at first glance seems large, it should be noticed that according to the inventory of greenhouse gases in 2016, 54% of the total target for reducing GHG emissions in 2030 has been achieved. The Energy sector (mainly by decommissioning of the coal thermal power plants) should mainly contribute to the reduction of the remaining 46%. At the same time, the sinks from the Forestry, which although are increased by 18 times compared to 1990, in 2030 are projected to remain at the same level as in the period 2013-2016.

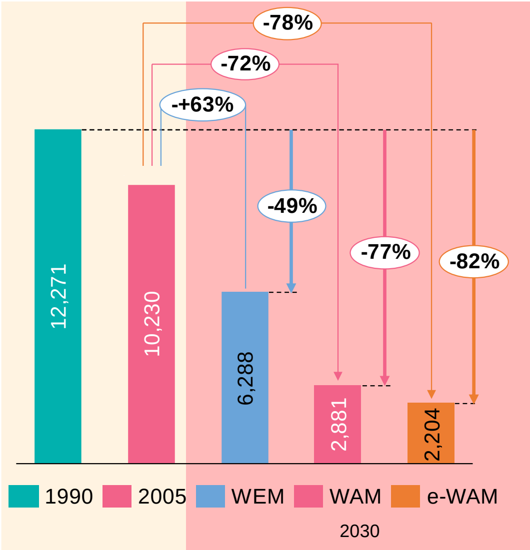

Figure 1-6. Total GHG emissions from all sectors without MEMO in WEM, WAM and e- WAM scenarios in 2030 compared to 1990 and 2005 level (in Gg CO2-eq)

To follow the progress of the mitigation scenarios, SDG indicators and related SGD goals are identified. A comparative analysis of the obtained results with the EU average (EU-28) and the countries of Southeast Europe has been made. An important indicator regarding climate change is the greenhouse gas emissions intensity of energy consumption. It monitors the extent to which low-carbon fuels replace high-carbon fuels while meeting the energy needs and the extent to which the efficiency of technologies for production and use of energy has increased compared to the level in 2000. Although there is an increase in the energy demand, in the mitigation scenarios, as a result of energy efficiency measures, the energy consumption rate of growth is expected to be slower than that of the WOM scenario, while at the same time, with the replacement of lignite with RES and partially with natural gas, this indicator is expected to reach 35% in the e-WAM scenario, which is 65% less than in 2000. In the worst case (WEM), the level of this indicator will stay almost the same as in 2014.

Another important indicator is GHG emissions per capita (CO_2-eq/capita), according to which Macedonia has the lowest value compared to the analyzed countries (3.3 tCO_2-eq/capita in 2016). In the best scenario (e-WAM), GHG emissions in 2040 will be reduced up to 45% compared to the 1990 level, which leads to 3.4 tCO_2-eq/capita. In the worst scenario (WOM), the tCO_2-eq/capita in 2040 in Macedonia will approach the Austrian 2017 level (9.6 tCO_2-eq/capita).

The more ambitious policies and measures proposed in the TBUR doubled the percentage of GHG reductions compared to the SBUR WOM scenario (Figure 1-7). In absolute terms, in 2030 the emissions in the SBUR WAM scenario were projected to 16,681 Gg CO_2-eq and in the TBUR e-WAM scenario to 3,900 Gg CO_2-eq. This WOM scenario is frozen to the 2017 level, which means that the measures implemented up to 2017 are included and is different compared to the WOM scenario in the SBUR (which was frozen to 2012 level). In addition, the lower GDP growth rate in TBUR (3.3% annually) also plays an important role in the projected results. Furthermore, the emissions from the waste sector in TBUR are almost six times lower compared to SBUR, because of the changes made in the calculation of the waste from the industry (waste generation rate as a percentage from GDP) as part from the GHG inventory preparation process.

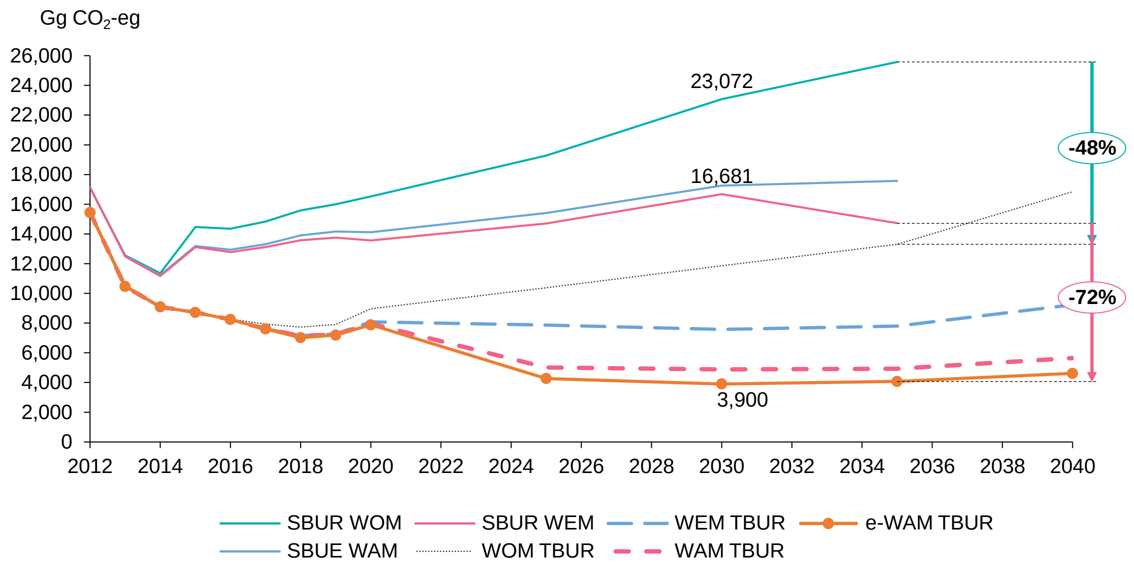

Figure 1-7. Comparison of the results from SBUR with TBUR

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

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

If one was to make a realistic comparison with the INDC goals, only the CO_2 emissions should be taken into account while the emissions related to electricity import should be disregarded. Additionally, a comparison with the INDC reference scenario should be made to assess the relative decreases with respect to that scenario. The results from the comparison are displayed in Figure 1-8 which shows that:

- in the year 2030 in TBUR the WEM is more ambitious than the mitigation scenarios defined in the INDC, as well as in SBUR.
- in TBUR WEM in 2030 the emissions are decreased by 60% compared to the referent Business-as-usual scenario defined in INDC,
- in the TBUR WAM scenario the emissions are decreased by 78% compared to the Business-as-usual scenario in INDC.
- in the TBUR e-WAM scenario the emissions are decreased by 83% compared to the Business-as-usual scenario in INDC.

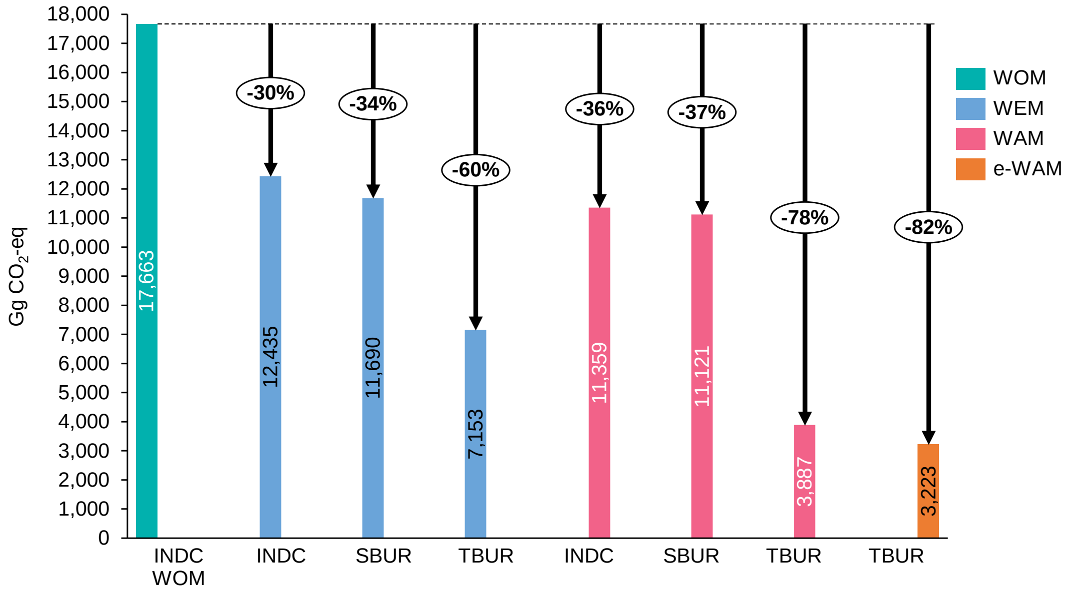

Figure 1-8. Comparison of the SBUR, INDC and FBUR, Mitigation and the Higher ambitious scenarios from the Energy sector with the INDC Reference scenario, 2030 (in Gg CO_2-eq)

For the realization of WEM scenario 13.308 mil. € are needed, of which about 99% are investment in the energy sector. WAM scenario requires an additional 38%, while for the realization of e-WAM almost 60% more compared to WEM (Figure 1-9). The average yearly investments in WEM are approximately 4.8% of the total average annual GDP, while in the e-WAM is 7.7% (Figure 1-10). If all of the measures are implemented in parallel and the “Energy efficiency first” principal is applied, then the total investment can be reduced in the range from 7% to 19%.

Finally, in accordance with the Mitigation scenario an Action Plan for mitigation of climate change was prepared, in which the stakeholders relevant for the implementation of all 47 measures and policies were identified. Furthermore, the plan contains information on each measure’s type, source of finance, indicative future emission reductions, specific costs (cost of reduced t CO_2), and necessary investments for the realization of the measures and the potential for green jobs creation. This Action Plan is a solid foundation for creating national policies that would enable the low-carbon sustainable development of Macedonia.

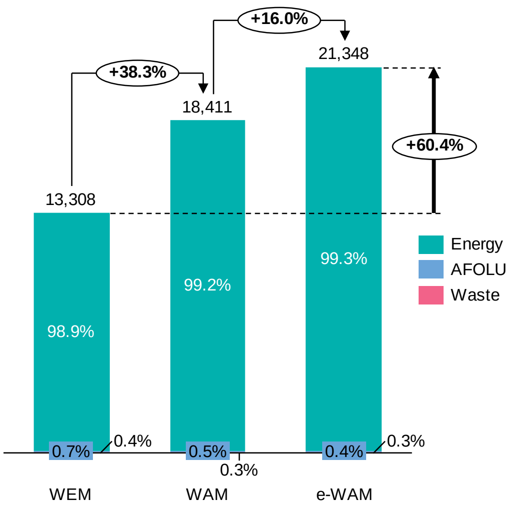

Figure 1-9. Investments by scenarios and by sectors

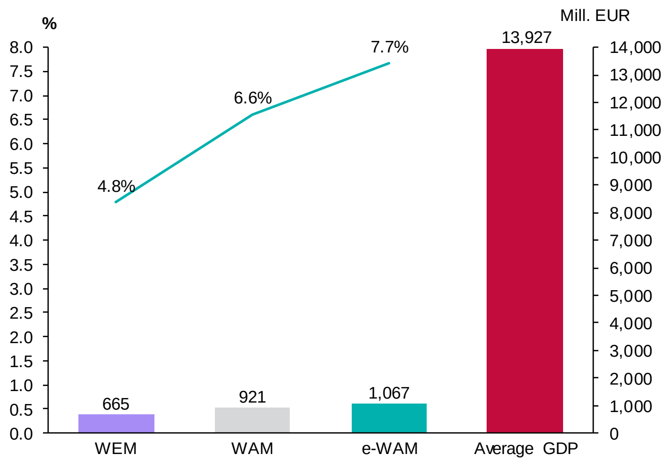

Figure 1-10. Annual investments compared to average GDP

1.4 Constraints and gaps, and related financial, technical and capacity needs, including a description of support needed and received

1.4.1 Financial, technical needs and capacity building needs

In recent years, the country has made progress in developing climate change actions for adaptation and mitigation, through the articulation of strategies at the sectoral, national and regional levels. Despite these advances and the recognition of the problems facing the country's future, there are still some needs to be met and challenges to be overcome in terms of financing, capacity and technical assistance in the different areas of climate change management.

New needs and challenges have been identified that need to be overcome in order to optimize the development of the reporting mechanisms at the internal or national level. These needs include (i) capacity building, (ii) financial resources, and (iii) technology transfer.

The country continues to depend on international cooperation sources for the preparation of national reporting to UNFCCC.

The analysis of the institutional capacity needs is based on the outcomes of the European Commission Report on North Macedonia for 2019 (*North Macedonia 2019 Report*).

The leading institution for climate action in the country is the Ministry of Environment and Physical Planning (MoEPP), which has a Unit for Climate Change under the Department for Sustainable Development and Investments. The Macedonian Environmental Information Centre (MEIC), which forms part of the MoEPP, has an important role to play in monitoring and reporting. However, MEIC does not have a specific department or unit for climate action and the responsibilities are covered by the existing departments. Although MEIC is collecting, processing, and disseminating data, it is only regarding air quality and does not involve the National GHG inventories. Instead, the Research Centre for Energy and Sustainable Development, part of Macedonian Academy of Sciences and Arts (MANU – RCESD) often prepares the assessments required for the national reporting to UNFCCC (Biennial Update Reports, National Communication, GHG inventories and Nationally Determined Contributions). This engagement is project based, given that the country’s reporting to the UNFCCC has been funded by GEF and is supported by UNDP.

At the government level, there is a lack of a permanent technical team for the development of the reports. Additionally, there is low capacity in the systematization of quality information and timely delivery for the reports. These are longstanding limiting factors, with regards to capacities for MRV. The previous BURs specifically identified the need to hire additional expertise to oversee Monitoring, Reporting and Verification (MRV) activities at MOEPP. This need, as a priority for the Government has been met in 2019 within a project “Strengthening institutional and technical Macedonian capacities to enhance transparency in the framework of the Paris Agreement (CBIT project)”, implemented with financial and technical support form GEF and UNDP. As a result, an MRV unit has been established at MOEPP, to oversee climate change reporting on national and international commitments. The unit comprises 5 young professionals with different backgrounds (engineering, economics, legal, and architecture/ urban planning). The MRV unit is expected to be absorbed into the MOEPP and should provide sustained capacity for transparency activities even after the CBIT project ends. At present a draft proposal for new staff in the MEIC was prepared in 2019 but is still not adopted. The proposal foresees a Senior Associate for the Preparation of a GHG Inventory from the Industry Sector and several other positions with tasks related to climate change management, monitoring and reporting (European Commission, 2020).

The CBIT project will be supporting institutional and technical capacity strengthening process in mainstreaming and integration of climate change considerations into national and sectorial development policies, initiated and sustained by the UNFCCC reporting under the expanded transparency framework, on three levels: national institutions, organizations and individuals. Detailed training plan has been prepared and implementation is underway. Other project-based capacity building activities are also planned, within other EU and Green Climate Fund ongoing activities.

As climate action is cross-sectoral, responsibilities need to be shared and effectively coordinated between ministries. The National Climate Change Committee (NCCC) as coordination body, which provides high-level support and guidance for overall climate change policies in the country is not functional due to frequent elections and changes in governmental positions. The NCCC status is being revised within the Law on Climate Action (under preparation) as an advisory body, which shall provide high-level support and guidance for the overall climate action in the country as well as to contribute to the integration of climate action in sectoral policies, plans and measures.

While the existence of an inter-ministerial coordination mechanism on climate change is worthwhile, participating Ministries do not have units/departments dedicated to climate change. Therefore, the lack of adequate specific structures and resources in terms of sufficient and qualified staff, illustrates the constrained capacities of the Ministries on climate change. This is likely an obstacle to an effective cooperation in climate action matters in the government.

Supporting country's capacity to undertake sustainable transparency activities and facilitate reporting requirements to the UNFCCC, a network of climate change national practitioners from various relevant institutions i.e. Macedonian Climate Transparency network of national practitioners, has been established within the CBIT project. This network comprises 64 representatives from 27 governmental institutions and organizations (61% women), such as NGO sector, academia, universities and international organizations that implement complementary projects.

1.4.2 Financial resources, technology transfer, capacity building, and technical support received

Republic of North Macedonia has received significant financial, capacity building, technical and technological support from international donor organizations and developed countries. As a non-Annex I country to the Convention, the Republic of North Macedonia is a recipient of international support and is therefore required to report the amount of support received in the subsequent two-year period. In the last two-year period, the bilateral support from the European Union, GEF and UNDP has the highest contribution to financing climate change activities. Much of the support that has been received has been used to finance projects predominantly to mitigate the effects of climate change. It must be emphasized that the amount of support received is far from sufficient to meet the needs of undertaking other significant mitigation and adaptation activities to achieve green and resilient development.

Also, as a developing country, the Republic of North Macedonia allocates a considerable amount of its own budget funds for financing climate activities, which is still below the required level.

Section 5.4 presents information on the financial and technical support that the country has received from international cooperation and government budget for the development of initiatives related to climate change management. An assessment to estimate the international and domestic support received was prepared to inform the preparation of the TBUR. In order to obtain this information, a document analysis and consultation process via survey was carried out. The information on support received covers the reporting period 2018 - 2019.

The Republic of North Macedonia also received non-monetary support in the form of capacity building, technical support and technology. There are 14 projects registered in this category.

Based on the conducted analyses of the current country status of the research, development, innovation and technology transfer related to climate change on one hand, and the possibilities offered by the utilization of the UNFCCC technology mechanism on the other, it is more than evident that the country will benefit greatly from the utilization of this mechanism, which will significantly affect the development of the areas of environment and climate change in a very positive direction.

Therefore, it is highly recommended the selection and nomination of the National Designated Entity (NDE) as a focal point for the Technology Transfer (TT) mechanism as soon as possible. According to the ranking investigation and selection criteria of the assessment, the highest ranked organization, which should be promoted as organization that possesses significant potential to be nominated as NDE in Republic of North Macedonia, is the Fund for Innovation and Technology Development (FITD). Establishing the NDE will serve as a national focal point with goal to provide continuous information about financing through donor programmes for R&D and Innovation activities related to the climate change actions. Moreover, it will play a key role for the conversion of science, R&D and innovation results into competitive products and processes in industry.

1.5 Level of support received for the BURs

To assist the Republic of North Macedonia in the preparation of its three **Biennial Update Reports** to the UNFCCC, the GEF provided support in the form of an Enabling Activity grant, amounting total of USD 1,025,461. Co-financing was provided from UNDP and in-kind support from MOEPP. UNDP also provided technical support services to MOEPP, for assistance with reporting requirements and payment, ensuring that the capacity of the Government-designated institution is strengthened to enable it to carry out such activities directly. The project team also utilized in-kind technical and administrative support from the Global Support Programme for National Communications and Biennial Update Reports. Information on financial support for the BURs is also provided in tabular format in Annex 8.

1.6 Domestic Measurement, Reporting and Verification Systems

The Republic of North Macedonia is in a unique situation when it comes to its international obligations regarding monitoring, reporting and verification. Namely, the country is a Party to the UNFCCC, but it is not part of Annex I; i.e., it does not have quantified commitments. Despite the fact that Republic of North Macedonia is not an Annex I Party, it is voluntarily attempting to incorporate Annex I reporting principles as much as possible into the framework of its National Communications and Biennial Update Reports. As a country that has also begun the process of EU pre-accession, it must now also adhere to the **EU 2030 climate and energy framework** includes EU-wide targets and policy objectives for the period from 2021 to 2030. The Republic of North Macedonia is also a Contracting Party of the Energy Community (EnC), which is rapidly implementing many policies that are directly related to the issue of MRV.

According to the Law on Environment, The Ministry of Environment and Physical Planning is obligated to collect data and to cooperate with several bodies of the state administration: State Statistical Office, Ministry of Economy, Ministry of Agriculture, Forestry and Water Economy, Ministry of Interior etc. Strengthening the institutional cooperation for data exchange relevant for the preparation of the inventory is considered a key issue that would enable easy and successful preparation of the national reports.

According to the Law on Environment, the Ministry of Environment and Physical Planning (MOEPP) should establish, develop, manage and coordinate a national system for inventory of greenhouse gas emissions. This system will provide the necessary data for the preparation of the Greenhouse Gas Inventory, as well as for the monitoring of the implementation of the National Climate Change Plan. However, the Law does not regulate in detail the issue of monitoring, reporting and verification of policies and measures.

The Law on Environment currently regulates the issue of monitoring of anthropogenic emissions by sources and sinks of greenhouse gases. However, the Law on Environment does not yet regulate the issue of MRV on policies and measures in detail. In order to be effective, the law would require an amendment. Other sectoral laws and strategies provide partial guidance on MRV for policies and measures but often are not adhered to nor enforced. The Republic of North Macedonia has recognized the importance of climate action and the need for the establishment of comprehensive climate legislation aligned with the EU acquis to enable future sustainable development in the country and has initiated the process of the development of a comprehensive Law on climate action that will provide enabling environment for establishment of the national system for MRV and climate action in the country.

As a candidate for EU membership the transposition of EU regulations on accurate monitoring, reporting and regular evaluation of greenhouse gas emissions are currently the main objectives of the project Preparation of a long-term strategy and Law for climate action funded by the EU within the IPA 2014-2020.

A variety of electronic systems under development or testing address monitoring and reporting needs, including software to partially automate data collection for the preparation of the energy balance; a monitoring and verification web platform (MVP) to monitor the implementation of the National Energy Efficiency Action Plan; ExCITE, software for monitoring energy consumption in municipalities; a special tool to monitor the energy market in Republic of North Macedonia; Emission Monitoring in Industry (EMI) software; and the Vehicle Registry. Although national legislation clearly indicates that monitoring systems should be established, and several systems are under development or testing, the responsible institutions still require comprehensive, fully operational systems. The Ministry of Environment and Physical Planning (MOEPP) is currently designing the National Environmental Information System (NEIS), incorporating all existing information systems under their jurisdiction, including the climate change MRV platform anticipated within the CBIT project.

Section 7.6 provides a series of recommended measures for an MRV system for the country that will comply with UN and EU requirements as well as reflect the Paris Agreement. Recommendations cover GHG inventories, legal frameworks for monitoring, mitigation policies and measures and implementation and improvement of electronic systems for data collection, processing and reporting.

1.7 Other relevant information

There are a number of noteworthy activities related to education, gender inclusion, sustainable development and public awareness related to climate change relevant to Article 6 of the UNFCCC.

1.7.1 Climate change knowledge and perceptions survey

The survey is built upon previous surveys conducted in 2014 and 2016 as part of the "Third National Communication on Climate Change" and the "Second Biennial Update Report on Climate Change.

The survey showed that the respondents detected corruption and the lack of clean water as biggest social problems, while climate change is seen as third most serious threat to the society. However, compared to previous findings, the respondents consider that they have higher knowledge regarding climate change. 51.9% from the respondents think that they are well informed for the different influences and consequences of climate change, while 40.3% of them stated that they are informed to a certain extent. Extreme temperatures and the change in seasonality and precipitation are recognized as most visible effects of climate change. In that regard, the respondents stated that the issue of climate change is more present in the media compared to the previous surveys. It is believed that this is possibly a result of the raise of the public awareness and interest in the issue, rather than the increased occurrence of extreme weather events. Also, the survey shows that 68% of the citizens perceive the connection and the differences between climate change and air pollution.

1.7.2 Mainstreaming gender in climate change

Under the support and guidance of the Global Support Programme (GSP), in the Republic of North Macedonia, as part of climate change projects implemented by the Ministry of Environment and Physical Planning with the support of the United Nations Development Programme (UNDP), an Action Plan on Gender and Climate Change has been prepared. The Global Support Programme, has initiated and supported integrating the gender perspective into the climate change by supporting development of Action Plans on Gender and Climate Change, not only in the country but as well as in the Western Balkan region.

In that direction, for the first time the topic of gender and its intersection with climate change was introduced in the region, by the GSP efforts and its comprehensive approach by sharing knowledge, best practices and most effective models of plans development and finding best solutions for their effective implementation in the Western Balkan countries.

In the period from June 2019 to February 2020, within the project "Macedonian Fourth National Communication and Third Biennial Update Climate Change Report" the country took a systematic approach to introduce measures and models for strengthening the implementation of a Draft Action Plan on Gender and Climate Change. It foresees concrete steps by which, through increasing the knowledge and awareness of all relevant gender and climate change stakeholders, will build institutional capacity for specific actions in this area, both at policy and implementation level.

1.7.3 Education and climate change:

An assessment prepared for the “Macedonia’s Fourth National Communication and Third Biennial Update Report on Climate Change under the UNFCCC” shows that although there is evidence that climate change and sustainable development issues are to an extend integrated in the educational curricula, it is not done with a systemic approach for the national educational system.

There are four state universities that have undergraduate, postgraduate and PhD degree programmes relevant to climate change and sustainable development issues.

1.7.4 Advances on achieving the Sustainable Development Goals

Since its independence in 1991, the Republic of North Macedonia has made significant progress towards sustainable development and the rational use of natural resources. This process was guided by the fundamental values enshrined in its Constitution, legal framework and strategic policy documents such as the National Development Plan 2007-2009, National Strategy for Sustainable Development 2009-2030, Strategy for Regional Development 2009-2019, etc. In 2015, the Government reaffirmed its commitment to sustainable development by pledging “to leave no one behind” and agreeing to implement the 2030 Agenda. In May 2020, the country finalized its Voluntary National Review i.e. main achievements and challenges in each of the five areas of the 2030 Agenda

1.7.5 Open Government Partnership Activities

By accessing the global voluntarily initiative for Open Government Partnership (OGP), Macedonian Government has committed and reaffirms its commitment to the continuous improvement of its work based on open, transparent, liable and efficient government institutions that communicate and collaborate with the civil society. The responsible institution in the country for realization of the project Open Data under this initiative is the Ministry of Information Society and Administration (MISA). Climate change data from the BUR are part of the available datasets on the national open data web platform.

***Note:* Sectoral analyses and reports that served as input for development of this Third Biennial Update Report on Climate Change, are accessible on the following link on the national climate change platform*.

2 National Circumstances

2.1 Country profile

The Republic of North Macedonia is one of the smallest countries in the South-Eastern Europe region, with around 2.076 million inhabitants in 2019. In the past two decades the country's economic growth was the most stable in the Western Balkans, income per capita doubled, and the country moved from low-middle- to upper-middle-income status. Its gross domestic product (GDP) totals EUR 10.7 billion and GDP per capita in 2018 was EUR 5,153. As of 2019, the unemployment rate was 17.1%.In 2018, the structure of GDP was dominated by the services sector at 54.4. The sectors of Mining and quarrying; Manufacturing; Electricity, gas, steam and air conditioning supply; Water supply; sewerage, waste management and remediation activities; and Construction had a combined with 23.9%. Agriculture, forestry and fishing had a share in the structure of GDP of 7.9% in 2017 and 8.5%.

The Republic of North Macedonia hosts several natural resources including precious minerals such as gold, iron ore, silver, copper ore, manganese, and lead. Other major resources include non-metallic minerals, arable land, and agricultural products such as tobacco, grapes, and vegetables. Its strategic geographic location is also a major asset, given the largely untapped export potential of its agriculture and services sectors.

The Republic of North Macedonia can use the EU accession process to strengthen its institutions and the rule of law, align policies and strategies and complete its transition to a well-functioning market economy. The country is under a process of integration of environmental, energy and climate change issues into other sectoral policies. Continuous upgrading of existing monitoring and reporting systems for climate change and the upgrading and integration of policy have become a major priority proceeding in parallel with European integration.

However, the transition to a well-functioning and inclusive market economy is not yet complete. It is critical to maintain the pace of transposition of EU acquis, harmonisation of climate and energy policies and strategies. Finally, climate and environmental threats, including air pollution, require urgent attention or they may slow economic growth and reverse poverty reduction.

Acknowledging the significance of the climate change problem and the necessity to take effective actions for its mitigation, the Republic of North Macedonia ratified the UN Framework Convention on Climate Change (UNFCCC) on December 4, 1997 (Official Gazette of RM ñ 61/97),and its Doha Amendment (2019), it ratified the Kyoto Protocol (Official Gazette of Republic of Macedonia - 49/04) and has associated itself with the Copenhagen Accord (2009).

Although the Republic of North Macedonia is a non-Annex I country, it is also a candidate member state to the EU; therefore, it has to adhere to EU Climate and Energy policies which assume the obligations of the UNFCCC Annex I countries. The country is also Contracting Party of the Energy Community, which is rapidly advancing the implementation of EU regulations for monitoring, reporting and verifying greenhouse gases and taking steps to tackle the climate crisis.

Finally, the country is a member of the Open Government Partnership (OGP) and a participant in its Open Climate Working Group, which involves many countries and civil society organizations. As a working group member, the country is expected to develop clear, concrete and ambitious commitments to addressing climate change in consultation with civil society. Furthermore, the Republic of North Macedonia is among the first seven countries in the world to incorporate climate commitments in their respective OGP National Action Plan (NAP) 2016–2018 and proceeded with these efforts in two subsequent OGP plans (2019-2020 and 2021-2022). The country has committed to develop national climate policies in a transparent, participatory manner. It has also provided: open access to national databases that show the amounts and sources of greenhouse gas emissions, including information and data on climate change effects, relevant climate scenarios and climate change mitigation. It also commits to establish appropriate legal and regulatory frameworks for the private sector to deliver data relevant to climate change.

Energy

Compared to the other sectors, the energy sector generates by far the largest share of GHG emissions in the Republic of North Macedonia. This is due to the fact that the gross inland consumption of energy in the country is still dominated by fossil fuels, although their share is decreasing over the reported period, from 92% in 1990 to 79% in 2016 (Figure 2-1). At the same time, the share of renewable energy sources has doubled (7.5% in 1990 to around 15% in 2016). The rest of the gross inland consumption is covered by the electricity import, which increased from insignificant 0.2% in 1990 to 6.5% in 2016. The gross inland consumption in total in 2016 is 7% lower compared to the consumption in 1990.

Historically, the most dominant fuel in the country is coal (predominantly lignite) which has accounted for about 45% of the gross inland consumption. The situation changed in 2016 as oil products became the predominant fuel type with a 40% share, while the share of coal has reduced to 33% (Figure 2-1).

Final energy consumption does not follow the same trend line as the gross inland consumption. The highest consumption of 1,861 ktoe, in the reported period, is recorded in 2016 which is 7.8% higher compared to the consumption in 1990. In 2016, oil products accounted for the largest share of final energy consumption (49%), while electricity is next (29%), followed by biomass with 10%, coal with 7% and heat and natural gas with 2% each. The efficiency of the energy system, represented with the ratio of final energy consumption per gross inland consumption, has increased to nearly 70% in 2016 which is 10 percentage points higher than compared to 1990. This value is now at the same level as the average for member countries of the Organization for Economic Co-operation and Development (OECD) in Europe, where it is about 70%.

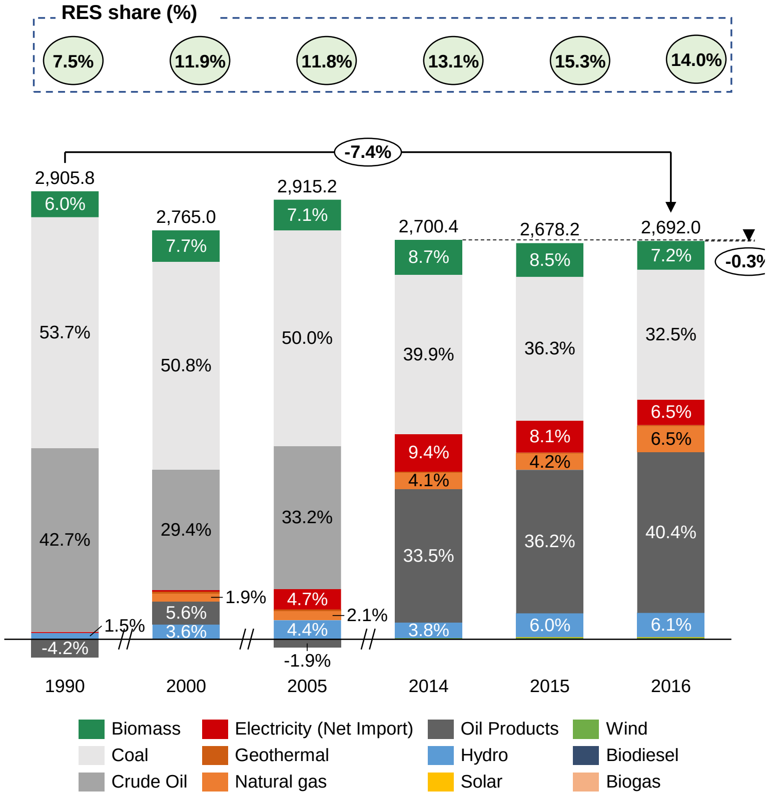

Figure 2-1: Gross inland consumption (in ktoe)

Electricity and biomass are very important commodities for the country, as domestic resources. In 2016, the electricity available for final energy consumption was 6,191 GWh (532.4 ktoe). Although in the reported years, the share of electricity in final energy consumption has increased from 23.4% in 1990 up to 32% in 2014, but in the subsequent two years it decreased to 28.6% by 2016, most probably as a result of energy efficiency measures as well as weather conditions.

The energy industry has the highest GHG emissions of the energy sector at 51% in 2016. The installed capacity for electricity production is mainly composed of thermal power plants, 71% in 1990 and 45% in 2016. They are followed by hydropower plants with 29% in 1990 and 36% in 2016. Technologies such as PV, wind and combined heat and power plants have also been deployed during the reported years and their shares in 2016 were 1%, 2% and 15% of the total installed capacity, respectively. The RES installed capacity in total represented 39% in 2016 which is 10% more compared to 1990.

Considering these installed capacities, electricity is mainly produced in the thermal power plants, i.e. 88% in 1990 and 39% in 2016, followed by the production from hydropower plants, which was 8% in 1990 and 25% in 2016. Although 15% of the installed Macedonian capacity is from CHPs, their production in 2016 accounted for only 7%. Net import of electricity also has a significant share and was about 27% in 2016.

As a result of the low GDP per capita, the Republic of North Macedonia falls into the category of countries with high gross domestic consumption and high final energy consumption per unit of GDP despite low per capita energy consumption. The total amount of energy required per unit of GDP in the country is around four times higher than the average of developed European countries. Because of the significant use of fossil fuels in the country and the dominant use of domestic lignite for electricity production, there is significant potential for GHG emissions reductions.

The transport category represents the second biggest contributor in the overall Energy sector emissions. Regarding the fuels, gas/diesel oil (road diesel), motor gasoline, liquefied petroleum gases (LPG), aviation gasoline and natural gas are used. Road Transportation was responsible for almost all of the emissions 99.7% in 2016, while emissions from Railways were 0.3% and emissions from Domestic Aviation were close to zero. Unlike the other categories and the Energy sector as a whole, the emissions from Transport show an increasing trend, 165% and 26.6% more emissions in 2016 compared to 1990 and 2014, respectively.

Manufacturing Industries and Construction as an Energy category represented 13.9% in the overall Energy sector emissions in 2016. The fuels used in this category consist of: coking coal, other bituminous coal, lignite, liquefied petroleum gases, residual fuel oil, natural gas, wood/wood waste (biomass and wood wastes, wood briquettes and pellets), sub-bituminous coal, petroleum coke, and gas/diesel oil (road diesel, and heating and other gasoil).

The top three most intensive subcategories are: Iron and Steel (51.5% of the category emissions in 2016), Non-Metallic Minerals (28.4% of the emissions in 2016) and Food Processing, Beverages and Tobacco (6.3% of the emissions in 2016). If the declining trend of the total category emissions is quantified, one can calculate 2.8% when comparing 2016 with 2015, and 8.4% when comparing 2016 with 2014.

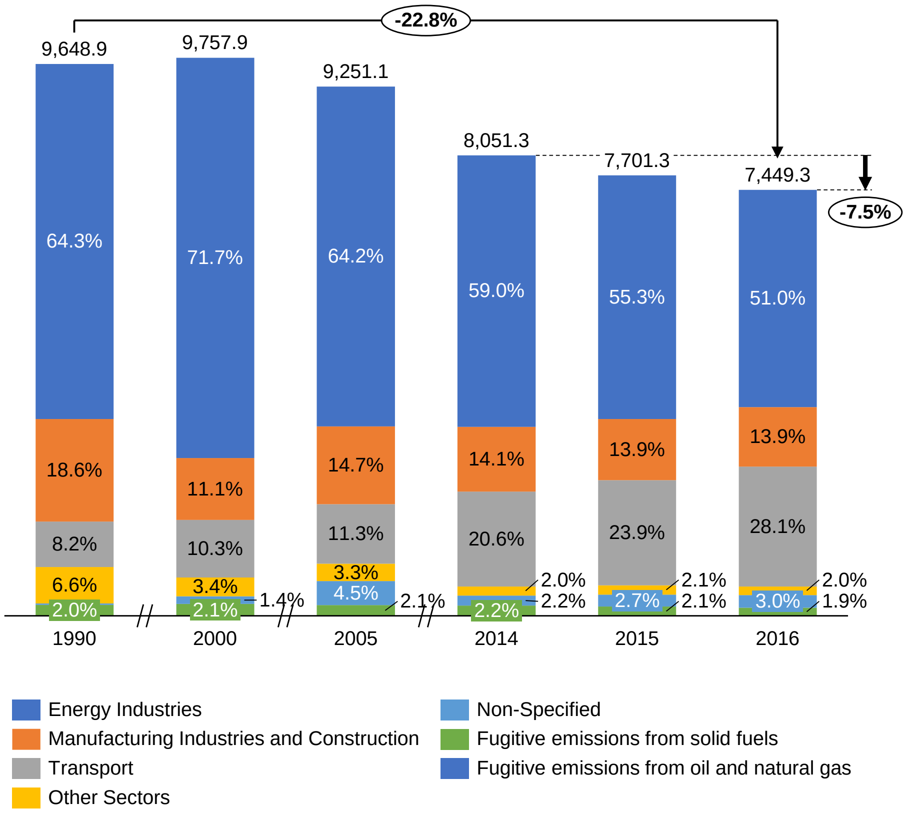

Figure 2-2: GHG emissions in Energy sector, by category (in Gg CO_2-eq)

Almost all of the Energy GHG emissions in 2016 are actually CO_2 emissions (96.4%), and CH_4 and N_2O emissions amount to only 2.8% and 0.8%, respectively (Figure 2-3)

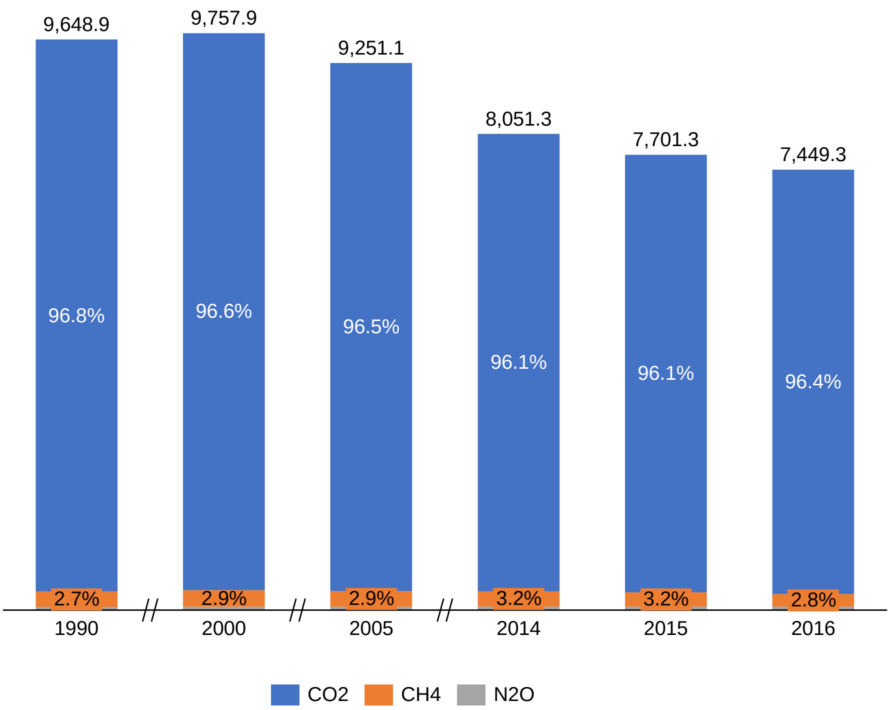

Figure 2-3: GHG emissions in Energy sector, by gas (in Gg of CO_2-eq)

Industrial processes and production use

Industrial production in the Republic of North Macedonia has slowed down after an economic transition period in the 1990s. Many industrial plants in the country have either lowered the volume of manufacturing or entirely shut down. However, several industries that continued their production have become the largest contributors of GHG emissions in the industrial processes and production use (IPPU) sector. Most of the GHG emissions come from the metal industry (from steel and ferroalloys production) and the mineral industry (from cement production).

The rest of the GHG emissions from industrial processes and production use in the country come from usage of substitutes for ozone-depleting substances (ODS) for refrigeration and air-conditioning. All of the ODS alternatives are imported in the country, either pure or as a blend.

Over the reported period, the emissions from this sector slightly changed, with a generally decreasing trend, however the different sub-categories have significantly changed. In 2016, the emissions from IPPU sector decreased by 8% relative to 1990, and 3.2% compared to 2014 (Figure 2-5). Overall, the IPPU emissions in 2016 were 850 Gg CO_2-eq, which is 3.2% lower compared to 2014 or 8% lower compared to 1990.

Until 2000, the metal industry was the prevailing source of the emissions, mostly from the ferroalloy production. After 2000, when Ozone Depleting Substances (ODS) substitutes usage in the country started to increase, the share of the GHG emissions from the metal industry decreased considerably (from 64% in 1990 to 19% in 2016), while the emissions from the mineral industry have been fluctuating over the inventory period. In the last three reporting years the product uses as substitutes for ODS had grown around 50%, resulting with a share of almost 37% of the IPPU emissions in 2016. However, the dominant share in 2016 had changed to the mineral industry with 44%, while the share of the metal industry had reduced to 19%. Emissions from the other categories, like chemical industry, non-energy products from fuels and solvent use, electronics industry and other product manufacture and use do not occur in the country. In the previous BURs, emissions were reported in the chemical industry, from soda ash production, but during the preparation of this report, all publications from the State Statistical office for the Industry sector were carefully scrutinized and it was concluded that there is only consumption of soda ash in the country (in the industry for production of basic chemical products and in the industry for processing of chemical products). Therefore, the data previously reported under soda ash production, is now reported as other uses of soda ash, under the subcategory other process uses of carbonates category in mineral industry.

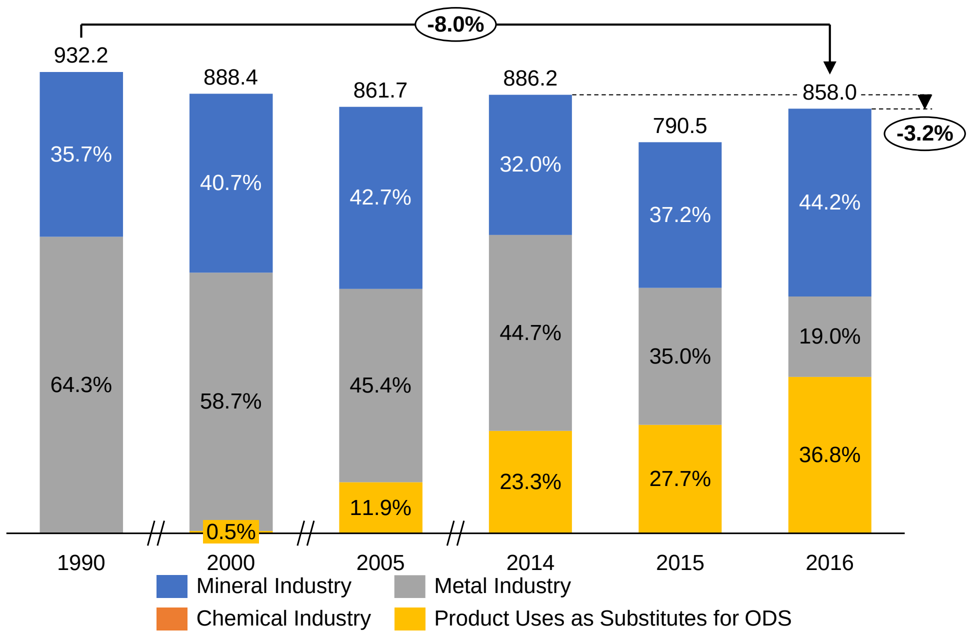

Figure 2-4: GHG emissions from the IPPU sector, by category (in Gg CO_2-eq)

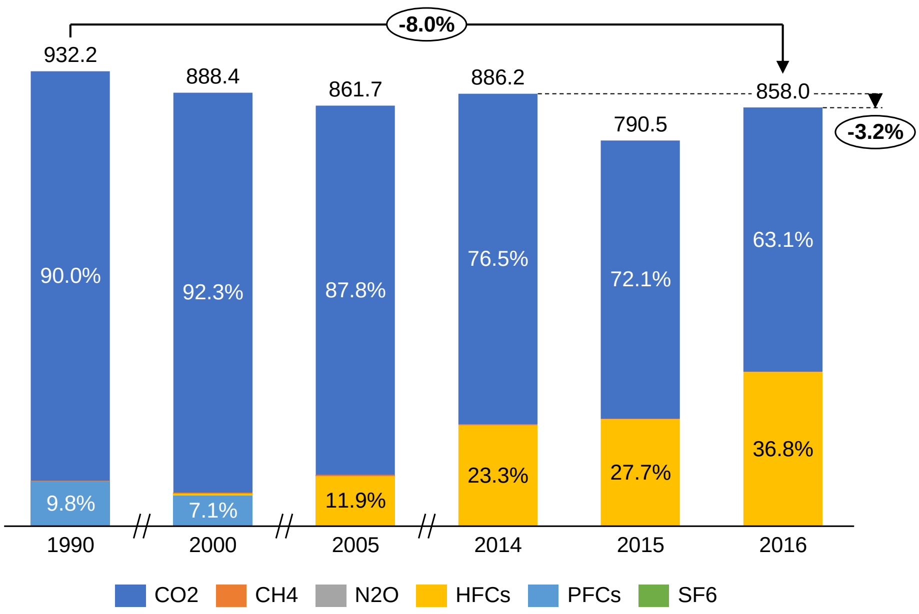

Figure 2-5: GHG emissions from the IPPU sector, by gas (in Gg of CO_2-eq)

Agriculture, Forestry and Other Land Use

Agriculture, Forestry, and Other Land Use (AFOLU) is unique among the sectors considering the numerous processes leading to emissions and removals of greenhouse gases, which can be widely dispersed in space and highly variable in time.

Forests and forestland in the Republic of North Macedonia cover around 1.1 million ha and are characterized with great species diversity, but low quality and small annual growth. More than 70% of the forests are coppice, 90% are deciduous and almost 90% are state owned. The most dominant species is beech, and then various oak species. The total wood reserve is estimated at around 70 million m^3, and total annual growth is around 1.7 million m^3. Most land considered as forest is typically Mediterranean type forest, characterized by broadleaf and conifer, other small trees and bushes.

The livestock sector is one of the main sources of GHG emissions with a total emissions of CO_2-eq varying in a range of 1,108.11 Gg in 1990, to only 792.68 Gg in 2014 (Figure 2-6). Cattle are the main source of GHG among the ruminants. The majority of methane emission is from enteric fermentation while manure management contributes only 18% of the total CH_4 emissions.

The forestry sector is the major contributor of GHG sinks in the country, within the Land subsector of AFOLU, with the exception of several years when the amount of forest fires (burned areas) reduced sequestration rates significantly (GHG sinks) to the point where this sector was a net emitter. The area of forestland, the species composition (conifers, broadleaved, mixed), as well as the annual increment and removals from the forests are relatively stable. The estimated GHG sinks in this sector for 2015 was estimated to be 1,608.31 and in 2016 it was 2,120.65 Gg CO_2 eq.

Other land uses like cropland, grassland, settlements and other land, result in the net emissions of CO_2-eq, and in some years can be considered as a significant source of emissions of GHG. GHG emissions from this sector are mainly the result of the conversion from one category of land use to another, when significant amounts of above and below ground biomass is rapidly removed and is considered as a direct loss.

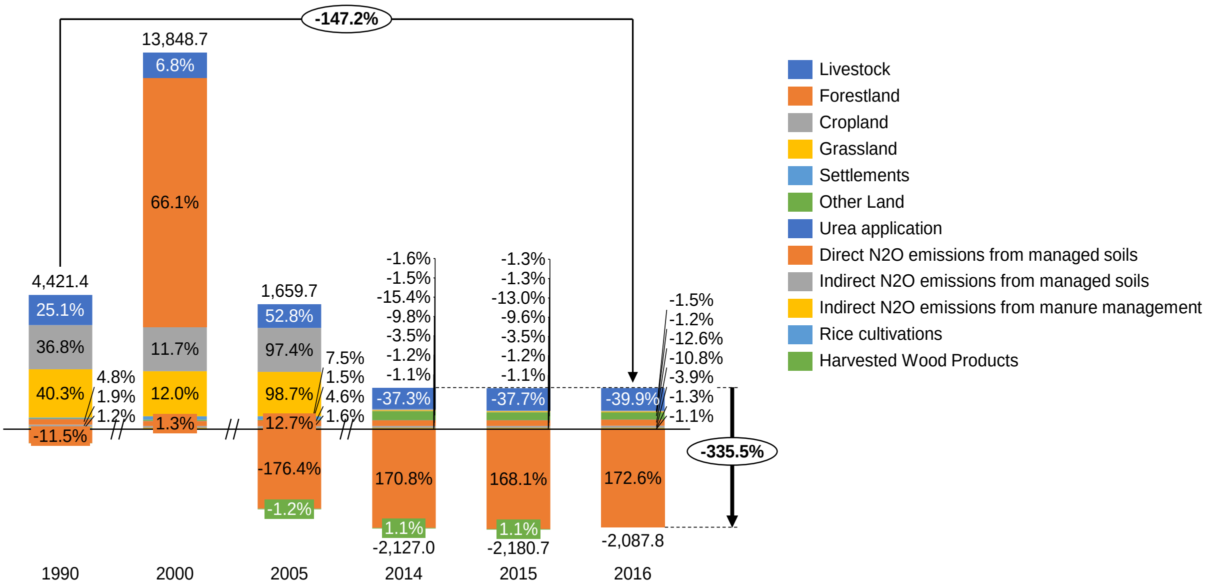

Figure 2-6: GHG emissions (and removals) from AFOLU sector (in Gg CO_2-eq)

Waste

The categories reported under the waste sector are solid waste disposal, biological treatment of solid waste, incineration and open burning of waste and wastewater treatment and discharge. The data categorization format is consistent with previous years in order to preserve the existing time series, except in sectors where data was introduced for the first time.

It is important to note that in the Second BUR (SBUR) the waste sector was the second largest source of GHG in the Republic of North Macedonia. Based on revisions the emissions from the waste category in this inventory are less than one quarter of the results from the SBUR. More details are provided in Chapter 3.

According to the National Waste Management Plan 2009 – 2015, the solid waste generated in the country is mostly disposed in non-compliant landfills. The landfill Drisla, serving the Skopje region, with approximately 590,000 habitants, is the only permitted landfill and it is relatively well managed. At the around 50 municipal non-compliant landfills, dumpsites or in rural areas, waste is simply dumped by the Communal Enterprises with almost none standard landfilling activities, no operational costs, except some overheads and occasional waste consumption costs for the extinguishing of emerging landfill fires. The need for improvement of their waste management practices has been recognized in national, regional and local waste management strategic documents. Furthermore, there are around 1000 illegal disposal sites which need to be stopped.

The calculations show that the waste sector is one of the sectors with an increasing trend of GHG emissions achieving 610 Gg CO_2-eq in 2016, which is doubled compared to 1990 or 6.3% more compared to 2014. Out of all the sectors, the emission from solid waste disposal category are most significant with 77.5% in the total sector GHG emission in 2016 (Figure 2-7). The second category with the most significant amount of GHG emissions is wastewater treatment and discharge with around 19% in 2016. Incineration and open burning of waste category contribute around 4% in the last three reported years. The CH_4 and N_2O emissions from the biological treatment of solid waste category do not contribute largely to the overall emissions due to the small amount of reported composted waste. Around 92% of the GHG emissions in the last three years of the reporting period are CH_4, while N_2O and CO_2 participates with 7.2%, 1% respectively.

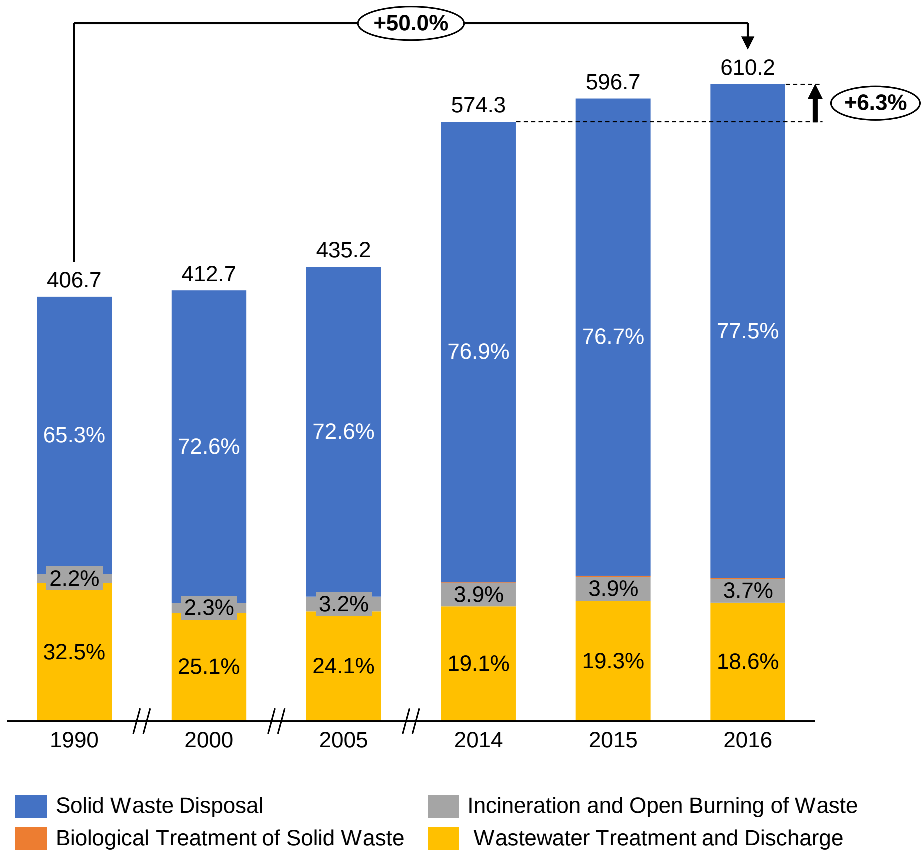

Figure 2-7: GHG emissions from Waste sector, by category (in Gg CO_2-eq)

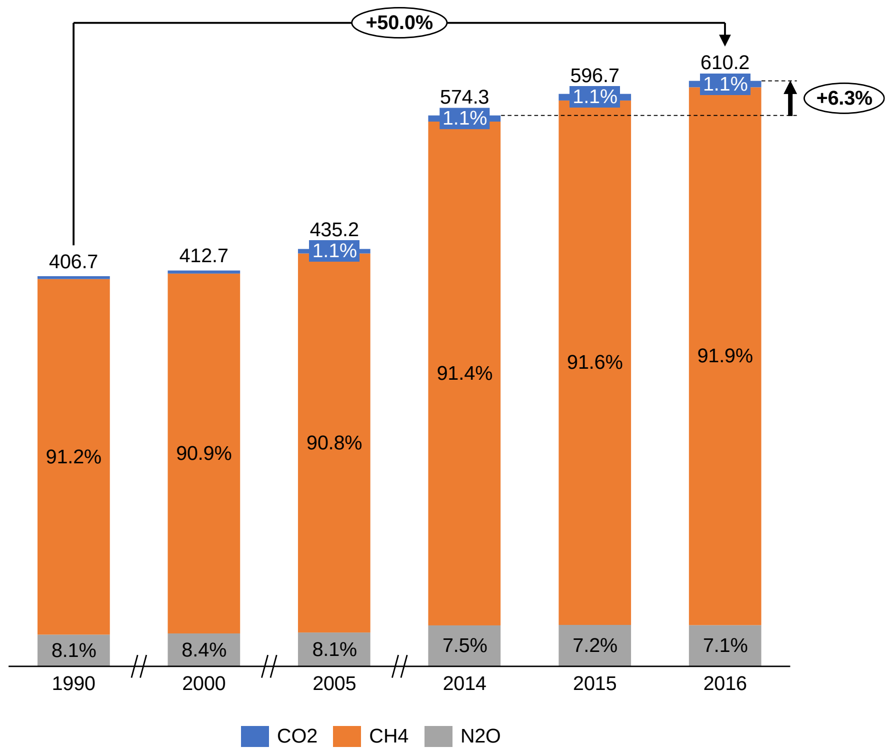

Figure 2-8: GHG emissions form Waste sector, by gas (in Gg CO2-eq)

2.2 Climate Change-Related Institutional Framework

The **Ministry of Environment and Physical Planning** (MOEPP) has been designated as the National Focal Point to the UNFCCC and the National Authority for the implementation of the Kyoto Protocol. UNFCCC National Gender and Climate Change Focal Point has been nominated from the Ministry of Labour and Social Policy. The Office of the Deputy Prime Minister for Economic Affairs is responsible for the achievement of the Sustainable Development Goals, and it is also a National Designated Entity for the Green Climate Fund, strongly supporting the implementation of climate and energy-related projects in the country. Other ministries responsible for relevant climate change policymaking are: Ministry of Economy, Ministry of Agriculture, Forestry and Water Economy, Ministry of Transport and Communications, Ministry of Health, and Ministry of Finance. The National Climate Change Committee (NCCC), established by the Government, provides high-level support and guidance for the overall climate change policies in the country. It comprises of key stakeholders representatives from national institutions, academic institutions, the private sector and civil society and the climate change coordinators appointed by ministries. While work of the NCCC is currently on hold due to parliamentary elections in July 2020, relevant legal setting and further rules of procedures will be stipulated by the new Law on Climate Action and supporting bylaws, governing the NCCC as an advisory body “which shall provide high-level support and guidance for the overall climate action in the country as well as to contribute to the integration of climate action in sectoral policies, plans and measures”.

While the existence of an inter-ministerial coordination mechanism on climate change is worthwhile, participating Ministries do not have units/departments dedicated to climate change. Therefore, the lack of adequate specific structures and resources in terms of sufficient and qualified staff, illustrates the constrained capacities of the Ministries on climate change. This is likely an obstacle to an effective cooperation in climate action matters in the government.

Supporting country’s capacity to undertake sustainable transparency activities and facilitate reporting requirements to the UNFCCC, a network of climate change national practitioners from various relevant institutions i.e. Macedonian Climate Transparency network of national practitioners, has been established within the CBIT project. This network comprises 64 representatives from 27 governmental institutions and organizations (61% women), such as the NGO sector, academia, universities and international organizations that implement complementary projects.

The National Council for Sustainable Development, as well as other key stakeholders in government and in civil society, also participate in the process of development of climate change relevant policies in the country and mainstreaming climate change into sectoral documents.

2.3 Climate Change-Related Legal and Policy Frameworks

Significant progress has been achieved in mainstreaming climate change into sectoral policies/legislation (mostly supported within the process for development of NCs and BURs) in the areas of energy, energy efficiency, renewables, transport, gender, spatial planning, waste, air pollution, green jobs and implementation of the Agenda 2030 and the Sustainable Development Goals. The Country is currently taking action towards the full transposition/implementation of the EU acquis enabling a low carbon emissions and climate resilient development. In the process of EU accession, new laws and policies have been adopted and regularly updated for constant harmonisation with the EU acquis. In the field of climate change, the process of **harmonisation with the EU acquis** is advancing. The planned Law and Strategy on Climate Action will be informed by the European Union’s 2030 Climate and Energy Framework. The Strategy for Energy Development of the Republic of North Macedonia until 2040 fully integrates climate and environmental aspects of the energy sector, while proposing an affordable, reliable and sustainable energy for the future. It enables overall energy sector modernisation and transformation in line with EU energy trends, contributing to increased access, integration and affordability of energy services, reduction in local and global pollution, and increased private sector participation, while considering North Macedonia's development potential and domestic specifics. As a member of the Ministerial Council of the Energy Community (EnC), the Republic of North Macedonia is required to produce their National Energy and Climate Plans (hereafter referred to as NECPs) in accordance with Regulation (EU) 2018/1999 of the European Parliament and of the Council. The purpose of the NECP is to support the attainment of the long-term energy and climate policy objectives, reduce the administrative burden and enhance transparency while promoting investor certainty in the region. The process of Macedonian NECP development started in 2018, with the establishment of the Working Group consisted of representatives of key stakeholders in the country. The Ministry of Economy and the Ministry of Environment and Physical Planning lead the whole process, as institutions with the ultimate responsibility for implementing the NECP. Macedonia has prepared a draft version of its NECP in May 2020. The process is still ongoing until the Government adopts the final version of the document.

The Law on Excises, which came into force on January 1, 2020, is largely in line with EU directives related to excise issues. The Law on Excises taxes goods that are subject to excise, including energy and electricity. When prescribing the amount and calculation of the excise tax, it takes EU directives and best practices in EU member states into account, as well as the economic and social aspects in North Macedonia. The new Law on Excises does not subject passenger cars to excise tax, and therefore a new Law on Motor Vehicle Tax was adopted that also entered into force on January 1, 2020. This law represents a kind of reform, as it prescribes a new legal solution according to which the calculation of motor vehicle tax includes an environmental component. This component aims to encourage the use of vehicles with lower CO_2 emissions, which will contribute to renewal of the vehicle fleet in North Macedonia and reduce air pollution. The Law on Motor Vehicle Tax also takes the recommendations of the EU into account regarding the return of motor vehicles in order to reduce CO_2 emissions. With the adoption of the Law on Motor Vehicle Tax, all bylaws that arose as an obligation for successful implementation of the Law were adopted simultaneously. Pursuant to Article 6 paragraph (3) of the Law on Motor Vehicle Tax, the following motor vehicles are not subject to taxation under the motor vehicle tax:

- Electric vehicles under tariff code 8703 80;
- Motorcycles and scooters with electric motors only under tariff code 8711 60 and;
- Tricycles and quadricycles electric motors only regardless of their tariff designation in the Customs Tariff Nomenclature.

In addition, the tax on "plug-in" hybrid electric passenger vehicles that fall under tariff codes 8703 60 and 8703 70 is calculated at a rate that 50% lower than the standard motor vehicle tax rate.

The endeavour towards climate action and commitment to the 2030 Agenda for Sustainable Development is also demonstrated through the national reform agenda that focuses on key development objectives targeting all citizens. In line with these objectives, the National Council for Sustainable Development has identified SDG 1: no poverty, SDG4: quality education, SDG8: decent work an economic growth, SDG 13: climate action and SDG16: peace, justice and strong institutions as five priority goals for the period 2018-2020. A 2019 Rapid Integrated Assessment of the alignment of the national policy framework with the Sustainable Development Goals (SDGs) indicated a level of alignment of 83 percent, showing that the Republic of North Macedonia's existing policy framework addresses key aspects of sustainable development.

The **legal framework on climate change** currently is incorporated into the Law on Environment which currently regulates the monitoring of anthropogenic GHG emissions by sources and sinks and details requirements for the development of national GHG inventories. Article 187 refers to the National Plan for Climate Change mitigation, and Article 188 refers to the National Inventory of GHG Emissions. The Law on Climate Action, which is under development[3] and is to be completed in 2020, is expected to fully transpose EU climate legislation, enabling low-carbon development and climate change resilience.

Regarding the adjustment of the national legal framework for climate change to the United Nations Framework Convention on Climate Change, the Republic of North Macedonia has adopted the following laws:

- Law on Ratification of the United Nations Framework Convention on Climate Change (Official Gazette of the Republic of Macedonia No. 61/97)
- Law on Ratification of the Kyoto Protocol to the United Nations Framework Convention on Climate Change (Official Gazette of the Republic of Macedonia No. 49/2004)
- Law on Ratification of the Paris Agreement (Official Gazette of the Republic of Macedonia No. 161/2017)
- Law on Ratification of the Doha Amendment to the Kyoto Protocol to the United Nations Framework Convention on Climate Change (Official Gazette of the Republic of Macedonia No. 152/2019 dated 25.07.2019)
- Law on Ratification of the Kigali Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (Official Gazette of RSM No. 34/2020)

Different aspects of climate change are integrated to varying degrees into **sectoral laws** on national level:

- Climate change and energy
  - Energy Law (2018) (Official Gazette of the RM no. 96, 28.5.2018)
- Climate change and energy balances
  - Rulebook on energy balances and energy statistics
- Climate change and energy markets
  - Rulebook on the manner and procedure for monitoring the functioning of energy markets
- Climate change and energy efficiency
  - Law on Energy Efficiency (2020) (Official Gazette of the RNM no. 32, 10.2.2020)
  - Rulebook on Marking Energy Consumption and Other Resources for Energy Products (2016)
- Climate change and renewable energy
  - Rulebook on Renewable Energy Sources (2019) (Official Gazette of the RNM no. 112, 3.6.2019)
  - Decree on the measures for support of the electricity generation from renewable energy sources (2019) (Official Gazette of the RM no. 29, 5.2.2019)
  - Decision on the total installed capacity of the preferential producers of electricity (2019) (Official Gazette of the RM no. 29, 5.2.2019)
  - Decision on the national mandatory goals for the share of energy generated from renewable sources in the gross final energy consumption and for the share of energy generated from renewable sources in the final energy consumption in transport (2019) (Official Gazette of the RM no. 29, 5.2.2019)
- Climate change and waste
  - Law on Waste Management (Consultation document 2020)
- Climate change and transportation
  - Law on Vehicles (2016) (Official Gazette of the RM no. 140/08, 53/11, 123/12, 70/13, 164/13, 138/14, 154/15, 192/15, 39/16)
  - Law on Motor Vehicle Tax (2019) (Official Gazette of the RNM no. 261/2019)
  - Law on Excises (Official Gazette of the RNM no. 108/19, 143/19, 225/19 and 275/19)

[3] The development of a Law and Strategy on Climate Change project is under the EU Instrument for Pre-Accession Assistance (IPA II) funding mechanism.

- Climate change and spatial planning
  - Law on Urban Planning (2020) (Official Gazette of the RNM no. 32/2020)
- Climate Change and water
  - Law on Waters (Official Gazette of the RNM no. 87/08, 06/09, 161/09, 83/10, 51/11, 44/12, 23/13, 163/13, 52/16)
- Climate Change and environment/nature
  - Law on ratification on Convention on biological diversity (Official Gazette of the RNM no. 54/97)
  - Law on Nature protection (Official Gazette of the RNM no. 67/04, 14/06, 84/07, 35/10, 47/11, 148/11, 59/12, 13/13, 163/13, 63/16)
  - Law on ratification on Bonn Convention on migratory wild species (Official Gazette of the RNM no.38/99)
  - Law on ratification on Bern Convention on the conservation on European wildlife and natural habitats (Official Gazette of the RNM no. 49/97).

The **strategic framework for climate change** at the national level includes strategic documents, national action plans and programs that contain aspects related to climate change:

- Climate change and climate action
  - Long-term Strategy on Climate Action (under development, it is expected to be completed in 2020), serving as a key milestone on the path towards sustainable development in general, and in particular towards a sustainable energy transition
- Climate change and energy
  - National Energy and Climate Plan (under development, it is expected to be completed in 2020)
  - The Strategy for Energy Development in RNM until 2040 (2019) (Official Gazette of the RNM no. 25/20, 05.02.2020)
- Adaptation
  - National Climate Change Adaptation Plan (GCF project proposal under development, supported by UNDP)
  - National Strategy for Nature Protection 2017-2027
  - National Biodiversity Strategy and Action Plan 2018-2023
- Climate change and energy poverty
  - Program for protection of vulnerable energy consumers for year 2020 (Official Gazette of the RNM no. 13, 17.01.2020)
- Climate change and energy balances
  - Statistical research program for the period of 2018-2022
- Climate change and energy efficiency
  - The Third Energy Efficiency Action Plan (EEAP) of the Republic of Macedonia (2016-2018)
- Climate change and renewable energy
  - Program for financial support for generation of electricity from preferential producers who use premium for 2019 (2019)
- Climate change and waste
  - National Waste Management Plan of the Republic of Macedonia 2020 - 2026 (Draft Consultation Document)
- Climate change and transportation
  - National Transport Strategy 2018-2030 (2018)
- Climate change and agriculture
  - National Strategy for Agriculture and Rural Development for the period 2014-2020 (2014)
  - National Program for Agricultural Development and Rural Development for the period 2018-2022 (2018)
- Climate change and green jobs

- Based on the conclusions of the 59th Session of the Government of RSM for development of youth policies, a working group has been established to connect the "green" jobs with youth unemployment. Promotion of green jobs inserted in the *Strategic Plan of the MoEPP for the period 2020-2022*
    - The potential of creation of green new jobs according to the analysis in the Climate Change Scenarios (TBUR) (2020)
- Climate change and air
    - National Ambient Air Protection Plan in the Republic of Macedonia (2012)
    - Clean Air Plan - reduce air pollution. Government Strategic Program (2019)
- Climate change and gender equality
    - Draft Action Plan for integrating gender aspects responsiveness in the preparation of the 4th National Communication/ 3rd Biennial Update Report
- Climate change and health
    - Action Plan for Prevention of Harmful Impacts and Consequences of Cold Weather and Cold Waves on the Health of the Population in the Republic of Macedonia (2012)
    - Action plan for prevention of the consequences of heat waves on the health of the population in the Republic of Macedonia (2011)
- Agenda 2030 and Sustainable Development Goals
    - Voluntary National Review (2020)

Policies, laws and strategies currently under development, mainstreaming climate change into:

- Climate Action - Long-term Strategy on Climate Action and Action Plan, as well as Law on Climate Action and two bylaws;
- Adaptation - GCF project proposal for National Climate Change Adaptation Plan;
- Energy - Development of the National Energy and Climate Action Plan (NECP);
- Waste - Waste Managing Plans and Law on Waste Management;
- Gender - Gender Equality Strategy and the Law on Gender Equality;
- Spatial Planning - Spatial Plan 2021-2040 and the Law on Spatial planning.

2.4 Climate Change Reporting

The country has submitted three National Communications to the UNFCCC (in 2003, 2008 and 2014) and two Biennial Update Reports (2015 and 2017). All National Communications, the FBUR, SBUR, background reports contributing to this TBUR, and other key climate-related documents are available publicly at the national Climate Change platform www.klimatskipromeni.mk.

As part of the Bonn Conference in June 2019, at the workshop for the facilitative sharing of views, the Republic of North Macedonia presented its Second Biennial Report on Climate Change. The presentation included comprehensive assessments of the impact of current, planned and potential greenhouse gas mitigation measures put into three different scenarios that the country could implement. The Climate Change Mitigation Component and the corresponding Action Plan of the Macedonian Second Biennial Report form the basis for an ambitious national policy that will enable low carbon and sustainable growth and development while ensuring proper implementation and monitoring. The document was rated as excellent by the EU member states. The technical analysis process of the SBUR identified 17 capacity building needs (outlined in chapter 5) that are intended to facilitate reporting in accordance with UNFCCC reporting guidelines for the preparation of biennial climate change reports.

The country has signed and ratified the Paris Agreement (2018) and submitted its initial Nationally Determined Contributions on Climate Change (NDC) in 2015 (Decision of the Government No. 42-17/91). The enhanced NDC is under development within the UNDP' Climate Promise initiative and is to be completed by the end of this year. The enhanced NDC (under development) will build upon the ambitious mitigation analyses of this 3rd BUR, in terms of de-risking and improving efficiency of implementation of the planned climate actions.

International institutions and donors, specifically the Global Environmental Facility (GEF) and the United Nations Development Programme (UNDP), have provided financial and technical support for this reporting process. It should be also noted that the Global Support Programme for National Communications and Biennial Update Reports (GSP), which is implemented for the GEF by UNDP and UNEP, has facilitated peer review of communications and reports, technical support for GHG inventories and other aspects of reporting, and technical support for initiatives designed to support gender mainstreaming in climate change reporting and programming.

The current project-based cycle for reporting, rather than a continuous process, makes it difficult to respond to emerging requirements. Transitioning arrangements for data collection, analysis, and reporting from a project-based cycle to a continuous process are under implementation within the CBIT project, supported by GEF and UNDP. It is anticipated that the development of a continuous process for reporting will be undertaken as part of the development of the new Law and Strategy on Climate Action. In addition, another IPA II project is supporting the development of a National Environmental Information System which will develop the data flow for information into the national GHG Inventory. The overall aim of the NEIS (National Environmental Information System) is to maintain and improve the quality and availability of information required for environmental policy, in line with better regulation, while keeping the associated administrative burdens to a minimum both at the European and the National level.

The Republic of North Macedonia also submits GHG inventory reports to Eionet, the central data repository of the European Environment Agency, when new data become available through National Communications or BURs.[4] In 2016, the Ministerial Council of the Energy Community, of which the Republic of North Macedonia is a Contracting Party, adopted a non-binding recommendation to implement EU Regulation 525/2013 on monitoring, reporting, and assessment of GHG inventories and steps taken to address climate change. The recommendation involves providing an annual report to the Energy Community on anthropogenic GHG emissions (to be submitted by 15 January each year starting in 2019). Information provided to the Energy Community by the Republic of North Macedonia will simultaneously be provided to the UNFCCC.

Although the Republic of North Macedonia is a non-Annex I country to the UNFCCC, it is also a candidate country for European Union (EU) membership, and thus must adhere to EU Climate and Energy Policy, which actually assumes the commitments of Annex I countries. For this reason, the Republic of North Macedonia has made voluntary efforts to incorporate UNFCCC reporting principles that apply to Annex I parties to the greatest extent possible. This confirms the commitment of the Government to join the global efforts for addressing climate change by implementing activities for reducing the GHG emissions in order to limit the rise of global temperature to maximum 2˚C by the end of the century and to ensure low carbon growth and development.

[4] Data are available at the following link: http://cdr.eionet.europa.eu/mk/un/unfccc/

2.5 Climate Change and Gender-Related Policies and Frameworks

With support from the Global Support Programme an action plan for integrating gender aspects in the TBUR and FNC was developed (Draft Action Plan on Gender and Climate Change). The action plan outlines actions at various stages of the FNC and the TBUR. The list of activities from the Draft Action Plan for Gender Mainstreaming in Climate Change can be found in Annex 12. It foresees concrete steps by which, through increasing the knowledge and awareness of all relevant gender and climate change stakeholders and builds institutional capacity for specific actions in this area, both at policy and implementation level. The Ministry of Labor and Social Policy actively participates in and supports all these activities.

The TBUR made a huge step forward towards implementation of the Draft Action Plan on Gender and Climate Change. Namely, within the project a systematic approach was developed, encompassing all relevant levels of implementation, such as following:

1. Work Plan to strengthen the implementation of the Draft Action Plan on gender and Climate Change, with concrete activities and timeline developed;
2. A comprehensive analysis conducted on the inclusion of the gender perspective into the national climate change policies, aiming to assess all the points where actions are needed in order to strengthen the implementation of the Plan. It showcases analysis of the gender-based roles, needs, challenge and barriers of women and men in 5 sectors: Energy use in households, Transport, Green Jobs, Agriculture and ICT (information and computer technologies). The purpose of the analysis was
3. A qualitative analysis conducted in addition to the above-mentioned research, with a view to on the following:
   a. Gender and climate change intersection in the existing and planned national strategic and legal framework in both areas (gender and climate change)
   b. The degree of institutional (inter/intra) cooperation on gender mainstreaming in climate change planning processes.
4. Recommendations for strengthening the implementation of the Draft Action Plan on Gender and Climate Change developed and presented with all the relevant stakeholders at national level from the relevant institutions as well as with the members of the Parliament (a Public Debate with Parliamentary commission on Equal Opportunities on Women and Men)
5. A gender and climate change training toolkit has been developed that highlights the different needs and roles of women and men in mitigation/adaptation. It is designed for stakeholders working on climate change and gender equality issues at the administrative and decision-making level, and it can be used at the national and local levels.
6. A network of persons working in the field of gender equality and climate change at the administrative level has been established, comprising 319 representatives on both national and local level (61% women).

3 National GHG Inventory

3.1 Overview

The Republic of North Macedonia, as a Non-Annex I Party to the UNFCCC, has been developing an inventory of the anthropogenic emissions by sources and removals by sinks of GHGs emitted to or removed from the atmosphere since 2000 as a part of its National Communications on Climate Change and Biennial Update Reports. Up to now, three National Communications (2003, 2008 and 2014) and two Biennial Update Reports (2015 and 2018) have been delivered to the UNFCCC.

The first National GHG Inventory was developed under the First National Communication (FNC) for the period from 1990 – 1998 and under the Second National Communication (SNC), this period was revised and extended to cover the years 1999 – 2002. In the Third National Communication (TNC), the GHG inventory considered the timeframe 2003 – 2009. In these reports, the inventory was developed in accordance with the 1996 Revised IPCC Guidelines for National Greenhouse Gas Inventories and the 2000 IPCC Good Practice Guidance. In the First Biennial Update Report (FBUR), the inventory was compiled using the IPCC Inventory Software, in compliance with the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. The series was updated to consider the period 2010 – 2012 and additionally, the entire previous series of data from 1990 to 2009 were revised according to the requirements of the IPCC Inventory Software. The same approach was used in the Second Biennial Update Report (SBUR) and the emission trend was expanded by developing the GHG inventory for 2013 and 2014.

The inventory activities under the Third Biennial Update Report (TBUR) continue the work done in the previous BURs and include developing the GHG inventory for 2015 and 2016 in line with the IPCC 2006 Guidelines. The latest version of IPCC Inventory Software (version 2.54 – from July 6, 2017) is used in this process.

The inventory covers five main sectors: Energy, Industrial Processes and Product Use (IPPU), Agriculture, Forestry and Other Land Use (AFOLU) and Waste, disaggregated by categories and subcategories. It includes a database for the following GHGs: CO_2, CH_4, N_2O, PFCs and HFCs, as well as precursors and indirect emissions from: CO, NOx, NMVOC, SO_2 and NH_3. The emission of SF_6 is not estimated for the country due to unavailability of activity data.

Most of the activity data used for preparation of national inventory are taken from official national documents such as: statistical yearbooks, energy balances, sectoral reports and MAKSTAT database from the State Statistical Office (SSO), various strategies and reports from relevant institutions, such as Ministry of Environment and Physical Planning (MOEPP), Ministry of Agriculture, Forestry and Water Economy (MAFWE) etc. and various international databases such as UN projections for population and GDP and FAOstat.

The national inventory process (Figure 3-1) includes the following key players:

- **Ministry of Environment and Physical Planning**, responsible for supervising the national inventory process and reporting the emissions to UNFCCC and also for other international reporting;
- **GHG Inventory Development Team**, composed of MANU team and team and AFOLU team with experts from University of Ss. Cyril and Methodius (UKIM) - Institute of Agriculture, Hans Em Faculty of Forest Sciences, Landscape Architecture and Environmental Engineering, Faculty of Agricultural Sciences and Food;
- **Data Suppliers**, with State Statistical Office being the most important data source;

- **Verification Team,** which includes experts working on Quality Control, as well as experts working on Quality Assurance. The last is also ensured by multilayer structure involving CTA and GSP.

The preparation of the national GHG inventory is project based, supported by Global Environment Facility (GEF) and United Nations Development Programme (UNDP). The estimated emissions in the inventory are publicly available within the national climate change platform www.klimatskipromeni.mk, open data portal (data.gov.mk) and UNFCCC web site. Also, detailed Sectoral MRV schemes the relevant processes are being developed in the framework of 3rd BUR, including the inventory process.

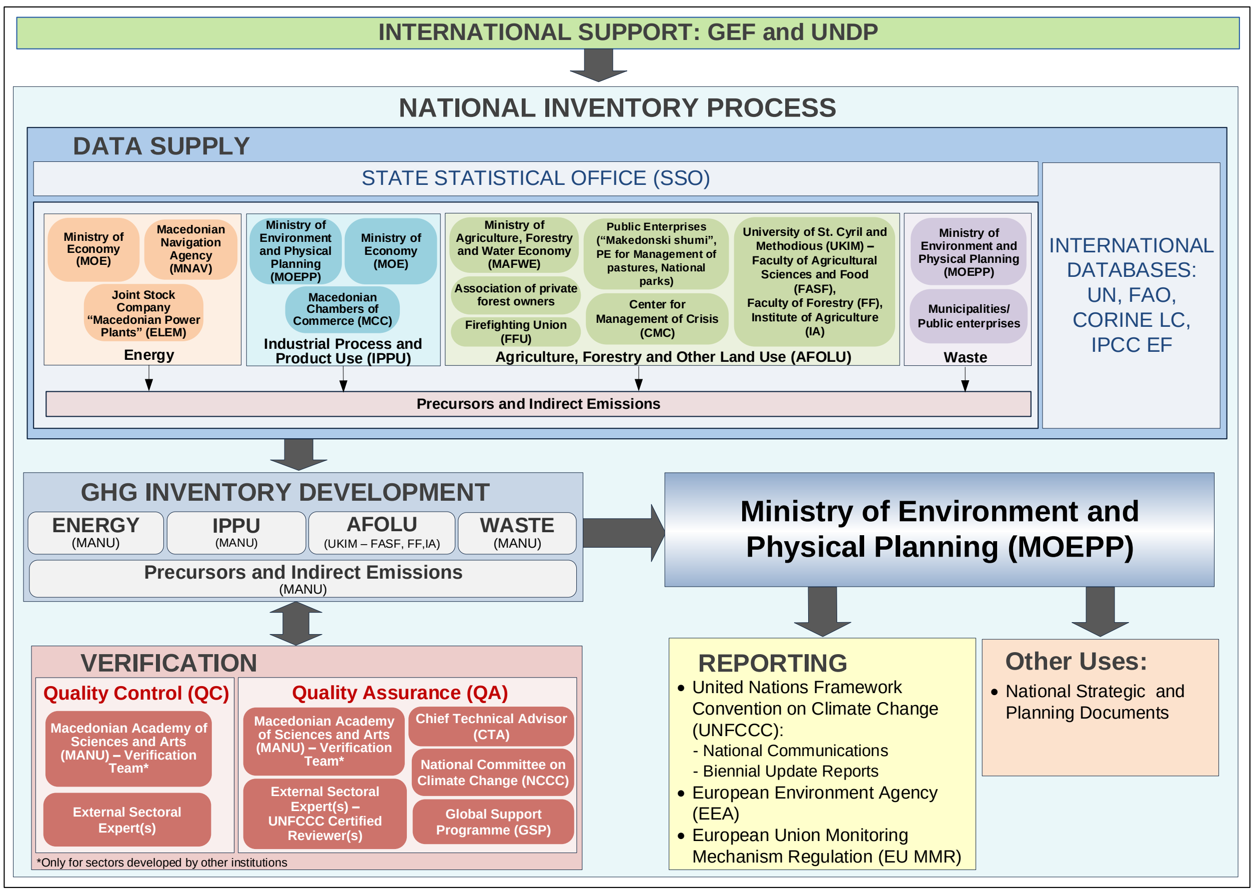

Figure 3-1: National Inventory Process

The uncertainty analysis is again conducted using **both methods**, Approach 1 (Error Propagation method) and Approach 2 (which is actually an implementation of the Monte Carlo method), for **each sector** of the inventory for 2014, 2015 and 2016. IPCC software was used for the first approach, while for the second one, the MATLAB model developed in SBUR was applied.

The Macedonian approach towards **QA/QC activities** and the **QA/QC plan** is elaborated in chapter 3.9.

Training materials on GHG inventory preparation developed by the GHG inventory team. These materials are country-specific and based on personal experience gathered and lessons learned during the GHG inventory preparation in Macedonian conditions, would provide clear guidance for newcomers in the process.

In chapter 3.10 this report also outlines by sector the **good practices, improvements and recommendations for future inventories**, regarding activity data collection, level of disaggregation, consistency and quality of the activity data, as well as application of more sophisticated methods for emissions estimates.

The national GHG inventory development process incorporated well balanced gender team: 43% women and 57% men. Additional efforts have been made to integrate gender responsive considerations into the GHG inventory to the extent possible, following the national Action plan on gender and climate change and the UNDP Gender Responsive National Communications Toolkit. The results of the assessments indicate that at this time the GHG Inventory cannot reflect the gender dimension, due to the absence of official statistical gender disaggregated data in the analyzed sectors: Energy, Industrial Processes and Product Use (IPPU), Agriculture, Forestry and Other Land Use (AFOLU) and Waste, disaggregated by categories and subcategories on the percentage of female and male participation in the production of the GHG emissions (more details in Chapter 11 of the National Inventory Report).

The official statistical agencies are recommended to start collecting gender disaggregated data in the listed sectors.

3.2 GHG Inventory Summary

3.2.1 Key Categories

The analysis of **key categories** that contribute the most to the absolute level of national emissions and removals (level assessment) and to the trend of emissions and removals (trend assessment), is conducted using the Approach 1. According to this approach, key categories are identified using a pre-determined cumulative emissions threshold. Key categories are those that, when summed together in descending order of magnitude, add up to 95% of the total level/trend.

The **level assessment** is performed for 1990 as a base year and for 2016, as the latest year. The results in Gg CO_2-eq and percentages (up to 95%) for 2016 are depicted in Figure 3-2. Consequently, the top five categories with the highest values of Gg CO_2-eq (both emissions and removals) include:

- Energy Industries – Solid Fuels (27.4%) (Energy sector),
- Forest Land Remaining Forest Land (17.5%) (AFOLU sector),
- Road Transportation (16.6%) (Energy sector),
- Enteric Fermentation (5.3%) (from Livestock in AFOLU sector)
- Manufacturing Industries and Construction – Solid Fuels (4.1%) (Energy sector).

The Forest land category is relevant for sinks, while the other categories for GHG emissions. The level assessment of key categories in 1990 and 2016 in details is given in the related Inventory.

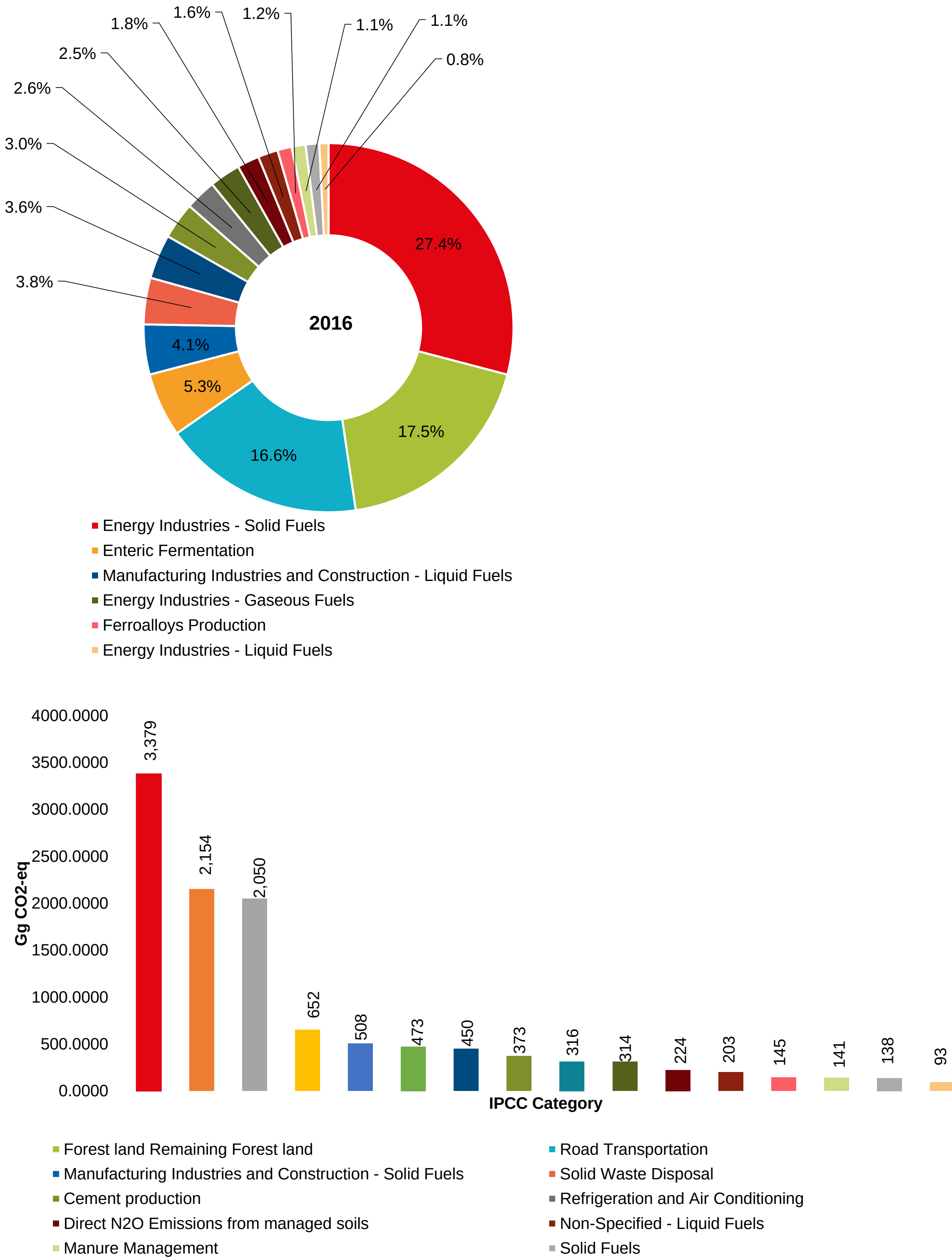

Figure 3-2: Level assessment of key categories and their contribution in 2016

The **trend assessment** of source categories is also executed, taking 1990 as base year and 2016 as latest inventory year. The purpose of this trend assessment is to emphasize the categories whose trend is significantly different from the trend of the overall inventory, regardless whether the category trend is increasing or decreasing, or is a sink or source. The results in percentages (up to 95%) presented on Figure 3-3 shows the contribution of key categories to the trend 1990, 2016 in percentage as follows:

- Forest Land Remaining Forest Land category (27.4%)
- Road Transportation (22.8%)
- Energy Industries-solid fuels (5%)
- Manufacturing Industries and Construction – Liquid Fuels (4.8%)
- Refrigeration and Air Conditioning with (4.6%)

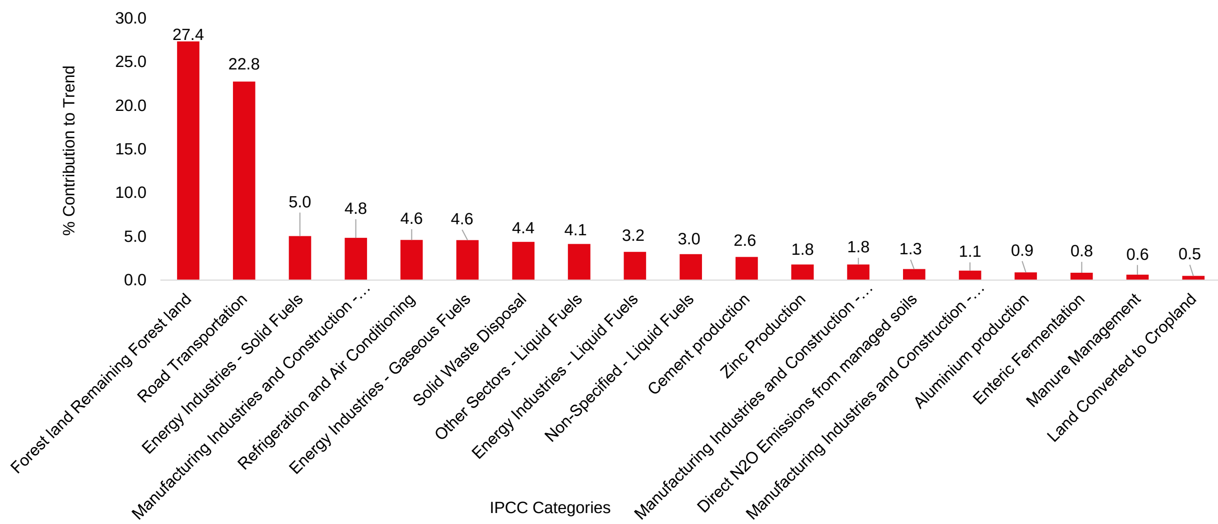

Figure 3-3: Contribution of key categories to the Trend (1990, 2016) in percentages

3.2.2 Aggregate GHG Emissions and Removals

The aggregate GHG emissions and removals (net emissions) in 2016 are estimated at 8,020 Gg CO_2-eq (including the FOLU sector) Table 3-1 and Figure 3-4 shows the time–series of emissions and removals, (in CO_2-eq), from 1990 to 2016. There are significant fluctuations in the net emissions in 2000, 2007 and 2012, where increased emissions can be noticed in the FOLU sector (instead of removals) as a result of the intensified forest fires/wildfires. The GHG emissions in 2016 are reduced by 34.6% compared to 1990. This is mainly result of reduced electricity production from lignite, fuels switch (residual fuel oil for electricity and heat production is replaced with natural gas), and lower industrial production, which is decreasing after 2012.

Table 3-1: GHG emissions and removals by sector (in Gg CO_2-eq)

Sector	1990	2000	2005	2014	2015	2016
Energy	9,648.9	9,757.9	9,251.1	8,051.3	7,701.3	7,449.3
Industrial Processes and Product Use	932.2	888.4	861.7	886.2	790.5	858.0
Agriculture (without FOLU)	1,490.4	1,249.6	1,204.1	1,131.5	1,159.4	1,193.2

FOLU	-207.0[5]	10,441.4	-1,522.1	-3597.4	-1,625.4	-2,090.1
Waste	406.7	412.7	435.2	574.3	596.7	610.2
Total (incl. FOLU) – Net emissions	**12,271.2**	**22,749.9**	**10,230.0**	**7,045.9**	**8,622.6**	**8,020.6**
Total (excl. FOLU)	**12,478.2**	**12,308.6**	**11,752.1**	**10,643.3**	**10,247.9**	**10,110.8**

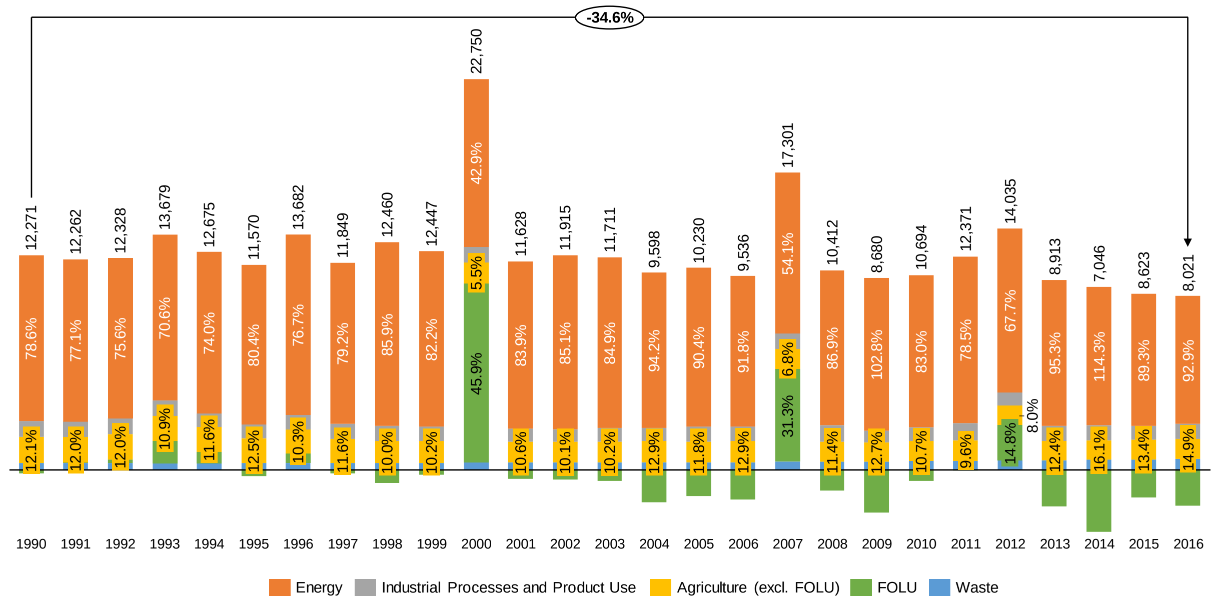

Figure 3-4: GHG emissions and removals by sector (in Gg CO2-eq)

If the removals from FOLU sector are not accounted for, then the total GHG emissions in 2016 are 10,111 Gg CO_2-eq (Figure 3-5). The greatest share of emissions is from the Energy sector, accounting for 73.7% in 2016, followed by the Agriculture (excluding FOLU) with 11.8% and IPPU sector with 8.5% and Waste sector with 6% share. The dominant share of emissions for the Energy sector is evident throughout the whole time series. Excluding FOLU, the emissions in 2016 are reduced by 19% competed to 1990.

[5] The value for 1990 does not include the emissions/sinks from land use changes that are reported in the AFOLU chapter.

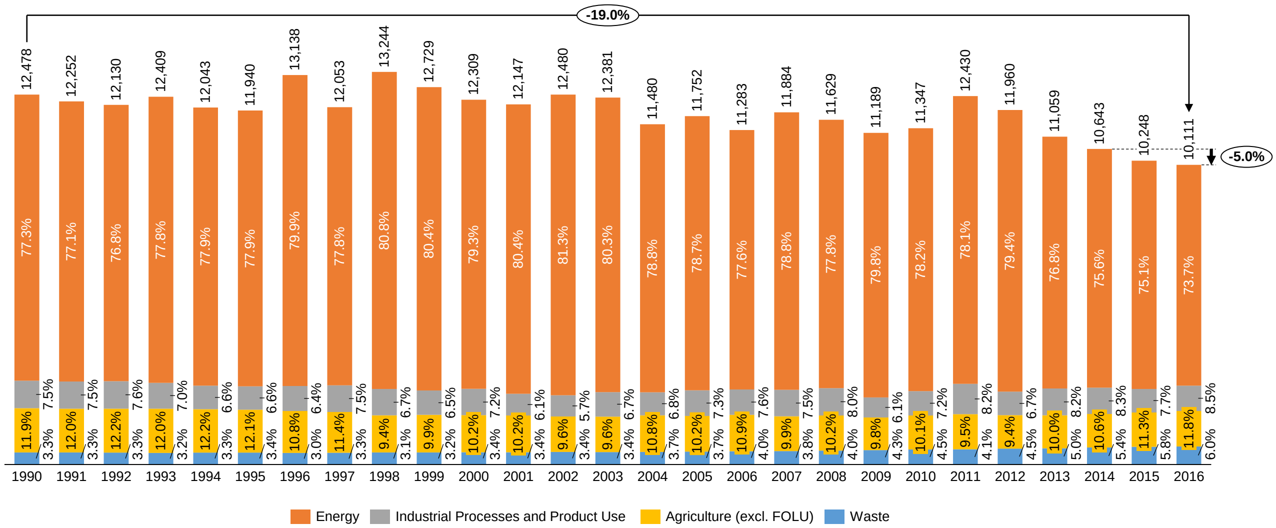

Figure 3-5: Total GHG emissions by sector, excluding FOLU sector (in Gg CO_2-eq)

Analysing the GHG emissions by gas (excluding FOLU sector), it is evident that across the series the most dominant are the CO_2 emissions (Table 3-2 and Figure 3-6). Their share accounts for 76.5% in 2016, followed by the CH_4 emissions with 15.7%, then N_2O emissions with 4.7% and all F-gasses with 3.1%.

Table 3-2: GHG emissions by gas (in CO_2-eq)

Gas	1990	2000	2005	2014	2015	2016
CO_2 (incl. FOLU)	9978.1	20697.0	8171.2	4825.0	6355.9	5641.0
CO_2 (excl. FOLU)	10185.1	10255.6	9693.3	8422.3	7981.3	7731.1
CH_4	1740.3	1571.1	1509.4	1563.3	1595.2	1588.3
N_2O	461.1	414.2	446.2	451.0	452.4	475.6
HFCs	0.0	4.8	102.8	206.6	219.1	315.7
PFCs	91.7	62.9	0.3	0.0	0.0	0.0
SF_6	0.0	0.0	0.0	0.0	0.0	0.0
Total (incl. FOLU) - Net emissions	**12271.2**	**22749.9**	**10230.0**	**7045.9**	**8622.6**	**8020.6**
Total (excl. FOLU)	**12478.2**	**12308.6**	**11752.1**	**10643.3**	**10247.9**	**10110.8**

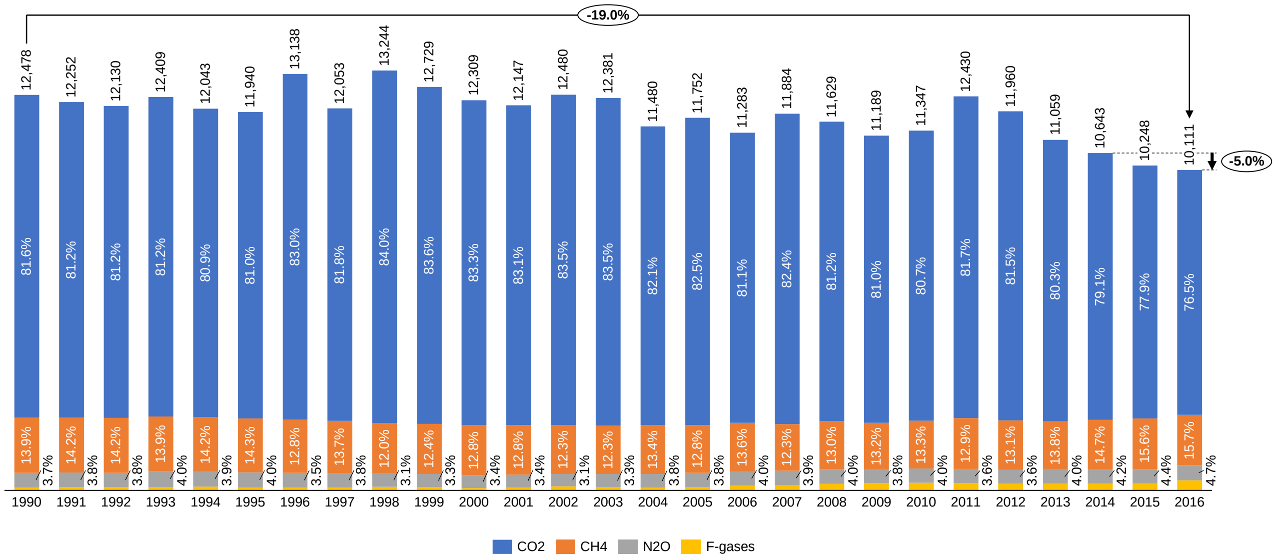

Figure 3-6: Total GHG emissions by gas, excluding FOLU (in Gg CO2-eq)

In spite of the small share of the F-gases in the total emissions, only HFCs and PFCs are reported in the inventory. SF_6 is not estimated for the Republic of North Macedonia due to unavailability of activity data. As can be seen in Figure 3-7, the emissions of HFCs start in the year 2000 with some fluctuations over the time-series, depending on the activities in the IPPU sector achieving 316 Gg CO_2-eq in 2016, while the emissions of the PFCs are considerably decreasing after 2003. The significant growth in import of gases (blends) used for refrigeration and air-conditioning results with increase of HFCs emissions in 2016 compared to 2015.

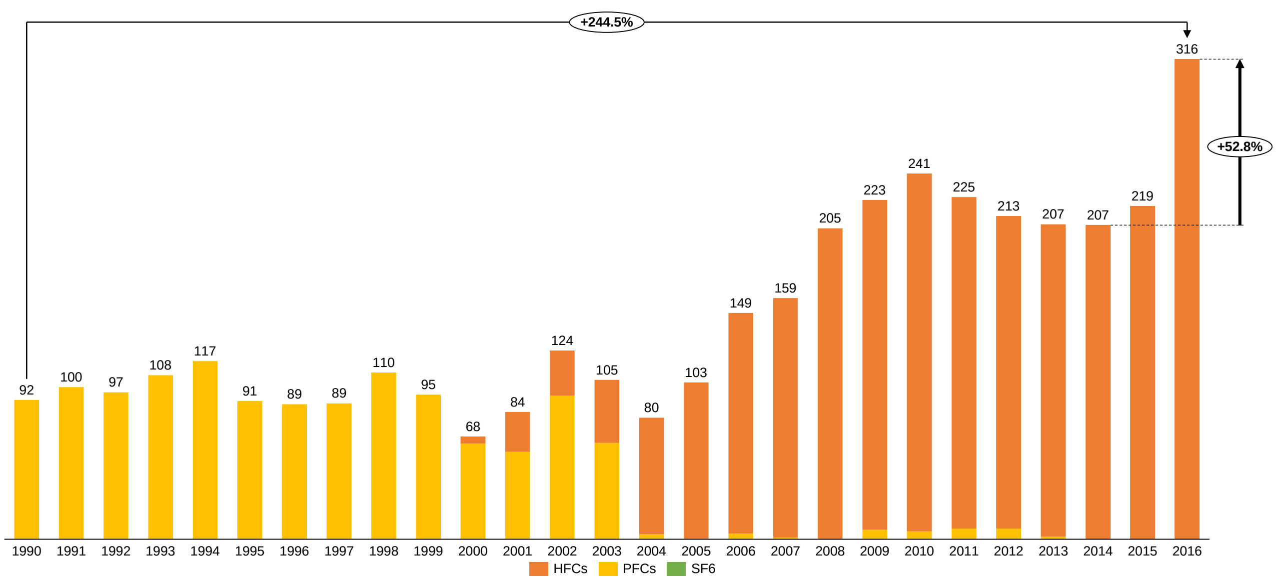

Figure 3-7: Emissions of F-gasses (in Gg CO2-eq)

3.3 Energy

The GHG inventory in the Energy sector accounts for the emissions released as a result of fuel combustion activities, as well as the fugitive emissions from extraction of solid and transmission and distribution of liquid and gaseous fuels. Emissions in this report have been calculated by using two methods: 1) the Reference approach (top-down), which uses the apparent fuel consumption to account for the carbon flows into and out of the country; and 2) the Sectoral approach, which accounts for fuel consumption by sector. The summary tables for GHG emissions in the Energy sector have been estimated using the Sectoral approach.

The entire Energy sector emissions by category can be observed in Figure 3-8 and summarized in Table 3-3. A decreasing emission trend can be seen due to reduced electricity production from the Energy Industries, replaced mainly with electricity import. It is notable that overall, the emissions in 2016 have 7.5% lower values compared with the ones in 2014 and 22.8% lower compared with 1990.

Most of the GHG emissions in 2016 occur in the category Energy Industries (51.0%), followed by Transport (28.1%) and Manufacturing Industries and Construction (13.9%). The other two categories together account for 5% of the total emissions in 2016 and the remaining around 2% are Fugitive emissions from extraction of lignite, oil refining and transmission of natural gas.

Fugitive emissions originate from coal mining and handling within surface mines (mining and post-mining seam gas emissions), oil refining and natural gas venting. Direct GHG emissions arising from fugitive emissions from fuels are dominantly CH4 emissions, with lower share of CO2 emissions that were included in this BUR. The fugitive emissions contributed with 1.9% in the overall Energy sector emissions in 2016.

The contributions from the International Aviation are almost insignificant. Jet kerosine is used as fuel. The emissions have increased throughout the period 2014-2016 (27.8% more emission in 2016 compare to 2014).

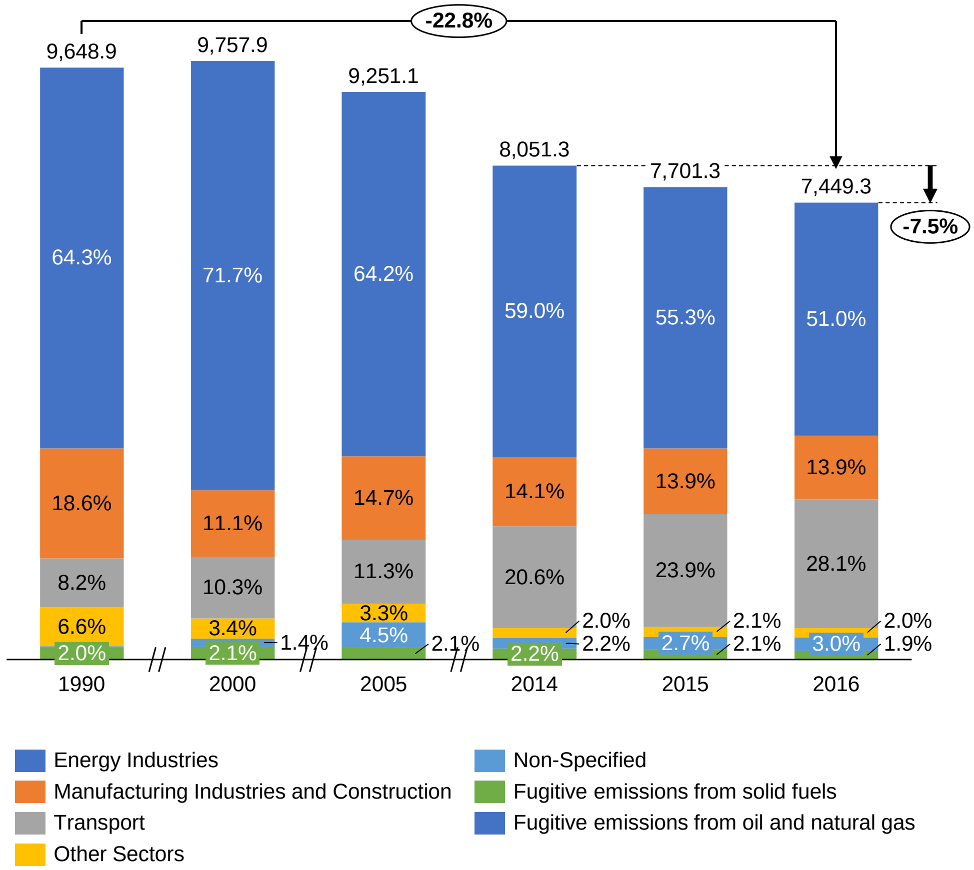

Figure 3-8: GHG emissions in Energy sector, by category (in Gg of CO2-eq)

In Table 3-3 concrete values of the GHG emissions in Energy sector, by category (in Gg CO_2-eq) are presented.

Table 3-3: GHG emissions in Energy sector, by category (in Gg CO2-eq)

Categories	1990	2000	2005	2014	2015	2016
Energy	**9648.9**	**9757.9**	**9251.1**	**8051.3**	**7701.3**	**7449.3**
Fuel Combustion Activities	**9455.5**	**9549.9**	**9060.6**	**7872.4**	**7537.4**	**7307.1**
Energy Industries	6205.3	6998.3	5940.5	4747.4	4260.6	3801.2
Manufacturing Industries and Construction	1796.5	1080.6	1356.2	1132.8	1067.1	1037.4
Transport	791.1	1006.5	1043.5	1656.4	1837.8	2096.7
Other Sectors	637.3	328.4	302.7	158.7	162.2	149.9
Non-Specified	25.4	136.1	417.8	177.2	209.6	222.0
Fugitive emissions from fuels	**193.3**	**208.0**	**190.5**	**178.9**	**163.9**	**142.2**
Solid Fuels	192.6	207.5	189.9	178.9	163.9	142.2
Oil and Natural Gas	0.7	0.5	0.6	0.0	0.0	0.0

The overall GHG emissions in Energy sector by gas (in Gg of CO_2-eq) for the reporting years, are given in Figure 3-9 notably, almost all of the GHG emissions in 2016 are actually CO_2 emissions (96.4%), and CH_4 and N_2O emissions amount to only 2.8% and 0.8%, respectively.

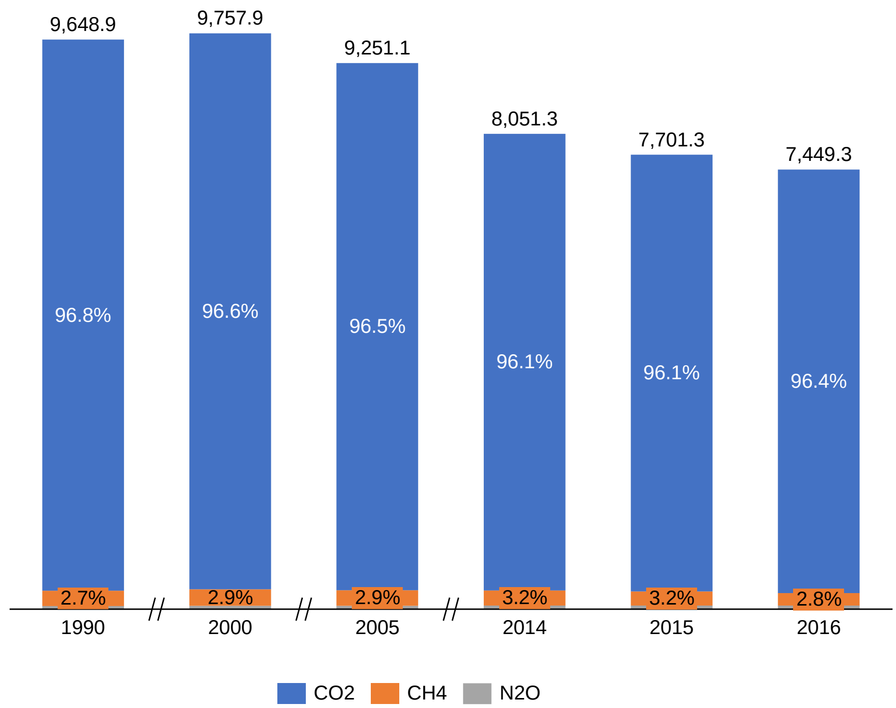

Figure 3-9: GHG emissions in Energy sector, by gas (in Gg of CO_2-eq)

3.3.1 Data Sources and Methodology for Energy Sector

The choice of Tier for each calculation of the GHG emissions from the Energy sector was determined by the accessibility of the corresponding national data. In this inventory report the following Tiers have been used:

- Tier 1: data on the amount of fuel combusted in the source category; default emissions factor
- Tier 2: data on the amount of fuel combusted in the source category; a country-specific emissions factor for the source category and fuel for CO_2 emissions

The CO_2 emissions from the combustion of lignite, residual fuel oil and natural gas have been calculated using the Tier 2 methodology. Due to lack of data on the carbon content of lignite since 2013 the country-specific emission factor of lignite calculated for 2012 was used to estimate the CO_2 emissions in this BUR as well for the years 2014, 2015 and 2016. Because the quality of natural gas is the same during the reported period, the national emission factor calculated in the FBUR is also applied in this report. The country specific emission factor has also been calculated for residual fuel oil, using the same data on carbon content and the Net Calorific Value (NCV) as in the previous BURs.

The State Statistical Office issues annual Energy balance reports with information on fuel consumption both in base units and also in kilotons of oil equivalent (ktoe). Included in the Energy balance are new NCV for biomass (calculated yearly) for fuels such as fuelwood. Furthermore, when compared to the FBUR, the Energy balances used for the SBUR and TBUR further disaggregate biomass fuel data sets. Disaggregated data sets now also include biomass by fuel type in the Energy balances issued since 2005. Included are the three following categories:

- Biomass
- Wood wastes, Wood briquettes and Pellets
- Wood of fruit trees and other plant residues

Regarding the fugitive emissions from fuels, specifically surface mines, the average CO_2 emission factor (0.44m^3 per tonne) from the 2019 Refinements to the 2006 IPCC Guidelines was taken in account, while for the CH_4 the factor remains the same as in the previous BURs.

In the previous reports (FBUR and SBUR) the total emissions from Manufacturing industries and construction for the period 1990 - 2004 were reported only under the category Non-specified Industries. In this report, using IEA data and SSO energy balances this is corrected, and the subcategory Non-Specified Industry is disaggregated by different subcategories, thus maintaining a consistency with the emissions reported from 2005 to 2016 in the inventory database.

In the previous reports (FBUR and SBUR), for the period 1990 – 2005 the category Other Sector also included the emissions under the subcategory Commercial/Institutional, while after 2005 these emissions were reported under the Non-specified subcategory (in accordance with the SSO energy balances). In this report, based on the IEA and SSO energy balances, the activity data for the period 1990 to 2005 are included within the Non-Specified instead of Commercial/Institutional subcategory. This was done in order to be compatible with the subcategories reported in the Energy Balances from the SSO, thus reporting a consistent time series of emissions for the period 1990 – 2016 under this category.

3.4 Industrial Processes and Product Use (IPPU)

Industrial production in the Republic of North Macedonia has slowed down after an economic transition period in the 1990s. Many industrial plants in the country have either lowered the volume of manufacturing or entirely shut down. However, several manufacturing industries, in particular cement and the use of ODS substitutes for refrigeration and air-conditioning that have continued have become the largest contributors of GHG emissions from the IPPU sector. The metal industry, which used to dominate industry sector emissions, is now the third-highest emitting subsector, with emissions from the production of steel and ferroalloys predominating. Only a small portion of emissions comes from the chemical industry sector, as there are no significant factories that produce chemicals.

Over the reported period, the emissions from this sector slightly changed, with a generally decreasing trend, however the different sub-categories have significantly changed. In 2016, the emissions from IPPU sector decreased by 8% relative to 1990, and 3.2% compared to 2014 (Figure 3-10 and Table 3-4). Overall, the IPPU emissions in 2016 were 850 Gg CO2-eq, which is 3.2% lower compared to 2014 or 8% lower compared to 1990.

Until 2000, the metal industry was the prevailing source of the emissions, mostly from the ferroalloy production. After 2000, when Ozone Depleting Substances (ODS) substitutes usage in the country started to increase, the share of the GHG emissions from the metal industry decreased considerably (from 64% in 1990 to 19% in 2016), while the emissions from the mineral industry have been fluctuating over the inventory period. In the last three reporting years the product uses as substitutes for ODS had grown around 50%, resulting with a share of almost 37% of the IPPU emissions in 2016. However, the dominant share in 2016 had changed to the mineral industry with 44%, while the share of the metal industry had reduced to 19%. Emissions from the other categories, like chemical industry, non-energy products from fuels and solvent use, electronics industry and other product manufacture and use do not occur in the country.

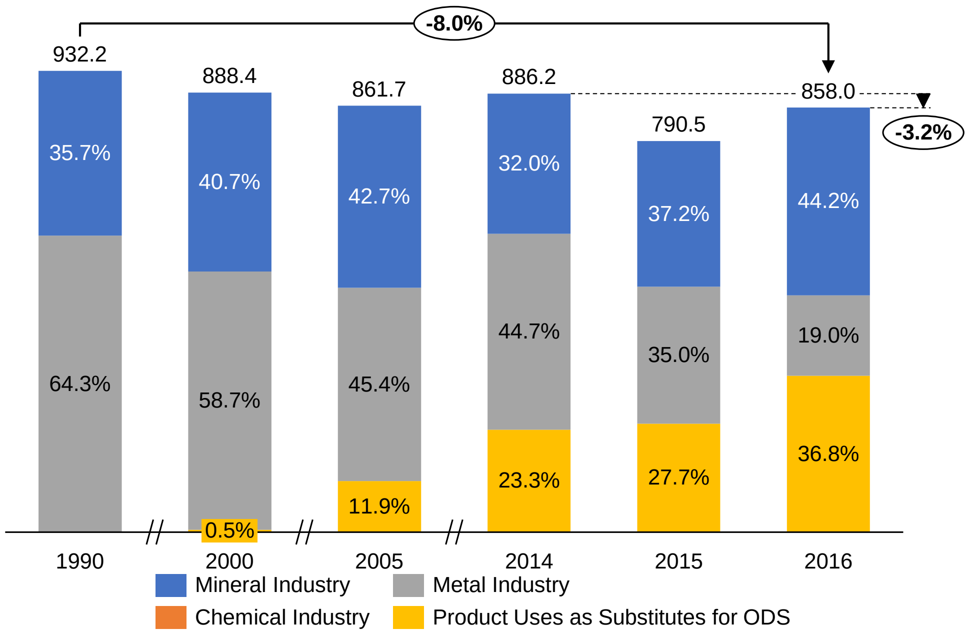

Figure 3-10: GHG emissions from the IPPU sector, by category (in Gg CO2-eq)

Table 3-4: GHG emissions from the IPPU sector, by category (in Gg CO2-eq)

Categories	1990	2000	2005	2014	2015	2016
Industrial Processes and Product Use	**932.2**	**888.4**	**758.5**	**886.2**	**790.5**	**858.0**
Mineral Industry	**333.1**	**361.8**	**368.1**	**283.2**	**294.4**	**379.4**
Cement production	293.8	348.8	355.3	275.7	288.6	372.9
Lime production	33.7	11.2	11.1	6.4	4.7	5.4
Glass Production	0.3	0.0	0.0	0.0	0.0	0.0
Other Process Uses of Carbonates	5.3	1.9	1.6	1.1	1.1	1.0
Ceramics	2.6	0.4	0.3	0.0	0.0	0.0
Other Uses of Soda Ash	2.7	1.4	1.3	1.1	1.0	1.0
Other	0.0	0.0	0.0	0.0	0.0	0.0
Chemical Industry	**NO**					
Metal Industry	**599.1**	**521.8**	**390.8**	**396.4**	**277.0**	**162.9**
Iron and Steel Production	24.7	15.2	58.2	17.0	11.0	15.3
Ferroalloys Production	265.6	196.4	332.2	379.4	264.6	145.3
Aluminium production	100.4	68.9	0.4	NO	NO	NO
Lead Production	22.1	23.0	NO	NO	1.4	2.3
Zinc Production	186.2	218.4	NO	NO	NO	NO
Non-Energy Products from Fuels and Solvent Use	**NA, NO**					
Electronics Industry	**NA, NO**					
Product Uses as Substitutes for ODS	**0.0**	**4.8**	**102.8**	**206.6**	**219.1**	**315.7**
Refrigeration and Air Conditioning	0.0	4.8	102.8	206.6	219.1	315.7
Refrigeration and Stationary Air Conditioning	0.0	4.8	102.8	206.6	219.1	315.7
Mobile Air Conditioning*	IE					

Foam Blowing Agents	NA, NE
Fire Protection	
Aerosols	
Solvents	
Other Applications	
Other Product Manufacture and Use	
Other	

Note: *Emissions from Refrigeration and Air Conditioning are calculated based on imported substitute of ODS and all are reported under Stationary Air Conditioning

NO - Not occurring, NA – Not Applicable, NE – Not Estimated, , IE – Included Elsewhere

The following trends were observed in the **Metal Industry** category:

- The trend of the CO_2 emissions from steel production had significant variations. The fluctuations can be partially described as consequences of financial crises that have occurred in the country and in the region, and for some years even globally. In 2012, the industrial installations in the country were obliged to buy electricity at the open market, therefore their production become highly dependent on the market price of the electricity, which had also reflection on the emissions from this industry. As a result, the emissions in 2016 from this industry were 38% lower compared to 1990, and 10% lower relative to 2014
- The trend of the GHG emissions from ferroalloy production is fluctuating over the observed period, mainly as a result of the financial crises (locally and globally). In 2016, the GHG emissions amount have decreased for 45% from 1990 level, and for 62% compared to 2014.

The following trends were observed in the **Mineral Industry** category:

- The emissions from the cement production were influenced by the volume of industrial activity and their fluctuation were observed over the inventory period. However, an increasing trend can be seen in the last three years, resulting with 35% higher emissions in 2016 relative to 2014.
- The emissions from lime production are influenced by the volume of industrial activity and are following generally decreasing trend over the inventory period. Thus, in 2016 the emission is 84% lower compared to 1990, and 14% lower compared to 2014.

The following trends were observed in the **Product uses as substitutes of ozone depleting substances** category:

- Hydrofluorocarbons (HFCs) and, to a very limited extent, perfluorocarbons (PFCs), are serving as alternatives to ozone depleting substances (ODS) being phased out under the Montreal Protocol. The HFC emissions from this sector followed an increasing trend in the reported years, reaching 317 CO_2-eq in 2016, or 53% more compared to 2014.

In terms of **emissions by type of GHG**, in 2016, the CO_2 emissions accounted for 63.1% of the overall greenhouse emissions from IPPU. The HFCs were second highest contributor and accounted for 36.8% of the total emissions. CH_4 emissions were negligible and accounted only for 0.1% of the greenhouse emissions from this sector. The emissions of SF_6 were not estimated due to unavailability of activity data. The emissions segregated by gas can be found in the National Inventory Report. The emissions segregated by gas are presented in Table 3-5 and Table 3-6

Table 3-5: CO_2, CH_4 and NO_x emissions from the IPPU sector, by category (in Gg CO_2-eq)

Categories	1990			2000			2005			2014			2015			2016		
	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
Industrial Processes and Product Use	**839.3**	**1.3**	**0.0**	**819.8**	**1.0**	**0.0**	**756.7**	**1.8**	**0.0**	**677.8**	**1.8**	**0.0**	**570.3**	**1.2**	**0.0**	**541.7**	**0.6**	**0.0**
Mineral Industry	333.1	NO	NO	361.8	NO	NO	368.1	NO	NO	283.2	NO	NO	294.4	NO	NO	379.4	NO	NO
Chemical Industry	NO, NA																	
Metal Industry	506.2	1.3	NO	457.9	1.0	NO	388.7	1.8	NO	394.6	1.8	NO	275.9	1.2	NO	162.3	0.6	NO
Non-Energy Products from Fuels and Solvent Use	NO, NA	NA		NO, NA	NA		NO, NA	NA		NO, NA	NA		NO, NA	NA		NO, NA	NA	
Electronics Industry	NA																	
Product Uses as Substitutes for ODS	NA																	
Other Product Manufacture and Use	NA																	
Other	NA																	

NO - Not occurring, NA – Not Applicable, NE – Not Estimated

Table 3-6: HFCs, PFCs and SF6 emissions from the IPPU sector, by category (in Gg CO2-eq)

Categories	1990			2000			2005			2014			2015			2016		
	HFCs	PFCs	SF_6	HFCs	PFCs	SF_6	HFCs	PFCs	SF_6	HFCs	PFCs	SF_6	HFCs	PFCs	SF_6	HFCs	PFCs	SF_6
Industrial Processes and Product Use	**NO**	**91.7**	**NO**	**4.8**	**62.9**	**NO**	**102.8**	**0.3**	**NO**	**206.6**	**NO**	**NO**	**219.1**	**NO**	**NO**	**315.7**	**NO**	**NO**
Mineral Industry	NA																	
Chemical Industry																		
Metal Industry	NO	91.7	NO	4.8	62.9	NO	102.8	0.3	NO	206.6	NO	NO	219.1	NO	NO	315.7	NO	NO
Non-Energy Products from Fuels and Solvent Use	NA																	
Electronics Industry	NA, NO		NE, NA	NA, NO		NE, NA	NA, NO		NE, NA	NA, NO		NE, NA	NA, NO		NE, NA	NA, NO		NE, NA
Product Uses as Substitutes for ODS	NO	NO	NO	4.8	NO	NO	102.8	NO	NO	206.6	NO	NO	219.1	NO	NO	315.7	NO	NO
Other Product Manufacture and Use	NA	NO, NA		NA	NO, NA		NA	NO, NA		NA	NO, NA		NA	NO, NA		NA	NO, NA	
Other	NA																	

NO - Not occurring, NA – Not Applicable, NE – Not Estimated

3.4.1 Data Sources and Methodology for IPPU

In the previous BURs, emissions were reported in the chemical industry, from soda ash production, but during the preparation of this report, all publications from the State Statistical office for the Industry sector were carefully scrutinized and it was concluded that there is only consumption of soda ash in the country (in the industry for production of basic chemical products and in the industry for processing of chemical products). Therefore, the data previously reported under soda ash production, is now reported as other uses of soda ash, under the subcategory other process uses of carbonates category in mineral industry.

In this BUR, some improvements have been made of the activity data for the cement production. Specifically, by taking into account the clinker production and the specific emission of CO2 (per tonne clinker) reported in annual reports from the factory “Titan-Usje”, the clinker fraction in cement was calculated for each year in the period 2007 – 2016, and for the previous years (1990 – 2006) the average value of these fractions was used., Also, the annual report for Industry from the SSO were used as a data source for the cement production.

The MOEPP has started to use Tier 2 approach for calculation of air pollutants from Iron and Steel Industry (for the separate processes) and during the preparation of this report only the data for 2016 and 2017 were available. Once MOEPP will have a consistent series of calculation for each of the Iron and steel processes from 1990 onward, the same activity data should be taken into consideration in the development of the future GHG inventories.

In this BUR a correction was made in the F-gases data used as input in the IPCC Software. Namely, for the Assumed lifetime of the equipment, the recommended value of 15 years was entered (according to the IPCC Guidelines), and for the Emission Factor from installed base the value of 15 % was used.

The data for preparation of the greenhouse gases inventory for the IPPU sector was generally collected from three main sources: the State Statistical Office, the Ministry of Environment and Physical Planning or directly from the industrial plants.

Study on Industry Analysis of Policies and Measures (STUIND)

Industry in Macedonia contributes 10% of GDP and is a significant employment sector (30% of the employees). On the other hand in the final energy consumption has a significant final energy demand (about 22% in 2018) and contributes to 17% of total GHG emissions in 2016. One of the main targets of the STUIND study was to propose measures for industrial production growth at reduced energy consumption, which will enable reduction of GHG and local emissions from this sector.

Other goals in this study are:

- to make an overview of the Industry in Macedonia and its role in the economy, the consumption of energy and in the GHG emissions (this is the first study that integrates all aspects),
- to propose more detailed measures to mitigate climate change,
- to determine the potential of each measure, as well as the potential for climate change mitigation when implementing all the measures together.

This study provides an overview of the Industry in Macedonia, its role in the economy, energy consumption and greenhouse gas emissions. From the analysis of the current situation, it can be concluded that:

- Industry accounted for about 10% of GDP in the period 2011-2017;
- Industry, which includes Construction (Other industries), contributes the most (49% in 2017) to the added value of the total Industry;
- From the total number of employees in Macedonia in 2018, about 30% are in the Industry, of which 36% are women;
- Industry participated with 22% in the final energy consumption (of which 44% are in the Iron and Steel Industry) in 2018;
- In general, there is an improvement in terms of energy intensity (the process of decoupling of the energy consumption from the industrial production index) for each of the industry branches;
- GHG emissions from the Industry in all three sectors accounted for about 16.7% (10.3% Energy, 5.4% IPPU and 1% Waste) in total GHG emissions in 2016.

Since most of the emissions are from the Industry in the Energy sector, this study proposes 7 measures that will increase energy efficiency and the participation of renewable sources for electricity production in the Industry. Additionally, a measure has been proposed in the Waste sector for improved waste management in the Industry. All measures are aimed at improving the productivity of the companies at reduced energy consumption and thus reduced emissions. If the proposed measures are implements, the results show that compared to the WOM scenario in 2040:

- The final energy consumption of the Industry will be reduced by 24% (which is about 4 percentage points more compared to the results of TBUR, due to the introduction and analysis of additional measures in this study, such as Insulation, Lighting and Steam systems);
- Total GHG emissions will be reduced by 10.6%;
- GHG emissions from the Waste sector will decrease by 1.9%;
- GHG emissions from the Energy sector will decrease by 13%;
- From the local emissions, SO_x will be reduced by 98%;
- 1,130 mill. EUR is needed to implement the proposed measures.

3.5 Agriculture, Forestry and Other Land Use (AFOLU)

Agriculture, Forestry, and Other Land Use (AFOLU) is unique among the sectors considering the numerous processes leading to emissions and removals of greenhouse gases, which can be widely dispersed in space and highly variable in time. The AFOLU Sector has some unique characteristics with respect to developing inventory methods. The factors governing emissions and removals can be both natural and anthropogenic (direct and indirect) and it can be difficult to clearly distinguish between causal factors. For the AFOLU Sector, anthropogenic greenhouse gas emissions and removals by sinks are defined as all those occurring on 'managed land'. Managed land is land where human interventions and practices have been applied to perform production, ecological or social functions.

The AFOLU sector is covering activates in Livestock production; Land use in particular Forestland, Cropland, Grassland, Wetland, Settlements and other land; Aggregate sources and non-CO2 emissions sources on land; and Other.

Emissions and removals in the **Land** category of the inventory are mainly the result of activities and changes in Forest Land (fuel wood, afforestation and forest fires, etc.) and conversion from one land use type of agricultural land to another.

Forests and forestland in the Republic of North Macedonia cover around 1.1 million ha and are characterized with great species diversity, but low quality and small annual growth. More than 70% of the forests are coppice, 90% are deciduous and almost 90% are state owned. The most dominant species is beech, and then various oak species. The total wood reserve is estimated at around 70 million m^3, and total annual growth is around 1.7 million m^3. Most land considered as forest is typically Mediterranean type forest, characterized by broadleaf and conifer, other small trees and bushes.

The forestry sector is the major contributor of GHG sinks in the Republic of North Macedonia within the Land subsector of AFOLU, with the exception of several years (2000, 2007, and 2012) when the amount of forest fires (burned areas) reduced sequestration rates significantly (GHG sinks) to the point where this sector was a net emitter. The area of forestland, the species composition (conifers, broadleaved, mixed), as well as the annual increment and removals from the forests are relatively stable. The estimated GHG sinks in this sector for 2015 was estimated to be 1,608.31 and in 2016 it was 2,120.65 Gg CO_2 eq.

Emissions from the forestry sector are a product of firewood consumption as well as the forest fires. The most constant producer of CO_2 emission are households that use firewood for heating. Forest fires are the second emitter of CO_2, but they are not constant, and their contribution varies greatly from year to year, depending on their number, and the area that they cover, as well as the species composition in burned areas.

Emissions from **cropland** have reduced significantly and are mainly a result to the conversions and changes in perennial plantations. Giving though that the converted areas, as previously explained, significantly differ among the reported years, in a range of over 12 thousand ha in year 2000, to only 155.1 ha in 2016, the quantities of emitted CO2 differ as well from more than 1620 Gg CO2-eq in 2000, to just 31.22 Gg, which is more reliable quantity than the former one.

The livestock sector is one of the main sources of GHG emissions with a total emissions of CO_2-eq varying in a range of 1,108.11 Gg in 1990, to only 792.68 Gg in 2014 (Figure 3-11). Cattle are the main source of GHG among the ruminants. The majority of methane emission is from enteric fermentation while manure management contributes only 18% of the total CH_4 emissions. In particular, dairy cows and other cattle are emitting the majority of GHGs. Sheep and goats (ruminants), horses, swine and poultry contribute significantly less to the sector's emissions. In 2015 and 2016, CH_4 emissions were around 775 Gg CO_2-eq.

Mainly CH_4 emissions are from enteric formation (82%), while manure management is contributing with 18%. The most CH_4 is produced by enteric fermentation and manure management in cattle (525 Gg CO_2-eq enteric and 100 Gg CO_2-eq manure) accounting for 80% of total methane emission form livestock. Enteric fermentation from all other species (sheep, goat, horses and swine) contributed about 15% in total CH_4 emission in the sector. The manure management in all those species contributes for only 5% to CH_4 emission from manure management.

N_2O emissions were solely due to manure management. The emissions in 2015-16 were 3.5 Gg CO_2-eq. The main emitters were again cattle manure with 78%, followed by sheep and swine manure contributing each with 7%. Similarly, to CH_4 emissions, dairy cows were the largest contributor with 57% of annual N_2O emissions generated in livestock sector.

Other land uses like cropland, grassland, settlements and other land, result in the net emissions of CO_2-eq, and in some years can be considered as a significant source of emissions of GHG. GHG emissions from this sector are mainly the result of the conversion from one category of land use to another, when significant amounts of above and below ground biomass is rapidly removed and is considered as a direct loss.

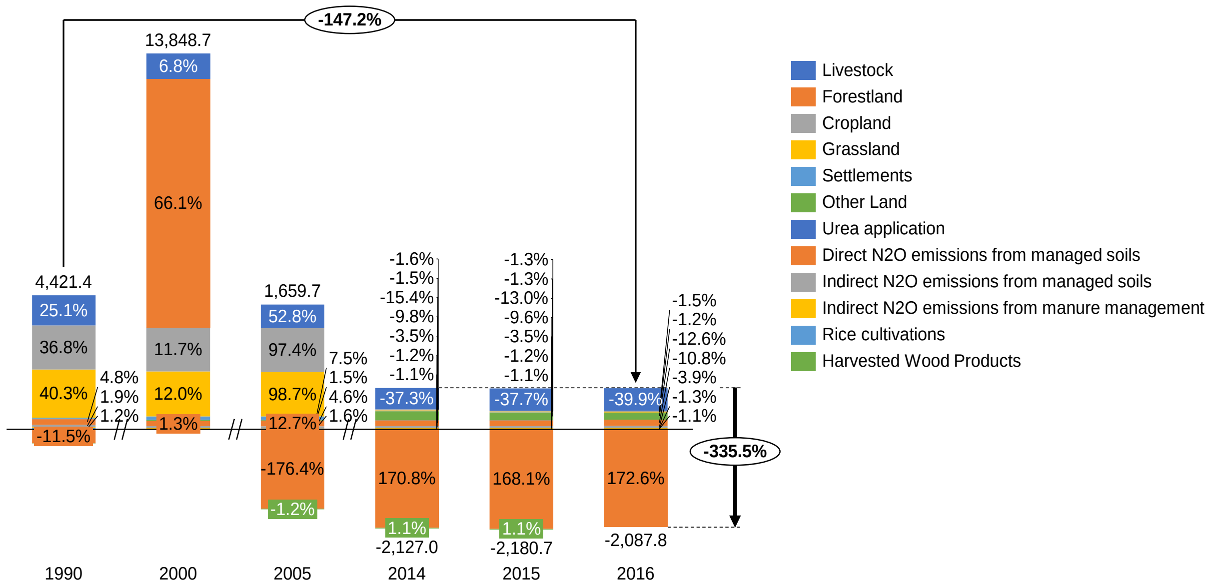

Figure 3-11: Figure GHG emissions (and removals) from AFOLU sector (in Gg CO2-eq)

Table 3-7: GHG emissions and removals from AFOLU sector, by category (in Gg CO2-eq)

	1990	2000	2005	2014	2015	2016
AFOLU	**4421,35**	**13848,73**	**1659,67**	**-2126,96**	**-2180,67**	**-2087,8**
Livestock	**1108.11**	**936.53**	**876.40**	**792.68**	**821.53**	**833.53**
Land	**2944,71**	**12613,02**	**476,22**	**-3234,23**	**-3316,34**	**-3281,12**

Forestland	-509,78	9160,32	-2927,68	-3632,75	-3666,64	-3603,62
Cropland	1627,44	1624,87	1616,19	34,76	28,84	31,22
Grassland	1780,39	1662,27	1638,68	32,25	27,94	25,80
Settlements	26,77	130,20	124,28	3,64	9,36	2,92
Other Land	19,88	35,35	24,76	327,87	284,16	262,57
Aggregate sources and non-CO_2 emissions sources on land	**382,27**	**313,11**	**327,73**	**338,78**	**337,41**	**359,78**
Urea application	3,74	9,09	1,28	3,67	3,51	3,19
Direct N_2O emissions from managed soils	211,96	183,67	210,79	209,33	208,37	224,45
Indirect N_2O emissions from managed soils	82,25	68,45	77,08	75,46	75,26	80,71
Indirect N_2O emissions from manure management	32,05	29,25	26,47	26,27	27,10	28,01
Rice cultivations	52,27	22,65	12,11	24,05	23,17	23,42
Other	**-13,73**	**-13,92**	**-20,69**	**-24,19**	**-23,27**	**/**
Harvested Wood Products	-13,73	-13,92	-20,69	-24,19	-23,27	/

3.5.1 Data Sources and Methodology for AFOLU

GHG emissions from **livestock** activities are consequence of their biological activity and manure management on the farms. However, there are differences in emissions in different species but also type of production, production system, level of productivity, farm specific management, and so on. National livestock production of cattle, sheep, goat and horses mostly is characterized with production systems with low to moderate intensity. However, some part of dairy cows, and the most of swine and poultry production systems are very intensive where emissions from manure management can be closely monitored. Although steps towards Tier 2 were done in SBUR, for 3rd BUR there is still insufficient data to describe various farms' profiles. However, as part of the UNDP-GEF project to support the TBUR and Fourth National Communication, support is being provided to strengthen the base for collecting data for livestock as part of the agricultural sector. As such, currently underway is a study to make assessments of the methodology of manure management at small dairy and pig farms in order to observe and assess in more detail greenhouse gases. Information obtained from these surveys will be included in the Fourth National Communication.

Emissions from **land use** were evaluated across forest land, cropland, grassland, wetland, settlements and other land. In an absence of national emission factors, the global emission factors were used, recommended within the IPCC manuals or various category of **land use.** The most important challenge is to develop country specific emission factors for various land use types. There is not any scientific/expert paper on determination of the GHG emission factors from various land use types in the country. The serious efforts and investment in research activities is required in order to develop country specific emission factors associated with different land use types.

In order to improve the quality and consistency of data for areas under **cropland,** in the TBUR Inventory Report additional data sources, like CORINE Land Cover (CLC), were used. In the SBUR, the digital data from CLC was used for calculation of areas under Cropland and were checked against the official state data; while for the period before 2000 (when CLC did not existed); SSO data were used for areas under Cropland.

In terms of emission factors for AFOLU, in an absence of national emission factors, the global one is used. This is a serious obstacle in accurate estimation of the emissions of GHG, since the emissions factors are the second crucial component in addition to the activity data, for estimation of emissions/removals, hence the use of global data, excludes any possibility for moving towards a higher Tier. Therefore, if the national priority is to implement higher Tier methodology in assessment of the GHG emissions in the crop production subsector, intensive investing in research related to determination of national emission factors is required.

3.6 Waste

The categories reported under the waste sector are solid waste disposal, biological treatment of solid waste, incineration and open burning of waste and wastewater treatment and discharge. The data categorization format is consistent with previous years in order to preserve the existing time series, except in sectors where data was introduced for the first time.

It is important to note that in the Second BUR (SBUR) the waste sector was the second largest source of GHG in the Republic of North Macedonia. In this inventory the recommendations from the SBUR were incorporated. Based on revisions the emissions from the waste category in this inventory are less than one quarter of the results from the SBUR. There are several factors which contributed to the large difference in the results. In the SBUR, for industrial waste the default waste generation rate IPCC factor was used. So far it has proven extremely difficult to distinguish data on waste production by industry type, so it was decided to use the data for total waste generated by the manufacturing industries. Having this in mind and following the IPCC 2006 guideline, the degradable organic carbon factor was revised and 15 was replaced with 1 (as instructed in Table 2.5 Chapter 2: Waste Generation, Composition and Management Data, IPCC 2006 guideline). Furthermore, based on SSO data more industrial sectors are introduced in the Industrial wastewater treatment and discharge sub-category. In addition, a revision of the overall time series was made. A domestic waste generation rate has been created using the latest data from the SSO. At the same time, based on the latest national waste management plans, revision of waste composition of municipal solid waste was made.

Based on new estimates, the calculations show that the waste sector is one of the sectors with an increasing trend of GHG emissions at 610 Gg CO2-eq in 2016, which is doubled compared to 1990 or 6.3% more compared to 2014. Out of all the sectors, the emission from solid waste disposal category are most significant with 77.5% of the total GHG emission in the waste sector in 2016 (Figure 3-12 and Table 3-8). Second category with significant amount of GHG emissions is wastewater treatment and discharge with around 19% in 2016. Incineration and open burning of waste category contribute with around 4% in the last three reported years.

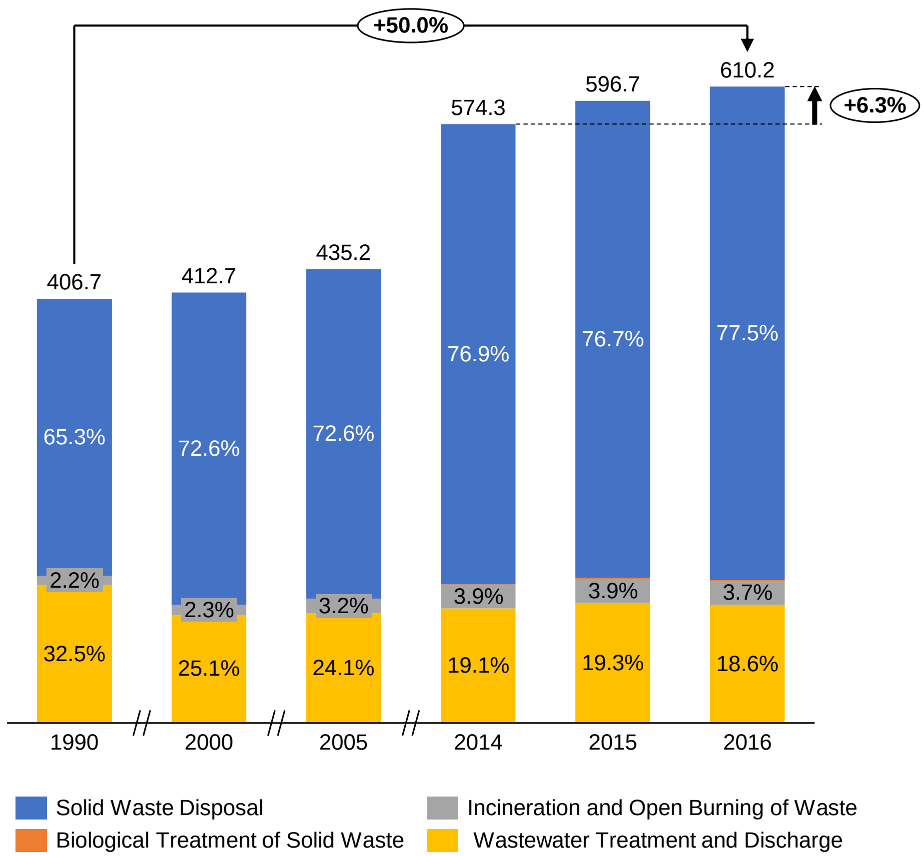

Figure 3-12: GHG emissions from Waste sector, by category (in Gg CO2-eq)

Table 3-8: GHG emissions from Waste sector, by category (Gg CO_2-eq)

	1990	2000	2005	2014	2015	2016
Waste	406.7	412.7	435.2	574.3	596.7	610.2
Solid Waste Disposal	265.6	299.4	316.0	441.4	457.4	473.2
Biological Treatment of Solid Waste	0.0	0.0	0.0	0.8	1.2	1.0
Incineration and Open Burning of Waste	8.8	9.6	14.1	22.2	23.0	22.7
Wastewater Treatment and Discharge	132.3	103.6	105.1	109.9	115.1	113.4

The CH_4 and N_2O emissions from the biological treatment of solid waste category do not contribute largely to the overall emissions due to the small amount of reported composted waste. Around 92% of the GHG emissions in the last three years of the reporting period are CH_4, while N_2O and CO_2 participates with 7.2%, 1% respectively Figure 3-13.

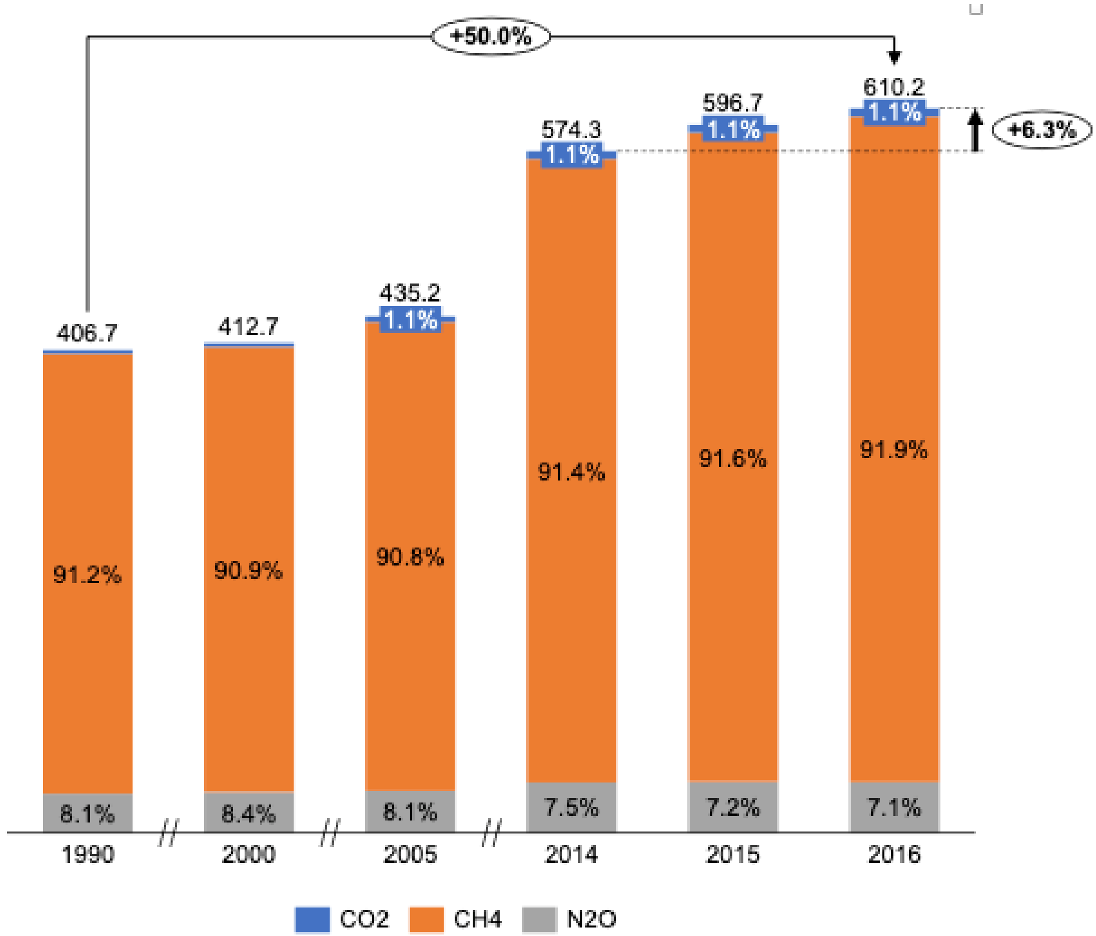

Figure 3-13: GHG emissions form Waste sector, by gas (in Gg CO2-eq)

3.6.1 Data Sources and Methodology for Waste Sector

In the inventory prepared in the 3rd BUR framework, the Solid Waste Disposal emissions are estimated in accordance with the IPCC 2006 Guidelines using the IPCC Inventory Software, which impose the First Order Decay (FOD) methodology. It produces a time-dependent emission profile that reflects the true pattern of the degradation process over time. Having in mind that solid waste disposal sites contribute the most to the sector's emissions, as well as the fact that country specific historic data on the amount of disposed waste are available, Tier 2 methodology has been used. Recent documentation reporting the amount of composted waste has made the relevant data available for the year 2011-2016. Because biological treatment of solid waste is not a widespread practice, country specific emission factors have not been assessed so far. Consequently, Tier 1 was applied for the estimation for the gases emitted from biological treatment of solid waste. Following the IPCC 2006 Guidelines, the Incineration and Open Burning of Waste and the Wastewater Treatment and Discharge are not found to be key sectors, thus, Tier 1 methodologies have also been applied for these sectors.

In regard to data sources, in the Solid Waste Disposal sector, the population and GDP data for the period 1990-2014 were revised as a part of SBUR inventory process. In this inventory the population and GDP for 2015 and 2016 were taken from the SSO annual reports.

The State Statistical Office has issued reports on Municipal Waste for the years 2014, 2015 and 2016. It contains information on quantities on generated, collected and waste disposed in waste disposal sites. The Ministry of Environment and Physical Planning releases annual reports on Quality of the Environment which include the amounts of composted waste. The industry product used as input in the category Industrial Wastewater Treatment and Discharge was obtained from the State Statistical Office Yearbook. All other data was used from the IPCC 2006 Guidelines.

In regard to municipal solid waste, in order to calculate the total municipal solid waste that was created in each year, the time series on population data has been updated for the years 2015 and 2016. Having in mind that in SWDS there is a category Uncategorized SWDS (in the IPCC software), which according to national methodology is a dump site, a recalculation of the overall time series was made, and it was found that from the total MSW, 90% is going to SWDS, including the Uncategorized SWDS. The remaining 10% of waste is reported in the category Open Burning of Waste. In addition, starting from 2006, annual share of different category of SWDS is made, based on the SSO data. The results show that the CO_2-eq emissions from solid waste disposal have been constantly rising achieving 473 CO_2-eq in 2016 compared to 1990 CO_2-eq emissions in 2016 are 78% higher, while compare to 2014 around 7%. Municipal solid waste participates with around 90% over the reporting period.

The existence of composting facilities has been acknowledged in the past, but it is only recently that data on the amount of composted waste has been reported. As no country-specific emission factors exist, default values have been used.

The GHG emissions from industrial wastewater treatment and discharge have been estimated using the industrial production data. The recommendations from the SBUR were incorporated, so based on SSO data more industrial sectors are introduced in the Industrial wastewater treatment and discharge sub-category. In addition, because of the inconsistence of the data for the reporting period, a revision of the overall time series was made.

3.7 Precursors and Indirect Emissions

In the SBUR, **Precursors and indirect emissions** of NOx, CO, NMVOC and SO2 were estimated for the period 1990 – 2014 in line with the EMEP/CORINAIR Emission Inventory Guidebook (referenced in the IPCC 2006 Guidelines) in a consistent, complete and comparable manner for the entire inventory period of 1990 – 2014. In this BUR, the emission for 2015 and 2016 year have been estimated, in line with the methodology in the latest EMEP/EEA air pollutant emission inventory guidebook, 2019. In addition, review and recalculation for come categories for the period 1990-2014 is done. Also, the NH3 emissions have been included, where applicable.

The results for precursors and indirect emissions show that they are reduced by 18.5% and 10.5% in 2016 compared to 1990 and 2014 respectively (Figure 3-14). At average the emissions are around 200 Gg/year, but there are peaks in 2000, 2007, 2008, 2011 and 2012 mainly as a results of forest fires. The highest numbers are estimated for 2000, 357 Gg. SO2 participates with around 50% over the entry reporting period, but in the last five years it shares is below 40%, as a result of reduction in electricity production from lignite, as well as fuel change (oil for heat production is replaced with natural gas). CO is the second contributor, participating with around 30%, with peak in the years with more forest fires. NH3 as a new gas that is introduced in this inventory, participate with around 8% during the reporting period. More details are provided in the NIR.

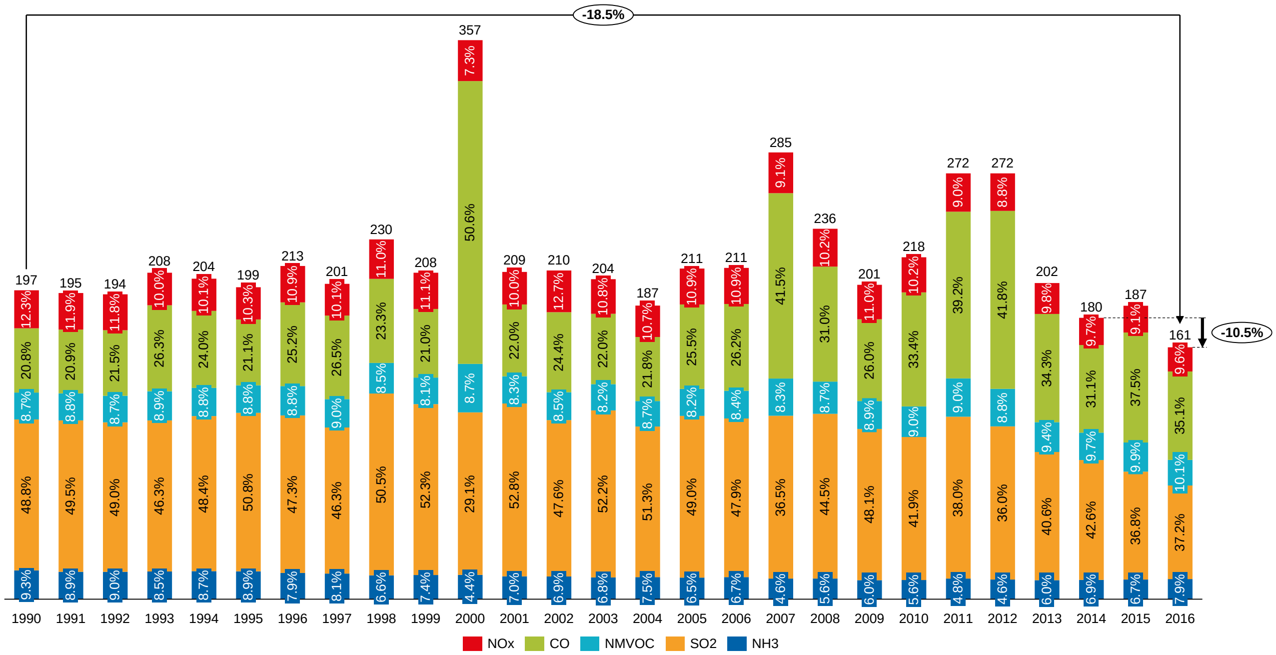

Figure 3-14: Emissions of NOx, CO, NMVOC, SO2 and NH3 in the period 1990 – 2014 (in Gg)

The assessment of the sectoral precursors and indirect emissions shows that during the entire reporting period, Energy sector is the most significant contributor in all of them except in NH_3. In 2016, this sector is a source of almost all SO_2 and NO_x emissions, 99.8 and 95.6%, respectively. At the same time the energy sector participate with 74% in CO and 66% in NMVOC. AFOLU is the second contributor with around 96% share in NH_3, 33.4% in NMVOC and 17.6% in CO. Waste represents 7.7% of CO mostly as a result of open burning of waste. Comprehensive information by sector is available in the National Inventory Report prepared for the TBUR.

3.7.1 Data Sources and Methodology for Precursors and Indirect Emissions

The IPCC Guidelines contain links to information on methods, used under other agreements and conventions, for the estimation of emissions of tropospheric precursors which may be used to supplement the reporting of emissions and removal of greenhouse gases. Table 7.1 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 7: Precursors and Indirect Emissions provides a link between the IPCC categories and the corresponding methodology chapters in EMEP/CORINAIR guidebook. In this BUR, the latest EMEP/EEA air pollutant emission inventory guidebook from 2019 was used. The estimation of precursors and indirect emissions of the Energy sector is done using the Tier 1 methodology. The reason behind that is that the higher Tier methodologies require detailed characteristics of the fuels used in combination with onsite measurements or other detailed parameters, which were not available in the period of preparation of the 3rd BUR.

During the preparation of the IPPU non-GHG emissions part of the inventory it was found that there is a big gap in the emissions for the entire reporting period. Although activity data have been available in the software for the period 1990-2001, the non-GHG emissions from Iron and steel were not calculated. In addition, for several categories different emission factors have been used. Having this in mind, the overall period before 2015 is revised.

During the preparation of the precursors and indirect emissions from waste it was found that there is inconsistence in the data and factors used in the period 1990-2014. Having in mind that better data are available, the revision of the times series was made. For example, for Domestic wastewater treatment and discharge, 100 times lower factors for waste generation per capita was used. This factor is revised according to the data that SSO is publishing staring from 2016. In 2016, the amount of precursors and indirect emissions is two times higher compared to 1990, resulting in an average annual growth rate of 3%.

The increase comes from the Open burning of waste at the dump sites. CO is the dominant one with a participation of around 75% during the overall reporting period, while the second one is NMVOC with 21%.

3.8 Uncertainty Analysis

Concerning the uncertainty calculations in the previous national reports, in the Second National Communication uncertainty is done using both methods for the Energy sector for 2000. In the Third National Communication Approach 2 is used for determining the uncertainty in the IPPU sector for the years 2003 to 2009, while in the First Biennial Update Report Approach 1 is used for the inventory for 2012 and for calculating uncertainty in trend for the years 1990 and 2012. In this report both, Approach 1 and Approach 2, are applied for each sector of the inventory for 2014, 2015 and 2016. Figure 3-15 provides uncertainty levels for both methods.

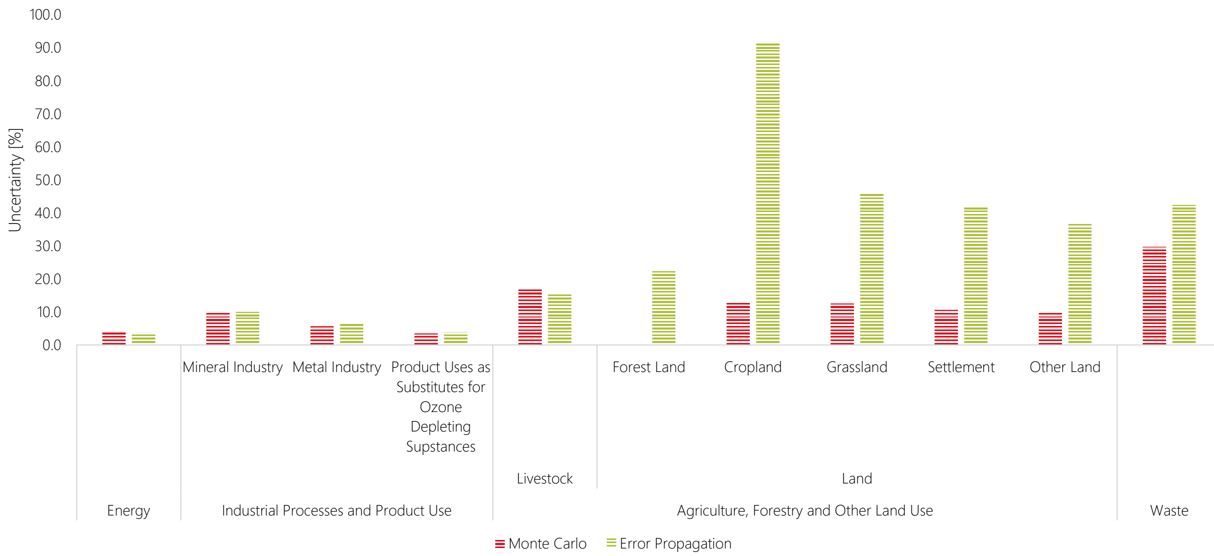

Figure 3-15: Comparison of Monte Carlo and IPCC Inventory Software method by subcategory for 2014

When using the **Error Propagation method** for calculating the uncertainty for each sector separately, the obtained results indicate that the AFOLU sector has the highest uncertainty. Immediately after this sector is the Waste sector. A characteristic of these two sectors is that uncertainty in certain subcategories reaches over 40% and in 2014 the uncertainty in the sub-category Land to cropland is more than 90%. On the other hand, the sector with the lowest uncertainty is the Energy sector with about 4%. This sector is followed by the IPPU sector, where the Metal Industry has the utmost uncertainty of around 10%.

The opportunity in the **Monte Carlo method** to insert uncertainty for each input variable separately, especially in the AFOLU and Waste sectors, changes the obtained results compared to the Error Propagation method. According to this Approach, by far the largest uncertainty is in the Waste sector, which exceeds 29% in all the three analyzed years

This sector is followed by the AFOLU sector, where the greatest uncertainty is in the Livestock subcategories of about 16%. On the other hand, Energy again has the lowest uncertainty, followed by the IPPU sector.

If the Monte Carlo and the Error Propagation method are compared, by subcategory (Figure 3-15) it may be noted that there are no significant differences in the obtained results for the Energy and IPPU sectors. However, there are major differences in the other two sectors, due to the inability to accurately set uncertainty to all variables in the IPCC Inventory Software, i.e. the fact that all the uncertainty should be reduced to only two values (for activity data and emission factors).

Obviously, these differences in the emissions by subcategory when using the two approaches leads to different uncertainty in the total annual emissions. However, the trend of uncertainty over time in both methods is the same; i.e., it increases with the growth of the share of sectors with higher uncertainty. Because the average emissions from all iterations in the Monte Carlo method is nearly equal to the actual estimates of the emissions, and because individual uncertainty for each variable may be used, it can be concluded that the results obtained from Approach 2 are much more relevant.

As it is presented, the highest uncertainty is in the Waste sector. This is primarily due to the large number of variables that have uncertainty, such as the total amount of municipal waste, the fraction of that amount sent to SWDS percentage wear landfill, methane correction factor, GPD and waste generation rate. Currently, regional waste management plans are in the process of preparation that can significantly contribute to uncertainty reduction in this sector. The data from these regional plans will be included in the preparation of the subsequent GHG inventories.

While the UNDP-GEF project is beginning to address uncertainty in the Livestock subcategory, in this report, default emission factors are used, which according to the Guidelines have great uncertainty associated with them. If, in the future, national emission factors can be calculated, with lower uncertainty, it would significantly reduce the uncertainty in the sector. The Livestock category is followed by the remaining subcategories from the AFOLU sector, where the main source of uncertainty are the areas of each type of land, as well as the areas that have been converted to other area type. As stated in the Section 6, due to the inconsistencies in the data related to these subcategories, it is recommended to establish system for continuous monitoring and inventory for each type of land that will also contribute to uncertainty reduction. However, according to the Guidelines there is also high uncertainty in the values for annual biomass carbon growth and annual loss of biomass carbon.

3.9 Quality Assurance / Quality Control (QA / QC)

The Macedonian approach towards **QA/QC activities** in the national GHG inventory process is based on the in-depth analyses of the current practices of the inventory compilation in the country and the relevant international best practices. The resulting **QA/QC plan** was presented within the FBUR. It was applied in the same manner over the Inventory process of the SBUR, with an extension of QA activities within the energy sector. The SBUR QA/QC plan has proved effective in achieving QA/QC objectives, and as such was implemented for the inventory processes under this TBUR and forthcoming National Communications on Climate Change and Biennial Update Reports.

The Macedonian inventory process meets the necessary technical conditions for ensuring sustainability, since:

- A strong focus is put on documenting essential information in a concise format;
- Activities and tasks are standardized, and clear procedures are stipulated;
- Roles and responsibilities of all players are clearly defined.

The GHG inventory team has developed training materials on GHG inventory preparation developed by the GHG inventory team. These materials are country-specific, and they are based on personal experience gathered and lessons learned during the GHG inventory preparation in Macedonian conditions, which can provide clear guidance for newcomers in the inventory process.

The National Inventory Report compiled in support of the SBUR included improvements based on recommendations from the review of the FBUR for further inventory improvements by sector for the Energy sector, the IPPU sector, the AFOLU sector, and the Waste sector. These recommendations address data collection, disaggregation of activity data, data from additional sub-categories, and the use of additional data sources, such as satellite imagery in the land-use sector. These improvements have been maintained in the TBUR.

Furthermore, in the TBUR a four step quality verification process of the GHG inventory has been introduced. The four steps include:

- Two steps on the national level (inventory team and a national UNFCCC certified reviewer – procedures described in the National Inventory Report)
- Two steps on the international level (by the Global Support Programme (for the TBUR National Inventory Report (NIR)) and technical analysis as part of the UNFCCC international consultation and analysis process for non-Annex I countries (for the TBUR).

Recommendations provided by the Global Support Programme and the Technical Analysis of the UNFCCC ICA Process have been implemented in the GHG development process and in the NIR to the extent possible. However, some of the recommendations for improvement shall be included in subsequent national BURs.

The quality assurance (QA) activities are performed at the inventory evaluation stage i.e. after the implementation of QC procedures to the finalized inventory. The GHG inventory quality is assured introducing external expert review conducted by QA Team (QAT) members. The QAT members have previous experience in GHG inventory development (were involved in the preparation of the previous GHG inventories). They check, and if needed, propose corrective actions and verify the following:

- Adequacy of the selected activity data and emission factors;
- Adequacy of the applied methodologies;
- Accuracy and consistency of the calculated emissions;
- Adequacy of the data documentation;
- Correctness of the conducted Key Sources analysis and Uncertainty Management.

As a final step, the Chief Technical Adviser checks the National Inventory Report, proposes corrective actions if necessary, and verifies the National Inventory Report once the proposed corrective actions are implemented by the Inventory Development team members.

According to the IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories, priority in the QA process should be given to key source categories, as well as to source categories where there are significant changes in methods or data. Because the Energy, IPPU and the Waste sectors are the most significant contributors to the Macedonian GHG inventory, an expert peer review was conducted for QA of the national GHG estimates of those sectors.

A full deception of the QA/QC process can be found in section 10 of the National Inventory Report.

3.10 Good Practices, Improvements, Recommendations

As a part of the preparation of the National Inventory Report, sectoral experts identified improvements in the current inventory and made recommendations for subsequent inventories.

3.10.1 Improvements

Good practices and improvements made in the GHG inventory for this TBUR in relation to the SBUR include improvements in the following sectors:

Good practices

Good practices identified include:

- QA/QC processes: As outlined, in the TBUR a four-step quality verification process of the GHG inventory was been introduced including two steps at the national level and two steps at the international level;
- National guidelines and training materials for development of the GHG inventories: The team has developed detailed country specific guidelines (based on personal experience gathered and lessons learned during the GHG inventory preparation in Macedonian conditions) These materials should not replace the IPCC/UNFCCC guidelines, they rather ease their use and enable transfer knowledge to newcomers.
- Institutionalization of the development of the GHG inventory in the academia sector i.e. the Macedonian Academy of Sciences and Arts - Research Centre for Energy and Sustainable Development (RCESD-MASA) develops GHG inventory for the energy sectors, and joint consortium (the Institute of Agriculture, the Faculty of Forestry and the Faculty of Agriculture) develops the GHG inventory for the non-energy sectors or so-called AFOLU sectors (Agriculture, Forestry and Land Use). Engaging institutions rather than individual consultants closely supports transition of development of the GHG inventory from project based to sustainable practices, enables transfer of knowledge and strong institutional memory.
- National emission factors are used for lignite, residual fuel oil and natural gas in Energy sector, Fuel combustion activities.

Improvements in GHG inventory

Energy sector

- Activity data are updated in compliance with the revised Energy Balances for the period 2005 – 2014 from the SSO (published in October 2016). In the process of updating the data, some errors and inconsistencies were noticed and corrected. This kind of collaboration between the institutions (particularly in the Energy sector) is a good practice and relevant for improvement of the quality of the information reported in the BURs.
- The activity data before 2005 for the Manufacturing industries and Construction category in the IPCC Inventory Software database were disaggregated in accordance with the SSO Energy balances (from 1998 till 2002). For the years for which the SSO did not publish Energy balances data from IEA databases were used.

- In this report, based on the IEA and SSO energy balances, the activity data for the category Other Sector during the period 1990 to 2005 are included within the Non-Specified instead of Commercial/Institutional subcategory.
- The category Diesel and Heating Oil used in the Energy balances until 2011 has been separated into Road Diesel and Heating & Other fuel oil.
- Similarly, the Biomass category has been separated into Biomass and Wood Wastes, Wood Briquettes and Pellets and Wood of fruit trees and other plant residues. The advantage of the disaggregation has been reflected in the NIR.
- The average CO_2 emission factor from the 2019 Refinements to the 2006 IPCC Guidelines was taken into account for the fugitive emissions from fuels, specifically surface mines.

IPUU sector

- The activity data for all industrial processes subcategories have been revised, using the Reports for Industry from SSO, thus providing consistent time series of activity data for the whole reporting period, without using interpolation/extrapolation for the missing data.
- The factor for clinker production has been also corrected based on the annual reports from the cement factory.
- The F-gases input data used in the IPCC Software have been adjusted in accordance with the IPCC Guidelines.

AFOLU sector

- Inventory of the GHG emissions in **livestock** for TBUR was done with background data from State Statistical Office.
- Data from the SSO and CLC were used in order to estimate the area under certain **land use** category and its dynamics, which serve as activity data according IPCC methodology. CLC data for all land use categories remaining in the same category, for each inventory year, were compared and adjusted to the SSO data, in addition, for this BUR, such comparison and calculation of dynamics among the newly established and uprooted, perennial plantations has been performed as well. The improvement of the assessment of GHG emissions from agricultural sector is important, particularly in establishing consistent data series. In this report, Land Use Changes for period 2000-2014, were introduced based on CORINE data sets.
- For these reasons, in this BUR, a special attention has been payed to the design of detailed methodology and implementation of activities for enforcement of the capacities for a number of Remote Sensing (RS) and Earth Observation (EO) activities is expected to be achieved on a yearly level moving forward.

Forestry sector

- Implemented satellite images for land use change from and to Forest land (CORINE Land Cover) for 2000, 2006, 2012 and 2018 and interpolation of the data on annual bases to cover the years in between.
- Improved data for commercial and firewood removals.
- Improved and updated data for burned forest area, using data from three different sources.

Waste sector

- Fractions for composition of the waste going to the SWDS have been updated using the data from the regional waste management plans.
- The emissions from waste composting activities introduced in SBUR for the period from 2012– 2014, are now extended for the period 2011 - 2016.

- The percentage of waste deposited in disposal sites has been recalculated and 90% of the total generated MSW is going to SWDS, including the Uncategorized SWDS. The rest 10% of waste is reported in the category Open Burning of Waste.
- The emissions from incineration of clinical waste have been estimated for period 2000 – 2016.
- More industry sectors have been introduced in the subcategory Industrial wastewater treatment and discharge based on SSO data.

3.10.2 Recommendations

The inventory team made the following recommendations for improving future GHG inventories.

In the **Energy sector**:

- Secure and constant channels for acquiring data on composition and carbon content of fuels should be established with relevant institutions in order to facilitate the estimation of country specific emission factors. This can be achieved by signing some kind of agreement, for instance, a Memorandum of Understanding.
- There are several existing biogas power plants, their electricity production should be also taken into account in the next inventories, especially if more of this type of power plants will become available in the future. Since there are no data available on the amount of biogas used for electricity production, it is recommended to develop a separate study for the existing biogas power plants.

In the **IPPU sector**:

- More detailed data regarding the carbon content of the feedstock in the following sectors: cement production, lime production and steel production. These data can be gathered directly from the industrial plants.
- Segregated data for the F-gas emissions from refrigeration and air-conditioning for the specific part of the equipment life-cycle. These data should be collected by the Ministry of Environment and Physical Planning.
- F-gas emissions from fire protection, aerosols and solvents or reiteration that emissions from these categories are not occurring in the country.
- N_2O emissions from medical appliances.
- SF_6 emissions from use and disposal of electrical equipment.

In the **AFOLU sector**:

- In preparation of next GHG inventory, the data from manure management in the **livestock sector** should be reduced for the use of manure in biogas digesters. In addition, Tier 2 methodology should be applied for dairy cows and swine, according to the results of the Survey of Manure Management at Small Dairy and Pig Farms[6].
- Particular attention should be paid to development of national emission factors for assessing GHG emissions/removals in the **land use sector** taking in consideration:
    - Field measurement of GHG emissions under various land use types, land management practices and inputs,
    - SOC dynamics under certain lad use, management practices and Inputs

[6] Assessment Study of Manure Management at Small Dairy and Pig Farms, project "Macedonian Fourth National Communication and Third Biennial Report on Climate Change towards UNFCCC", 2020

    - Annual biomass productivity of perennial crops measurements (orchards, vineyards, forage etc.)
- Development of national emissions factors in the **land use sector** is a complicated task and there is no other choice than building national capacities on assessing of this data that is not readily available in the country. This is serious gap that should be overcome trough investment in capacity building, particularly in institutions from agricultural and environmental sector.
- For the **forestry sector:**
    - Development of Forest inventory (PE "Nacionalni sumi", MAFWE, Faculty of Forestry)
    - Installation of software for annual evidence of the Land use change
    - Development of local tables for annual growth of different species
    - Development of system for monitoring the natural disturbance and prompt evidence
    - Collect data for other non-wood products

In the **Waste sector**:

- Currently, for the Solid waste disposal there are no data on waste production by industry type. It is recommended for the next inventories to disaggregate the data for waste generated from manufacturing industries by industry types, in order to be able to use the default values of DOC and fossil carbon contents in industrial waste for specific industry types (as per the IPCC 2006 Guidelines, Vol. 5, Ch. 2, Table 2.5). This should be done in close collaboration with the SSO.
- Having in mind that there are several existing biogas power plants, the biogas production in biodigestors should be further investigated and included in the inventory. This could be done as a separate study and in cooperation with biogas power plants installations.

3.10.3 Gender Aspects of the Inventory Report

The national GHG inventory development process incorporated well balanced gender team: 43% women and 57% men. Additional efforts have been made to integrate gender responsive considerations into the GHG inventory to the extent possible, following the national Action plan on gender and climate change and the UNDP Gender Responsive National Communications Toolkit:

Making Greenhouse Gas Inventory Process More Gender Responsive		
Approach to gender responsive processes	Y/N	More info
• Engage gender specialists from government, private sector and civil society to develop gender analysis framework for GHG data collection across sectors within the national context	Y	Link to the document. UNFCCC Gender and Climate Change Focal point appointed Gender consultant engaged to support integration of gender considerations within the 3rd BUR Gender composition of the Macedonian delegation at COP25 was 60% women and 40% men

• Establish criteria for technical working group (TWG) membership to ensure that social and gender analysis specialists participate in all aspects of GHG inventory process	Y	Network of climate change national practitioners established, comprising social and gender analysis specialists.
• Ensure work plan highlights categories where gendered divisions of labour indicate scope for in-depth gender analysis	N	There is absence of official statistical gender disaggregated data in the analyzed sectors. Additionally, the Inventory does not provide data on the labour force in each of the sectors, and therefore cannot include gender perspective in the social aspect as well.
• Where GHG inventories connect to social data, ensure collection of sex-disaggregated data, identify gaps in data and include consideration of gender issues in strategies to overcome data constraints	Y	To certain extend. Official data are not collected. However, an innovative approach has been used to collect sex-disaggregated data for the household heating sector and used for various case-studies /analyses/policies.

The results of the assessments indicate that at this time the GHG Inventory cannot reflect the gender dimension, due to the absence of official statistical gender disaggregated data in the analyzed sectors: Energy, Industrial Processes and Product Use (IPPU), Agriculture, Forestry and Other Land Use (AFOLU) and Waste, disaggregated by categories and subcategories on the percentage of female and male participation in the production of the GHG emissions.

The official statistical agencies are recommended to start collecting gender disaggregated data in the listed sectors.

THE POWER OF CLIMATE DATA

According to the GHG inventory data, energy is the main "sector to blame" for the national GHG emissions. On contrary, the relevant data statistics are far from gender sensitive which can prevent gender responsive policies that address sectoral issues and wider gender impacts.

As a result of UNDP's efforts to introduce innovation into climate change initiatives in the country, it was demonstrated that data can be collected and analysed efficiently and at low-cost. Data was collected for one of the "main" reasons for the increase of greenhouse gases and local air pollution in Skopje – the Household Heating Practice.

Utilising the Microsoft PowerBi software tool enabled access and interactive specific analysis of the data in line with citizen and expert needs. The data collected served as the baseline for many analyses, designing and testing actions for climate change mitigation, improving air quality and **identification of most vulnerable groups. In particular, the analyses highlighted the role gender plays in improving air quality and the impacts of poor air quality on the most vulnerable groups.**

3.10.4 Incorporation of UNFCCC Technical Analysis Recommendations

In the Summary report of the Technical analyses of the Macedonian second BUR (TASR.2) it was concluded that the country has reported all the elements of information on greenhouse gases as required by the BUR guidelines (summarized in Table 1 of Annex I of the TASR.2) and commended the country for the level and detail of the information provided in the NIR. Therefore, this NIR (under the TBUR) was developed in the same manner, following and in same foundations, further improving the good practices from the previous BURs.

4 Climate Change Mitigation and Action Plan

4.1 Overview

The climate change mitigation analysis conducted in the Third Biennial Update Report on Climate Change (TBUR) builds upon and continues the analyses of previous studies: Second Biennial Update Report (SBUR), Third National Communication on Climate Change (TNC), First Biennial Update Report (FBUR) and the Initial Nationally Determined Contributions (INDC)[7]. Meanwhile, the national climate and energy policies have been completely merged in the National Strategy for Energy Development of the Republic of North Macedonia until 2040 (Energy Strategy), adopted in December 2019. The Strategy integrates climate and environmental aspects of the energy sector, while proposing an affordable, reliable and sustainable energy for the future.

In order to achieve the 2040 vision, the Strategy depicts three scenarios: Reference, Moderate Transition and Green. The three scenarios reflect different dynamics of energy transition and enable flexibility into Macedonian response to relevant EU policies and governance for modern, competitive and climate-neutral economy by 2050. The scenarios are based on years of research in the areas of strategic energy planning and climate change within the energy strategies, Energy Efficiency and Renewable Energy plans, national communications and biennial update reports for climate change, particularly the climate change mitigation analyses conducted as a part of the SBUR.

Moreover, the scenarios from the Energy strategy are incorporated in the TBUR and additionally upgraded with mitigation potential of non-energy sectors – AFOLU and waste. The most ambitious scenario of the TBUR, e-WAM, is selected as the scenario in relation to which the targets and objectives are defined in the new National Energy and Climate Action Plan (NECP).

In SBUR, there were two mitigation scenarios (With Existing Measures - WEM and With Additional Measures - WAM), but the very fact that the Energy strategy now defines three scenarios, necessitated TBUR defining another additional mitigation scenario (Extended Mitigation - e-WAM). Accordingly, the Reference Scenario of the Energy strategy corresponds to the Scenario with Existing Measures (WEM) of the TBUR, the Moderate Transition Scenario, in TBUR is a Scenario with Additional Measures (WAM), while the Green Scenario, in TBUR is presented through the extended WAM scenario (e-WAM). Additionally, a reference or Scenario without Measures (WOM) is developed in the TBUR. Modelling has been conducted for the period from 2017 to 2040. In outreach materials, the WOM, WEM, WAM and e-WAM scenarios are also referred to as the Business as Usual, Survival, Safe Way, and Climate Champion scenarios, respectively, in order to make them more accessible to a broad audience. Also, the building principle of the scenarios is the same – reflecting different levels of ambition in mitigation action and different dynamics of the energy transition.

To assess the mitigation potential of certain measures and policies, all sectors recognized by the Intergovernmental Panel on Climate Change (IPCC) methodology (Energy, Industrial Processes and Product Use, Agriculture, Forestry and Other Land Use and Waste) have been modelled in the National Mitigation Report for the TBUR. The IPCC methodology does not include emissions from electricity imports, as well as from international aviation. In order to avoid electricity import to be used as a mitigation measure and at the same time to be able to compare the results with the GHG inventory of Macedonia, but also with the results from the other countries, in this BUR the results with and without electricity import and international aviation (MEMO) are presented. In addition, good practices and the established detailed and robust methodology developed in SBUR

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

have also been implemented in this BUR. They are supplemented with socio-economic research and with additional case study that reflect the mitigation potential of the actions induced by the Industry sector. Moreover, in this BUR, each measure is linked with adequate SDG goals.

Taking into consideration all national strategic and planning documents, **47 mitigation measures** were recognized out of which, **32 measures in the Energy sector, 11 measures in Agriculture, Forestry and Other Land Use (AFOLU) and 4 measures in the Waste sector**.

In accordance with the WAN Mitigation scenario an Action Plan (Annex 5) for mitigation of climate change was prepared, in which the stakeholders relevant for the implementation of all 47 measures and policies were identified. Furthermore, the plan contains information on each measure's type, source of finance, indicative future emission reductions, specific costs (cost of reduced t CO_2), and necessary investments for the realization of the measures and the potential for green jobs creation. This Action Plan is a solid foundation for creating national policies that would enable the low-carbon sustainable development of the country.

In Annex 6, each of these measures is represented with a separate table containing all the necessary information, progress of implementation (timeframe, expected results and costs, implementing entity), progress indicators as well as direct and indirect contribution to the SDG goals.

The SBUR and likewise, the TBUR exceed the requirements of the UNFCCC Guidelines for Non-Annex I Countries since, besides economic and environmental evaluation, it addresses social aspect estimating **co-benefits** from the implementation of mitigation policies and measures (PAMs).

In addition, worth mentioning are three studies finalized after the submission of the SBUR. The Study on the Heating in the City of Skopje (STUGRES), Study on Transport (STUTRA) and the Study on Industry Analysis of Policies and Measures (STUIND).

The STUGRES study was prepared as a response to the raising concerns about the air pollution in the City of Skopje, showcasing actions that can reduce GHG emissions and improve air quality. The main aim of this Study on the Heating in the City of Skopje - STUGRES is to determine, with as many details as possible, the impact of various heating measures on the GHG emissions (CO_2, CH_4, N_2O), but also on the local pollution ($PM_{2,5}$, PM_{10}, CO, SO_x, NO_x) and air quality. The proposed measures can reduce the consumption of energy obtained from GHG high emission energy sources and ensure their replacement with low-carbon fuels, as well as promote the use of technologies that will have minimum effect on local pollution. The implementation of the proposed measures can result in 12% reduction in CO_2-eq and 70% reduction in PM_{10} and $PM_{2.5}$ emissions by 2025. The research and the recommendations from this study were incorporated in the Governmental Clean Air Plan to reduce air pollution in the country.

The STRUTRA study explored GHG reduction options in transport which is the fastest growing category in the energy sector. The category of transport is complex and has limited potential for GHG emissions reductions. The study proposed measures and policies which would enable increasing the efficiency and electrification of passenger cars in the country. Also, an analytical modelling was made in order to determine the effect of the proposed measures and policies, by quantifying the mitigation potential.

One of the main targets of the STUIND study was to propose measures for industrial production growth at reduced energy consumption, which will enable reduction of GHG and local emissions from this sector. Since most of the emissions are from the Industry in the Energy sector, this study proposes seven measures that will increase energy efficiency and the participation of renewable sources for electricity production in the Industry. Additionally, a measure has been proposed in the Waste sector for improved waste management in the Industry. If the proposed measures are implemented, the results show that compared to the WOM scenario in 2040 the final energy consumption of the Industry will be reduced by 24% (which is about 4 percentage points more compared to the results of TBUR, due to the introduction and analysis of additional measures in this study, such as Insulation, Lighting and Steam systems). Furthermore, total GHG emissions will be reduced by 10.6%.

4.1.1 Economic Implications of Scenarios

For the realization of the measures proposed under the WEM scenario 13.308 billion EUR are needed, of which about 99% are investment in the energy sector. WAM scenario requires an additional 38%, while for the realization of e-WAM almost 60% more compared to WEM (Figure 4-1). The average yearly investments in WEM are approximately 4.8% of the total average annual GDP, while in the e-WAM is 7.7% (Figure 4-2). If all of the measures are implemented in parallel and the "Energy efficiency first" principal is applied, then the total investment can be reduced in the range from 7% to 19%.

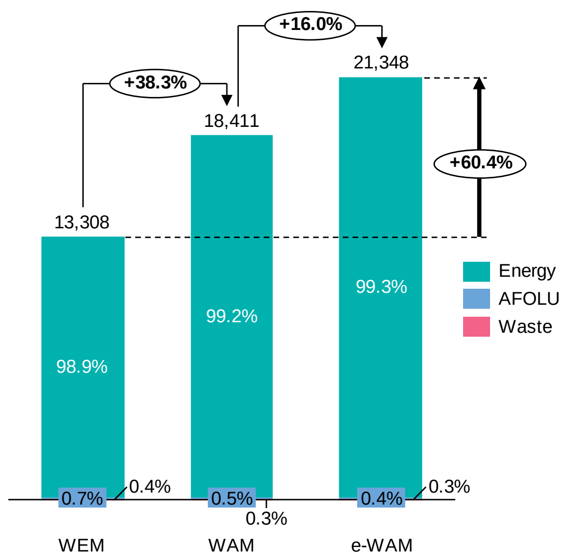

Figure 4-1: Investments by scenarios and by sectors

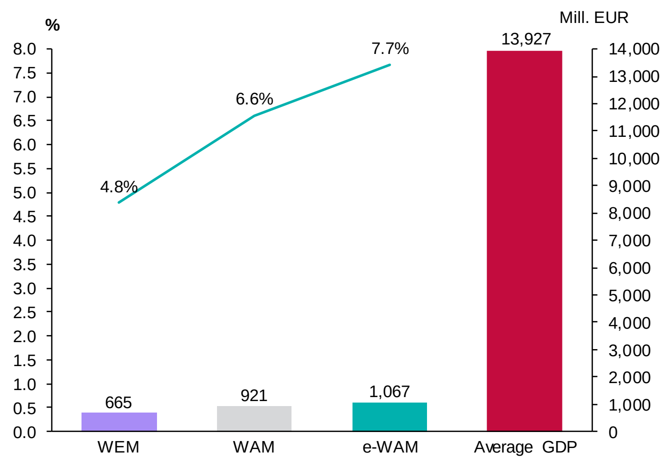

Figure 4-2: Annual investments compared to average GDP

4.1.2 Methodology approach

When comparing the results from the different scenarios there are two approaches: one is relative to the reference scenario (WOM) and the other is relative to a base year. Since the base year is not yet defined, in this report 1990 and 2005 are used. On the other hand, the total GHG emissions are calculated using the IPCC methodology, but in addition, in order not to use the electricity import (MEMO item) as a mitigation measure, in this report the emissions from electricity imports are also considered. This is very important for adequately calculating the impact of each measure for the Republic of North Macedonia, as import dependent country. However, with the aim of comparing the result with other countries and for compatibility with the GHG Inventory, the results without the emissions from electricity import are presented.

The Energy sector analyses are made with the MARKAL model, while for the AFOLU and Waste are calculated with the IPCC software. The emissions from IPPU are calculated based on the regression analyses model. Having in mind that the last year of the GHG inventory is 2016, the projections for GHG emissions are for the period 2017-2040.

In TBUR complete integration of the widely developed models for each of the sectors has been made, as well as their intersectoral connection through the main common drivers (Figure 4-3).

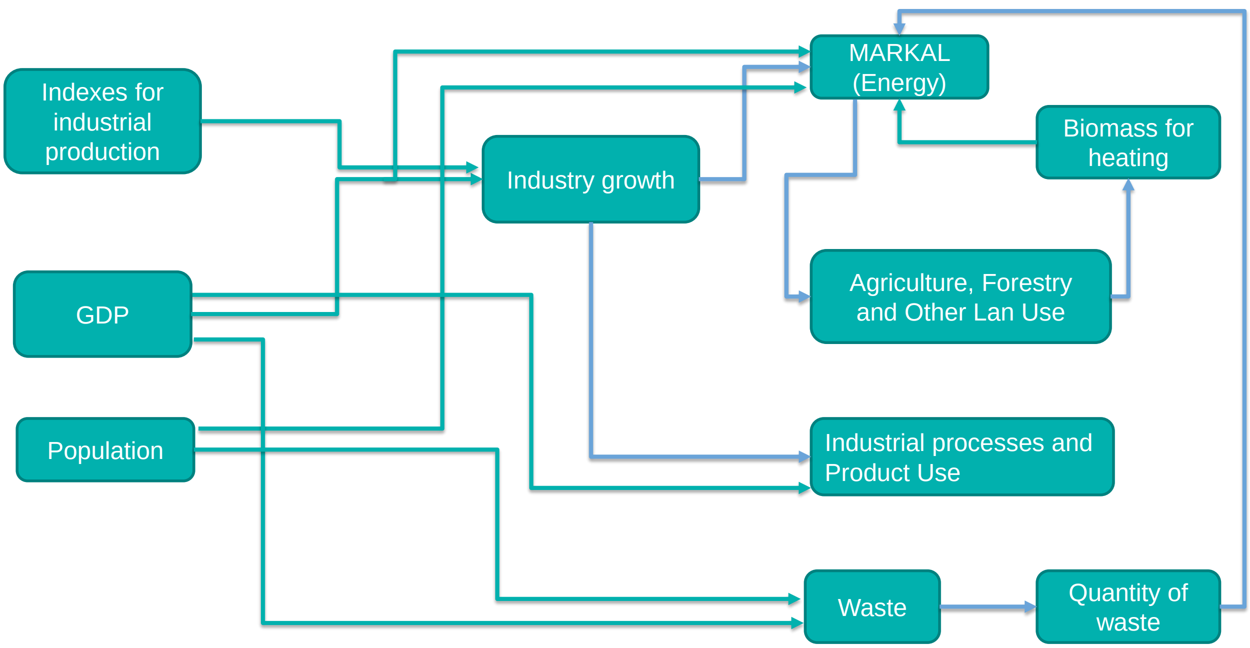

Figure 4-3: Intra and Inter-sectoral approach in the TBUR mitigation analyses

4.2 Reference Scenario Without Measures (WOM Scenario)

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

4.2.1 Assumptions

The WOM reference scenario contains several **key assumptions in each sector**

Energy

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

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

IPPU

- In this sector there are emissions from the following categories: Mineral Industry, Metal Industry and Product Uses as Substitutes for ODS
- In the Mineral Industry, Metal Industry, and Chemical Industry categories, emissions are primarily dependent on the increase in value added in those industries with the exception of Product Uses as Substitutes for ODS category. For this category it is assumed that the import of appliances depends on GDP.
- In the Product Uses as Substitutes for ODS category, all imported appliances are assumed to emit 100% of their emissions in the first year of operation.

Waste

- It is assumed that the average amount of waste per capita will continue to increase in the period up to 2035, when it will reach the EU-28 level (which has downward trend), after which it will start to decline.

AFOLU

- The scenario used in predicting the GHG emission from the AFOLU sector was based on the present situation of decreasing trends. Nevertheless, such a situation can quickly change and become outdated as a result of significant investments in the sector and possible rapid intensification.
- In the forestry sector, except for forest fires, there will be no other losses on forest land. Forest land in 2013 was taken and the average annual losses from fires for the period 1999-2015 and their share in the balance of carbon from forests were calculated.
- Official data show that the livestock number decreased, as well as utilized agricultural area and irrigated area. There is no evidence on increasing in fertilizer use.
- Only livestock, other land and direct emissions from N_2O subsectors will contribute to the emissions and will remain a carbon positive source in 2040.

4.2.2 Results

Overall results in terms of **final energy consumption** (Figure 4-4) are as follows:

- Final energy consumption under the WOM scenario increases by 83% from 2016 to 2040
- Increase in the useful energy demand and not investing in energy efficiency leads to an

increase in final energy consumption, which is growing at a rate of 2.4% per year in the period 2016-2040.

- The share of biomass is increasing by 2%, coal by 5%, diesel by 7%
- Electricity and diesel will continue to play an important role in the final energy consumption participating with around 60%.
- If the biomass consumption is excluded, the share of the other RES (solar, geothermal) is negligible.
- The share of coal and gas is going to increase, achieving 18% in 2040.

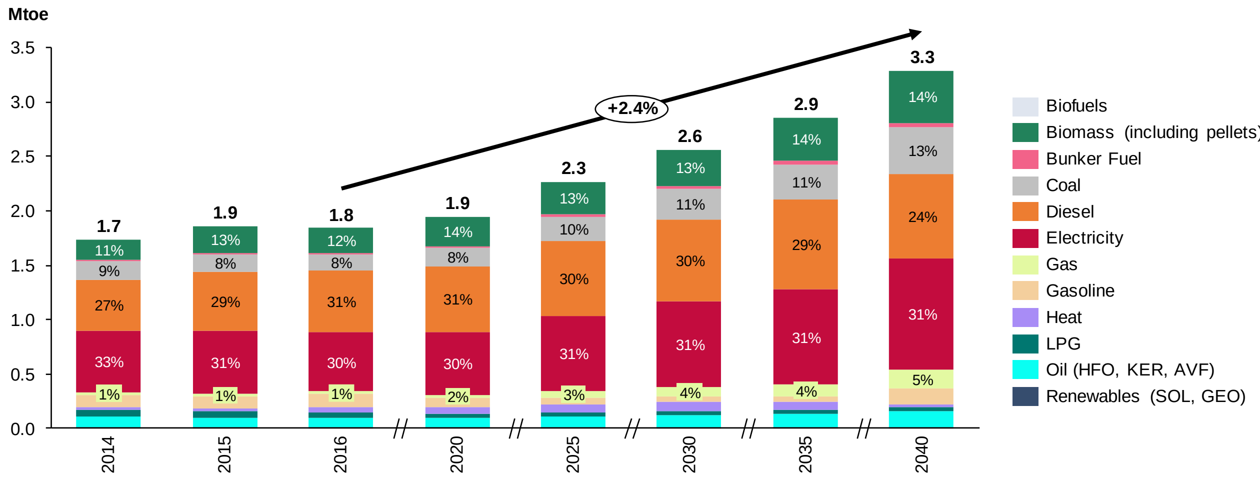

Figure 4-4: Final energy consumption by fuels

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

4.2.3 Greenhouse Gas Emissions in the WOM Scenario

Overall results in the WOM scenario were as follows:[8]

- GHG emissions growth sees a reduction between 2014 and 2016, then gradually increases to 2040.
- GHG emissions from all sectors are expected to increase by 37.3% in 2040 compared to 1990, or by 64.7% compared to 2005, reaching 16,844 Gg CO_2-eq in 2040.[9]

[8] It is important to note that the emissions presented for the period 2014-2040 also include the emissions from electricity import and international aviation, which are not used for reporting the national emissions in the GHG Inventory (according to the IPCC methodology). In this report, electricity import is included to properly evaluate the proposed mitigation policies and measures, and not include electricity import as a mitigation option.

[9] The comparison is made relative to 1990 and 2005 because the exact base year for Macedonia is not defined yet.

- When analyzing the total GHG emissions without the FOLU sector, this increase is even more dramatic, i.e. +57.7% in 2040 compared to 1990.
- Emissions from the Energy sector increases its share by up to 81% in 2040.
- The increase of the primary energy consumption based on fossil fuels will increase GHG emissions by 77% in 2040 relative to 2016.
- The emissions absorbed from the FOLU sector is increased in 2040 compared to 1990 and 2005, but it is decreased by 13% compared to 2016.
- The fastest growing sector in terms of emissions is the Waste sector, where the emissions in 2040 are 2.25 times larger than in 1990.

4.3 Possible Mitigation Measures

While the FBUR analyzed 18 measures in its scenarios, the SBUR has expanded the number of measures considered to 46 and the TBUR to 47 measures and additionally extended (most ambitious) mitigation scenario (e-WAM) is added. Table 4-1 provides an overview of these mitigation measures by sector and scenario, and it includes a description of the policies/measures involved. Annexes 5 and 6 contain more detailed information on the scope of the measures, their estimated impacts, the methodologies used for these estimates, and—for existing measures—the status of implementation.

Table 4-1: Overview of mitigation measures selected for inclusion in the WAM, WEM and/or e-WAM scenarios

IPCC SECTOR	ACTION AND SCENARIO	DESCRIPTION
Energy—Energy Industries	Reduction of network losses (WEM, WAM and e-WAM)	Operating and constructive measures necessary for losses reduction, implemented by electricity and heating distribution networks operators. Energy suppliers and distribution companies are required to achieve a certain amount of annual energy savings at the end-user level.
Energy—Energy Industries	Large hydro power plants (WEM, WAM and e-WAM)	Construction of new large hydro power plants
Energy—Energy Industries	Solar rooftop power plants (WEM, WAM and e-WAM)	Construction of solar rooftop power plant and introduction of “net metering”
Energy—Energy Industries	Biomass power plants (CHP optional) (WEM, WAM and e-WAM)	Construction of biomass power plants (CHP optional) and introduction of flexible feed-in premium tariffs to stimulate the construction
Energy—Energy Industries	Incentives feed-in tariff (WEM, WAM and e-WAM) (New measure in TBUR)	Increase of the domestic generation capacity from renewable energy sources Construction of new small hydropower plants, wind and biogas with feed-in tariffs that will stimulate the construction
Energy—Energy	Incentives feed-in premium	Increase of the domestic generation capacity

IPCC SECTOR	ACTION AND SCENARIO	DESCRIPTION
Industries	(WEM, WAM and e-WAM) (New measure in TBUR)	from renewable energy sources Construction of solar and wind power plants with feed-in premium tariffs to stimulate the construction
Energy—Energy Industries	RES without incentives (WEM, WAM and e-WAM) (New measure in TBUR)	Increase of the domestic generation capacity from renewable energy sources Construction of wind, solar and biogas power plants
Energy—Energy Industries	Introduction of CO2 tax (WEM, WAM and e-WAM) (New measure in TBUR)	Introduction of CO2 tax in order to stimulate the investments in RES and to increase the penetration of energy efficiency measures
Energy-- Residential and Non-Specified	Solar thermal collectors (WEM, WAM and e-WAM)	Installation of solar thermal collectors for hot water
Energy-- Residential and Non-Specified	Labeling of electric appliances and equipment (WEM, WAM and e-WAM)	Labeling of electric appliances and equipment to provide relevant information on the energy consumption of the products. The application of the labeling and eco-design of the products is necessary to ensure that the products sold in the country are in compliance with the EU regulations.
Energy-- Residential and Non-Specified	Increased use of heat pumps (WEM, WAM and e-WAM)	Phasing out heating devices with resistive heaters and their replacement with heat pumps in compliance with EU Climate and Energy Policy
Energy-- Residential and Non-Specified	Public awareness campaigns and network of EE Info Centers (WEM, WAM and e-WAM)	Establishment of EE info centers in municipalities or regional centers, in which energy advisors will operate, will share free advice to the interested citizens about the possibilities of saving energy and saving money in their homes
Energy-- Residential	Retrofitting existing residential buildings (WEM, WAM and e-WAM)	Reconstruction of residential buildings including windows replacement, initiated by the owners and/or supported by commercial banks and funds which exist in the Republic of North Macedonia This measure will provide issuing of certificates for energy performance of buildings, as a prerequisite for commissioning the reconstructed buildings.
Energy-- Residential and Non-Specified	Retrofitting of existing local self-government buildings (WEM, WAM and e-WAM) (modified measure in TBUR)	Retrofitting of existing public buildings with aim to meet the objectives of the EE Directive and the Energy Efficiency Law. Reconstruction including windows replacement of existing public buildings under jurisdiction of the central government. The measure will provide issuing

IPCC SECTOR	ACTION AND SCENARIO	DESCRIPTION
		of certificates for energy performance of buildings, as a prerequisite for putting the reconstructions into operation.
Energy--Residential and Non-Specified	Retrofitting existing central government buildings (WEM, WAM and e-WAM) (modified measure in TBUR)	Reconstruction including windows replacement of existing public buildings under jurisdiction of the central government or municipal government. This measure will provide issuing of certificates for energy performance of buildings, as a prerequisite for commissioning the reconstructed buildings.
Energy-- Non-Specified	Retrofitting existing commercial buildings (WEM, WAM and e-WAM)	Reconstructions of existing commercial buildings including windows replacement, initiated by the owners and/or supported by commercial banks and funds which exist in the Republic of North Macedonia This measure will provide issuing of certificates for energy performance of buildings as a prerequisite for commissioning the reconstructed buildings.
Energy--Residential	Construction of new buildings (WEM, WAM and e-WAM)	Construction of new buildings in compliance with the Directive on energy performance in buildings. This measure will provide issuing of certificates for energy performance of buildings, as a prerequisite for putting the building into operation
Energy--Residential	Construction of passive buildings (WEM, WAM and e-WAM)	Construction of new passive residential buildings in compliance with the EU Directive 2010/31/EU. This measure will provide issuing of certificates for energy performance of buildings, as a prerequisite for putting the building into operation
Energy--Residential and Non-Specified	Phasing out incandescent lights (WEM, WAM and e-WAM)	Replacing incandescent light bulbs with halogen ones (at the beginning) and later with compact fluorescent (CFL) and LED
Energy--Non-Specified	Improvement of the street lighting in the municipalities (WEM, WAM and e-WAM)	inefficient light bulbs should be replaced, purchasing new ones that comply with the criteria of belonging to the highest EE class possible (CFL and LED lamps).
Energy--Residential and Non-Specified	Green procurements (WEM, WAM and e-WAM) (New measure in TBUR)	Application of energy efficiency criteria ("greening") in public procurement procedures according to article 6 of the EE Directive

IPCC SECTOR	ACTION AND SCENARIO	DESCRIPTION
Energy--Non-Specified	Energy efficiency obligation schemes (WEM only) (New measure in TBUR)	Energy efficiency obligation schemes to set up the scheme the average annual final consumption for the period 2014 – 2016 is used. Implements the possibilities from the Article 7 of the EE Directive to exclude the transport sector consumption (paragraph 1) from the sum of the average annual consumption and reduce the consumption in the industry sector
Energy--Residential and Non-Specified	Increased use of central heating systems (WEM, WAM and e-WAM)	Increased use of the existing central heating systems through implementation of information campaigns for connecting new consumers, including those who have been disconnected from the system in the past.
Energy--Manufacturing and Construction	Energy management in manufacturing industries (WEM, WAM and e-WAM)	Implementation of obligatory energy audits of manufacturing industries and implementation of ISO 50001 standard, bottom up modelling and least-cost optimization using MARKAL.
Energy--Manufacturing and Construction	Introduction of efficient electric motors (WEM, WAM and e-WAM)	Introduction of efficient electric motors in manufacturing industries
Energy--Manufacturing and Construction	Introduction of more advanced technologies (WEM, WAM and e-WAM) (New measure in TBUR)	Introduction of more advanced technologies in the industrial processes that will also enable use of more environmentally friendly fuels.
Energy--Transport	Increased use of railways (WAM and e-WAM)	Increased use of the railway though awareness raising to use the railway for long-distance traveling and by improving the conditions of the companies
Energy--Transport	Renewing the national passenger car fleet (WEM, WAM and e-WAM)	This measure consists of successively organized and well-planned steps for faster renewal of the vehicle fleet of passenger cars.
Energy--Transport	Renewing of other national road fleet (WEM, WAM and e-WAM)	This measure involves introduction of a regulation that will enable renewal of the vehicle fleet of light-duty trucks, freight vehicles, and buses
Energy--Transport	Construction of the railway to Bulgaria (WEM, WAM and e-WAM)	Construction of the railway to Bulgaria
Energy--Transport	Electrification of Transport (WEM, WAM and e-WAM)	This measure consists of successively organized and well-planned steps for faster renewal of the vehicle fleet through introduction of electric vehicles

IPCC SECTOR	ACTION AND SCENARIO	DESCRIPTION
Energy--Transport	Advanced mobility (WEM, WAM and e-WAM) (New measure in TBUR)	Conducting campaigns/providing subsidies and systems for use of new or rented bicycles, electric scooters, promoting walking, and introduction of parking policies that would reduce the use of cars in the city area.
AFLOU-Land/Agriculture	Photovoltaic Irrigation (WEM, WAM and e-WAM) (New measure in TBUR)	Mitigation by replacing the non-renewable energy sources for water pumping with renewable, thus reducing the CO_2 emission.
AFOLU—Livestock	Enteric fermentation in dairy cows (WEM, WAM and e-WAM)	This measure involves modifying the feed composition and nutrition practice for dairy cows in order to reduce CH_4 emissions due to enteric fermentation through practical training and demonstrations for farmers.
AFOLU—Livestock	Reduction of NO2 emissions from manure management in swine farms by 13% (WEM, WAM and e-WAM)	This measure involves modifying manure management at swine farms to reduce NO_2 emissions through subsidies for adopting new practices and incentives for modified farm design and construction.
AFOLU—Livestock	Reduction of N_2O emissions from manure in dairy cows by 20% for farms below 50 Livestock Units (WEM, WAM and e-WAM) (New measure in TBUR)	By modification of the manure management in dairy cows, the emission of N_2O can be reduced up to 30%. In discussion with farmers, the most common system is dry manure management, where manure together with bedding (mostly wheat or barley straw) for composting
AFOLU--Forestry	Establishing integrated management of forest fires (WEM, WAM and e-WAM)	This measure includes the protection of the forest area by preventing the forest fires and the damages resulting from forest fires.
AFOLU--Forestry	Afforestation (WEM, WAM and e-WAM)	Afforestation of 5000 ha of barren land with Oak (Quercus spp.)
AFOLU—Land	Conversion of crop land in areas with more than a 15% incline to other uses (WEM, WAM and e-WAM)	This measure involves the conversion of inclined crop land into perennial grassland (pastures, meadows) in order to decrease the intensity of soil organic matter depletion and soil carbon emissions, creating a carbon sink. Areas above 15% inclination by law should not be cultivated and are not considered to be agricultural land.
AFOLU--Land	Contour farming on croplands on an inclined terrain (5-15% incline) (WEM, WAM and e-WAM)	This measure involves reducing the quantity of soil carbon released during downslope cultivation of cropland by encouraging farmers to adopt contour farming on terrain with a 5-15% incline through a systematic awareness-

IPCC SECTOR	ACTION AND SCENARIO	DESCRIPTION
		raising campaign.
AFOLU—Land	Perennial grass in orchard and vineyards on inclined terrain (5%-15% slope) (WEM, WAM and e-WAM)	This measure would plant perennial grass in vineyards and orchards using downslope cultivation in order to reduce erosion, protect organic matter in soil, and reduce carbon emissions from soil.
AFOLU—Land	Use of biochar for carbon sink on agricultural land (WEM, WAM and e-WAM) (New measure in TBUR)	The application of biochar can improve soil water holding capacity, nutrients storage into the soil, and increase yield. Biochar can capture even 3 times more CO_2 compared to its weight, because of its high carbon concentration.
Waste—Solid Waste Disposal	Landfill gas flaring and Closure of existing landfills (WEM, WAM and e-WAM)	This measure would reduce emissions of CH_4 and CO_2 by rehabilitating existing landfills and illegal ("wild") dumpsites with very high, high, and medium risk ratings in each of Macedonia's five waste management regions through measures such as covering existing non-compliant landfills, supplemented by gas extraction and flaring.
Waste—Solid Waste Disposal	Mechanical and biological treatment (MBT) in new landfills with composting (WEM, WAM and e-WAM)	This measure would reduce emissions of CH_4 and CO_2 opening new regional landfills in all waste management regions that feature systems for the mechanical and biological treatment of solid waste and composting.
Waste—Solid Waste Disposal	Waste paper collection (WEM, WAM and e-WAM)	This measure would reduce emissions of CH_4 and CO_2 through the installation of containers for collecting of selected waste, mainly paper.
Waste—Solid Waste Disposal	Improved waste and materials management at industrial facilities (WEM, WAM and e-WAM) (New measure in TBUR)	This measure would reduce emissions of CH_4 and CO_2 through setting targets for the reduction of generation, selection, reuse, recycling and treatment of waste at industrial installations

4.4 Assessment of Mitigation Measures

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

- Economic effectiveness or specific cost - shows the number of investments required in order to reduce 1 t CO2-eq by applying the specific policy/measure and it is expressed in €/t CO_2-eq.
- Environmental effectiveness or mitigation potential - indicates the extent to which emission reductions are achieved by applying the specific policy/measure and it is expressed in t CO_2-eq.

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

Additionally, the social aspect of the mitigation measures has been assessed though an analysis of job creation potential using the same methodological approach (a model for domestic green jobs) developed and implemented under the Intended Nationally Determined Contributions. That makes the measures triple win (win-win-win) measures, since they satisfy three criteria – economic, environmental and additional benefits.

4.4.1 Marginal Abatement Costs

The MAC curve is created for the WAM scenario for 2030 (as target year) and it shows that the total reduction from the proposed measures is estimated to around 5.6 Tg CO_2-eq (Figure 4-5). 70% of the reduction can be achieved with a "win-win" policies and measures, which means that these measures are reducing the emissions by a negative specific cost (total cost of the proposed measure are lower compared to the costs of the WOM scenario). Furthermore, additional 20% of the reduction is realized by measures with specific costs in range from 0-5 €/t CO_2-eq. It is very important to underline that this is not the total amount of GHG emission reduction, because there is one more measure which is very important, but its independent contribution cannot be estimated. This measure is the Introduction of CO_2 tax, which depends to a high extent on the other measures (such as the measures for RES, energy efficiency, fuel switch etc.) which are needed to replace the CO2 emitters.

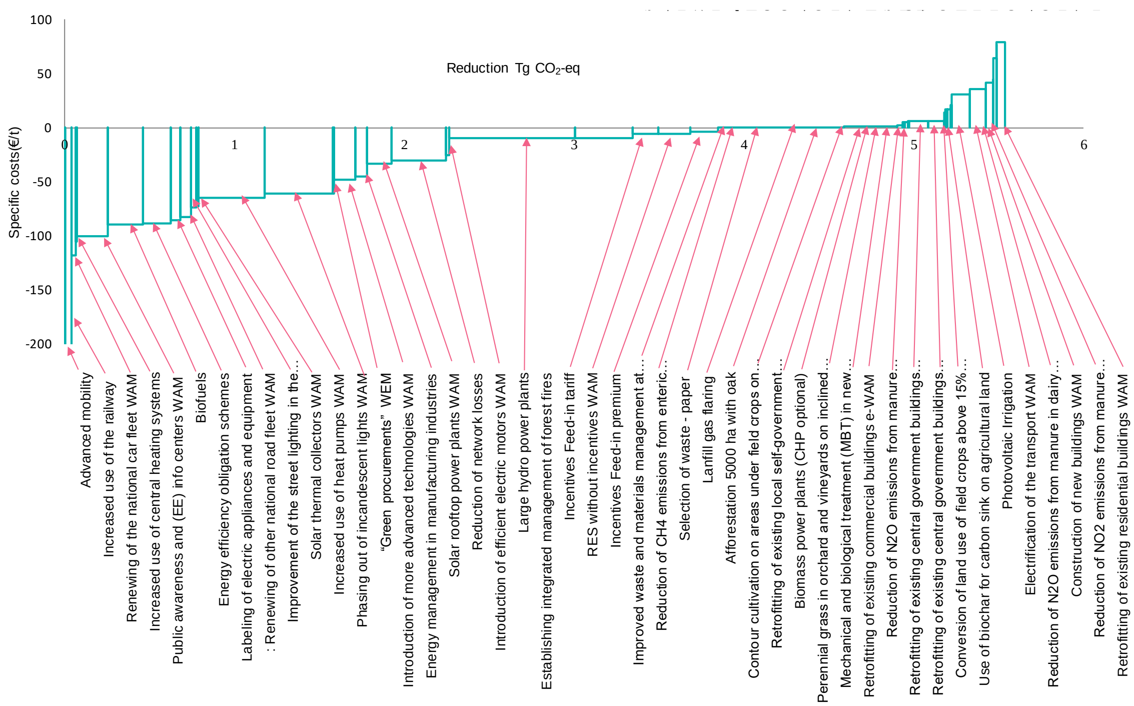

Figure 4-5: The marginal abatement cost curve for 2030

From a reduction point of view the best measure is the construction of Large hydropower plants (including all hydropower plants that are part from the measure), which in 2030 can reduce the emissions for 741 Gg CO_2-eq (Figure 4-6). On the second place is Landfill gas flaring with a reduction of 552 Gg CO_2-eq. On the other hand, Advance mobility and Increased use of railway are measures with lower specific costs (Figure 4-7).

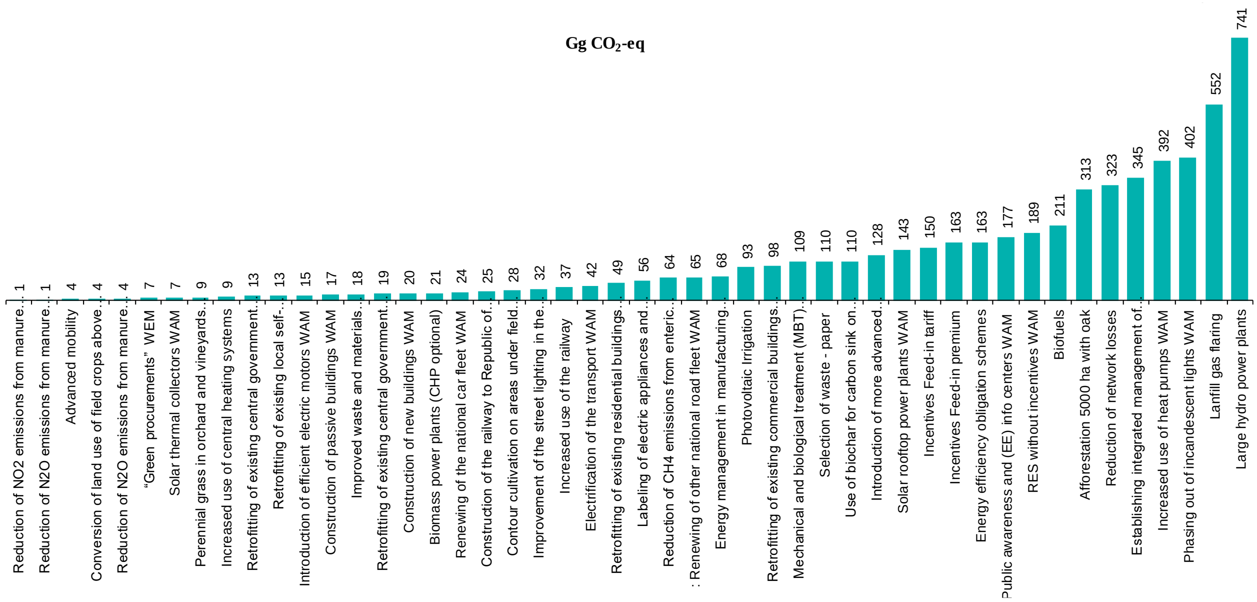

Figure 4-6: Reduction of CO_2-eq emissions in 2030 (in Gg)

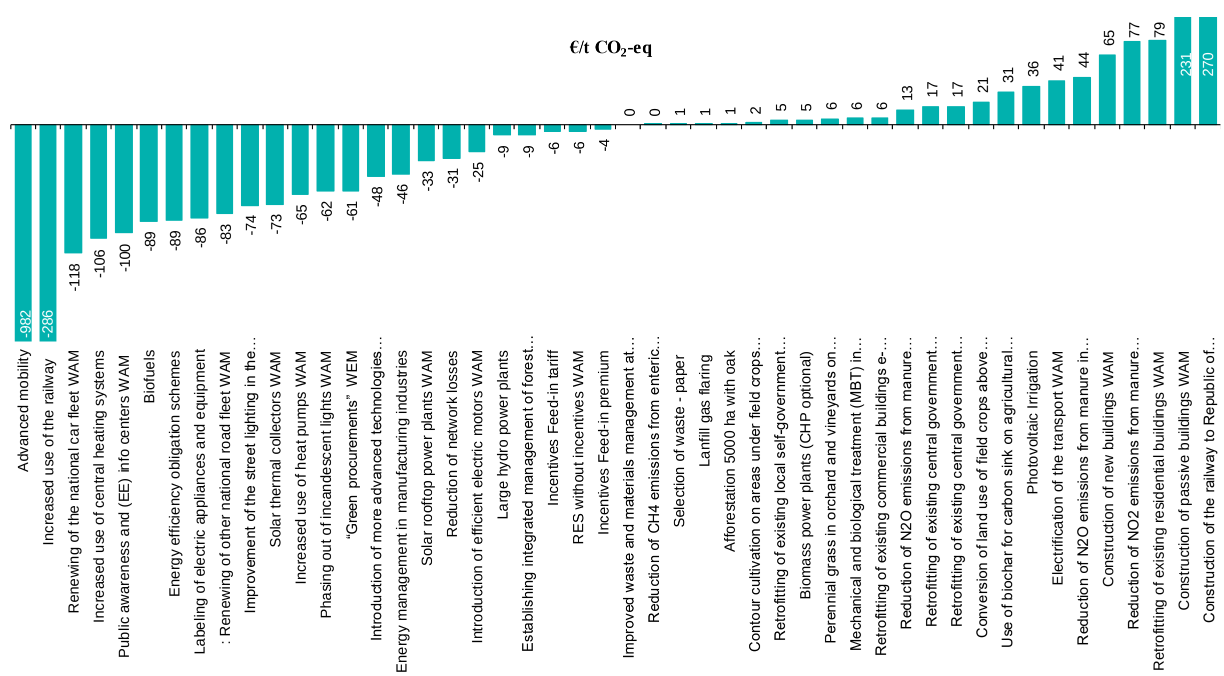

Figure 4-7: Specific costs for 2030 (in EUR/tCO_2-eq)

4.4.2 Social aspects - jobs

In addition to the economic and environmental effectiveness of the proposed policies and measures, their social aspect is also very important and should be considered for the overall process of sustainable development. In this study the social aspect is analyzed through the number of newly created green jobs. The methodology that was developed for the Intended Nationally Determined Contributions and also used in the FBUR and SBUR, is implemented in TBUR too. In addition, in TBUR the number of green jobs is calculated for the policies and measures of each of the scenarios.

The number of green jobs in each year depends on the time (year) of implementation of the policies and measures in each scenario. In general, in all scenarios the share of green jobs the field of Energy efficiency green jobs is higher compared to RES green jobs (Figure 4-8). The maximal number in the WEM scenario is in 2030 with 5,309 green jobs, from which 61% are from the energy efficiency and the remaining are from RES. In the WAM scenarios the maximal number is achieved in 2030 (7,035), while in the e-WAM scenario in 2035 (9,895). Moreover, the number of green jobs in 2035 in the e-WAM scenario is almost doubled compared to the WEM scenario.

Furthermore, the technologies which contribute most to the creation of new domestic green jobs is retrofitting with almost 50% in 2035 in e-WAM scenario, followed by Building of new houses, including passive houses (23%), PV (10%) and Solar thermal collectors (8%). After 2036 there is a decrease in the creation of domestic green jobs mainly because of the reduced number of PV installations, as well as retrofit of existing buildings (Figure 4-9).

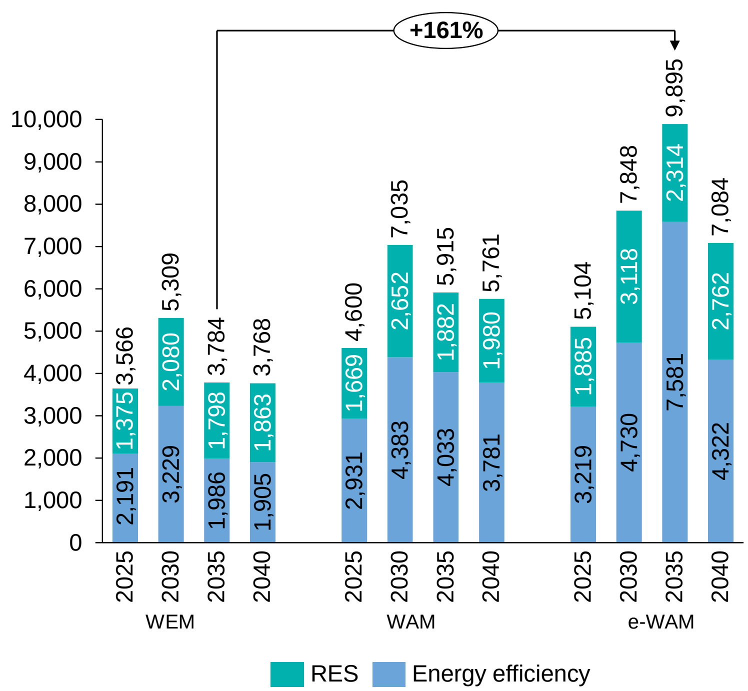

Figure 4-8: Number of domestic green jobs from RES and energy efficiency, by scenario

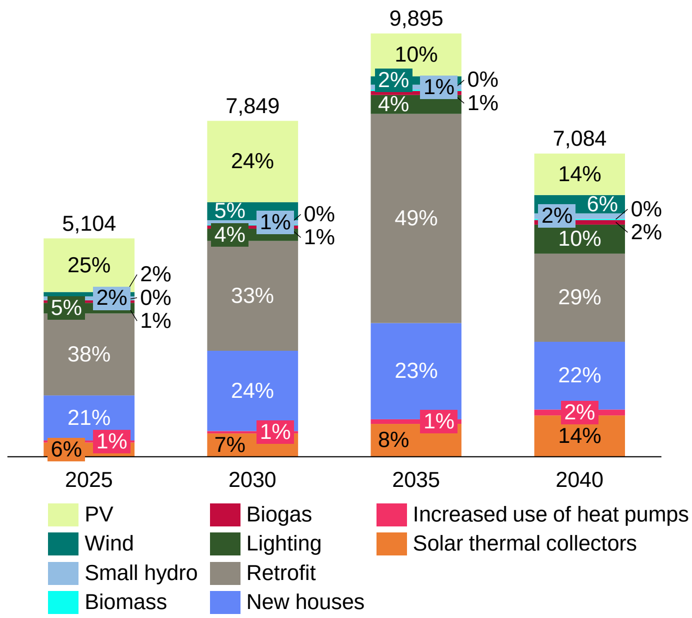

Figure 4-9: Number of domestic green jobs by technologies in E-WAM

Regarding the contribution by measures, the ones that have the highest share in the number of new domestic green jobs are: Retrofit of existing residential buildings (42%), Construction of passive houses (21%), RES without incentives (6%) and Solar thermal collectors (8%), in the e-WAM scenario in 2035 (Figure 4-10). Based on the types of jobs, very basic analyses are done concerning the gender issue. It is found that at least around 27% of the maximum number of jobs would be for women.

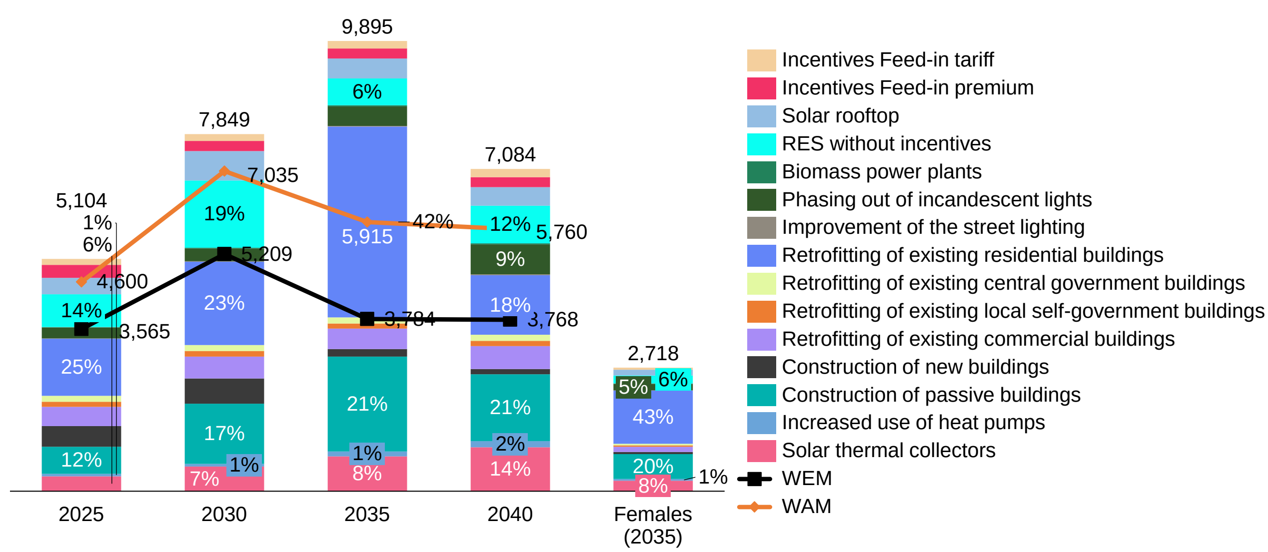

Figure 4-10: Number of domestic green jobs by measure in e-WAM

4.4.3 Social aspects - gender

The entire population is vulnerable to negative impacts of climate change. Still, different groups of people based on social, economic, educational, health (physical and mental), age, ethnicity, gender, place of living (geographical), environmental factors, as well as accessibility to the institutional mechanisms and sources for adaptation and mitigation are more vulnerable to the long-term effects of the climate change. Gender represents a basis for discrimination, violence (in the family and the society), unequal access to goods and services, lower income, lower inclusion in the education processes, labor market and decision-making processes. In general women are still exposed to gender-based violation of human rights and dignity. On the other hand, gender-based discrimination represents an obstacle for including full potential of women into the societal processes. Shifting the socio-cultural stereotypes remains basic and still most challenging obstacles to be resolved.

Within the TBUR, a set of activities were undertaken with a purpose of ensuring implementation of the Draft Action Plan for Gender Mainstreaming in Climate Change (developed with the support of the UNDP and implemented jointly by the Ministry of Environment and Physical Planning and the Ministry of Labor and Social Policy. Implementation of this Action Plan can significantly increase the efficiency of the mitigation actions. Gender issues in TBUR mitigation analysis are addressed in Table 4-2

Table 4-2: Making Climate Change Mitigation Process More Gender Responsive

	Y/N	More info
Making Mitigation Assessment More Gender Responsive	Y	To certain extent. ► Making Mitigation Assessment More Gender Responsive: contextual analysis of the needs, priorities, roles and experiences of women and men shall be developed. ► Gender Responsive Mitigation planning ensured by following gender perspectives: gender balanced team and identification of gender-based concerns/needs/priorities. ► Both women and men were involved in development of baseline scenarios and mitigation-related parameters, as well as represented by various stakeholders such as NGO sector, academia, business sector. However, the institutional gender machinery has not been included at this point. ► However, the Implementation phase will mean that all actors involved were aware that they will have to meet the gender requirements. The planned training on gender issues for participants from all implementing organizations will be a great opportunity to set the directions for achievement the gender perspective foreseen with this report, and at the same time to increase their capacity related to gender issues.

Ensure work plan highlights categories where gendered divisions of labor indicate scope for in-depth gender analysis	Y	▶ The number of green jobs calculated for the policies and measures of each of the scenarios has been disaggregated by gender i.e. at least around 27% of the maximum number of job positions in 2035 can be assigned to women; ▶ The gender specialist has identified mitigation measures relevant from gender aspects.
Establish criteria for all terms of reference to include a collection of sex-disaggregated data, establishment of a small set of gender-specific indicators, and employment of gender specialist to conduct gender analysis of mitigation findings	Y	▶ Gender specialist engaged to conduct gender analysis of mitigation findings
Ensure women and men are involved in the development of baseline scenarios and mitigation-related parameters	Y	▶ The national process for the development of mitigation scenarios incorporated well balanced gender team: 44% women and 56% men. Additional efforts have been made to integrate gender responsive considerations into the GHG inventory to the extent possible, following the national Action plan on gender and climate change and the UNDP Gender Responsive National Communications Toolkit.

Although in the Republic of North Macedonia there is an institutional "gender machinery" (staff in national institutions working on gender aspects) at central and local level on one hand, as well as a legal framework for gender equality and gender non-discrimination on the other hand, measures for equitable and gender responsive inclusion of both sexes in the mitigation actions have not been introduced into the institutional, legal and strategic framework. However, this project initiated the necessary momentum for change and mainstreaming of gender and climate change respective policies in underway.

Older women suffer greater impact of climate change

Socio-economic inequality and cultural factors are directly correlated with people's ability to cope with and influence or mitigate climate change and its adverse effects. Socio-economics analysis of gender disaggregated data collected from Skopje citizens on their heating habits identified seven most vulnerable groups:

1) Single mothers living in houses with children under the age of 18, using firewood
2) Single fathers living in houses with children under the age of 18, using firewood
3) Women 65+ age, with monthly income below 12.000 MKD single, divorced or widower and live alone
4) Men 65+ age, with monthly income below 12.000 MKD, single, divorced or widower and live alone
5) Households living in a rural environment in a house with a monthly income of up to 12.000 MKD
6) Households living in an urban area in the Skopje Valley, in buildings built up to 1963 or whose last renovation was at the latest until that year, have thermal insulated roof and insulation of a facade of up to 2cm
7) Households living in houses in urban areas, are highly educated and use firewood as a way of heating their homes

The third group i.e. **65+ women who live alone and have low monthly income** has been identified from the gender aspect as critical. According to the analysis, their number is app. 1,460 in the city of Skopje. The highest percentage of these, 62% use firewood as the primary energy source for heating the household. Age and low level of physical activity make them more susceptible to negative impacts of climate change. Muscle strain in these women often leads to injuries that are particularly emphasized in winter periods, and they are also prone to viral and bacterial respiratory infections (pneumonia), chronic diseases including arthritis or osteoporosis. Often, due to poor physical activity and the fear of injuries when moving in winter when there is snow, they spend time alone at home. Loneliness increases the possibility of depression, Alzheimer's and other types of dementia. Households are heated for more than 12 hours a day, throughout the week, during working days, weekends and holidays.

The Government initially approached the household heating issue with “first come, first served” subsidy model for changing their polluting and inefficient heating appliances, which has several shortcomings:

1) it is mostly used by households that have higher income and can bear the upfront payment;
2) the subsidies are not targeted to one specific group or area thus it is impossible to measure the impact;
3) it might be easily corrupted.

However, this data-driven approach prompted timely Government response: in the 2019/2020 heating season the subsidies criteria have been redesigned in order to support 10,000 most vulnerable households in most affected cities in the country.

4.5 Scenario with Existing Measures (WEM Scenario)

This Mitigation Scenario includes 46 measures/policies that are highly likely to be realized, i.e. they fall into one of the following groups:

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

Therefore, this scenario is also called "With Existing Measures" (WEM), and it can also be called baseline scenario that is likely to be achieved.

4.5.1 Results under the WEM Scenario

The main outputs under the Energy sector in the WEM scenario are as follows:

- 2% of the final energy or a total increase of 56.1% in 2040 (2.8 Mtoe) compared to 2017 (1.8 Mtoe);
- 2.1% of electricity consumption or a total increase of 61.2% in 2040 (10 TWh) compared to 2017 (7.1 TWh);
- 3.4% of the total installed capacity or an increase of 114% in 2040 (3.8 GW) compared to 2017 (1.8 GW);
- 1.8% of the gross inland consumption or a total increase of 49.2% in 2040 compared to 2017;
- 0.4% of greenhouse gas emissions or an increase of 9.2% in 2040 compared to 2017.

Implementing the measures/policies from the Energy, AFOLU, and Waste sectors, and taking into account the emissions from the Industrial Processes and Product Use sector from the Reference Scenario, results in the following outputs for total emissions (

Figure 4-11)

- There is a reduction in the total GHG emissions by 10% in 2040 compared to 2005 (or by 25% compared to 1990)
- The largest amount of emissions remains in the Energy sector, with a share of 76% in 2040 (excluding the FOLU sector, where there are sinks).
- During the whole planning period 2017-2040, the category FOLU has an absorption of emissions, which are increased by 15% compared to 2016 (or 147% compared to 2005).

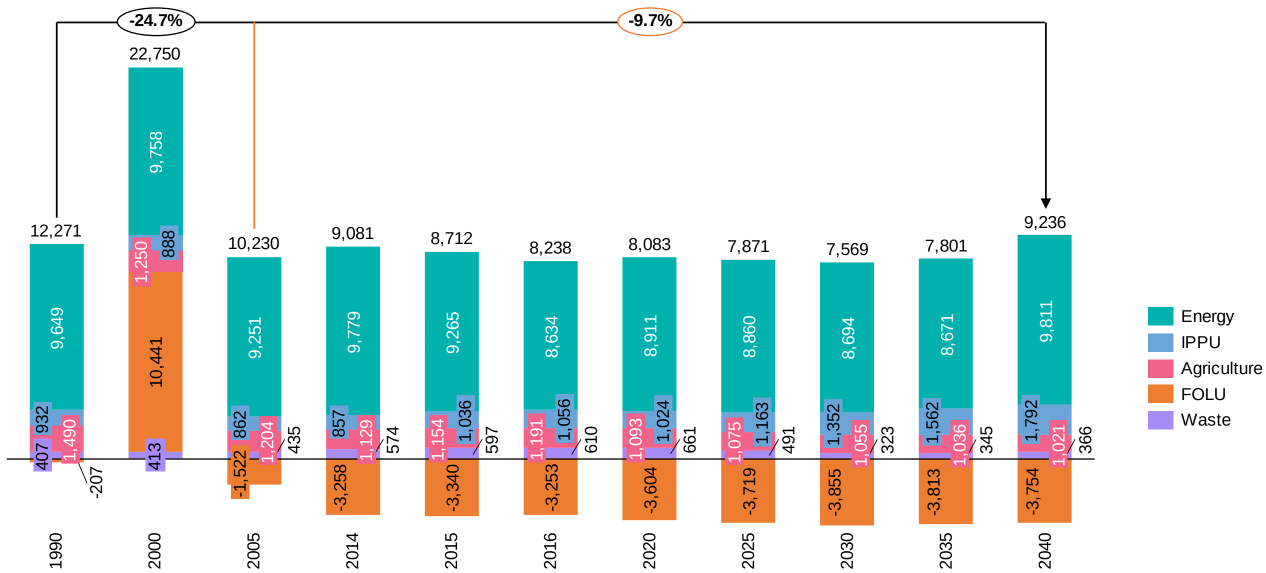

Figure 4-11: Total GHG emissions by sectors – WEM scenario (in Gg CO2-eq)

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

Measures in the Energy sector with the greatest potential for reducing greenhouse gas emissions are **reduction of network losses, large hydropower plants** and **RES without incentives. Public awareness campaigns and EE info centers** also have high potential. The measure with the most significant potential to reduce GHG emissions overall is the **landfill gas flaring and closure of existing landfills** in the Waste sector.

4.5.2 Economic Analysis of the WEM Scenario

For the realization of WEM scenario 13.308 billion EUR is needed, of which about 99% is investment in the energy sector. The average yearly investments in WEM are approximately 4.8% of the total average annual GDP of the same period.

For the implementation of the Mitigation measures in the Energy sector, investments of **13,156.8 mil. EUR** are needed, for the period from **2020 to 2040**. If the investments from the private sector are exempted, the remaining investments amount to around 3,000 mil. EUR or an average of 143 mil. € annually, (referring to the budget of the country, the local self-governments, the City of Skopje, JSC ESM). It is important to emphasize that these investments contribute to reducing the total system costs (38,532 mill. EUR discounted in 2012) compared to the reference scenario costs (39,786 mill. EUR), which is a reduction of 3%. If all of the measures are implemented in parallel and the “Energy efficiency first” principal is applied, then the total investment can be reduced by about 19%. Measures with the **most significant** potential for greenhouse gas emissions reduction are the **Large hydro power plants and RES without incentives.**

The measures from the **Forestry category** contribute the most to the reduction of greenhouse gases in the AFOLU sector - **account for 50.5%** in 2040. In order to obtain this reduction, it is necessary to invest **EUR 93 million for the period from 2020-2040**. 90% of the investments are from the private sector. Measures with the most significant potential for greenhouse gas emissions reduction are the Use of biochar for carbon sink on agricultural land and Afforestation.

Investments of **EUR 58.6 million** are necessary to implement the WEM scenario in the **Waste sector** for the period from 2020 to 2040, or an average of EUR 2.93 million annually. All investments are covered by the central budget or the local self-governments and the City of Skopje. A measure with the most significant potential for greenhouse gas emissions reduction is the Landfill gas flaring.

4.6 Scenario with Additional Measures (WAM Scenario)

In the WAM scenario, 32 measures/policies were included in the Energy sector. Most of the measures are the same as in the WEM scenario, but with different levels of penetration which leads to a higher reduction of GHG emissions. The proposed measures in the WEM scenario from the other sectors are also implemented in this scenario.

The main outputs from the WAM scenario are described through the following indicators:

- 1.5% of the final energy or a total increase of 42.2% in 2040 (2.8 Mtoe) compared to 2017 (1.8 Mtoe);
- 1.7% of electricity consumption or a total increase of 47.8% in 2040 (10 TWh) compared to 2017 (7.1 TWh);
- 3.7% of the total installed capacity or an increase of 128.5% in 2040 (3.8 GW) compared to 2017 (1.8 GW);
- 0.4% of the gross inland consumption or a total increase of 10.7% in 2040 compared to 2017;
- -1.6% of greenhouse gas emissions or a decrease of 30.6% in 2040 compared to 2017.

The implementation of all of the measures/policies selected under the WAM scenario results in the following outputs related to GHG emissions (Figure 4-12).

- Reduction in the total GHG emissions by 45% in 2040 compared to 2005 (or by 54% compared to 1990)
- The largest amount of emissions remains in the Energy sector, with a share of 66% in 2040 (excluding the FOLU sector, where there are sinks).
- During the whole planning period 2017-2040, the category FOLU has an absorption of emissions, which are increased by 15% compared to 2016 (or 147% compared to 2005).

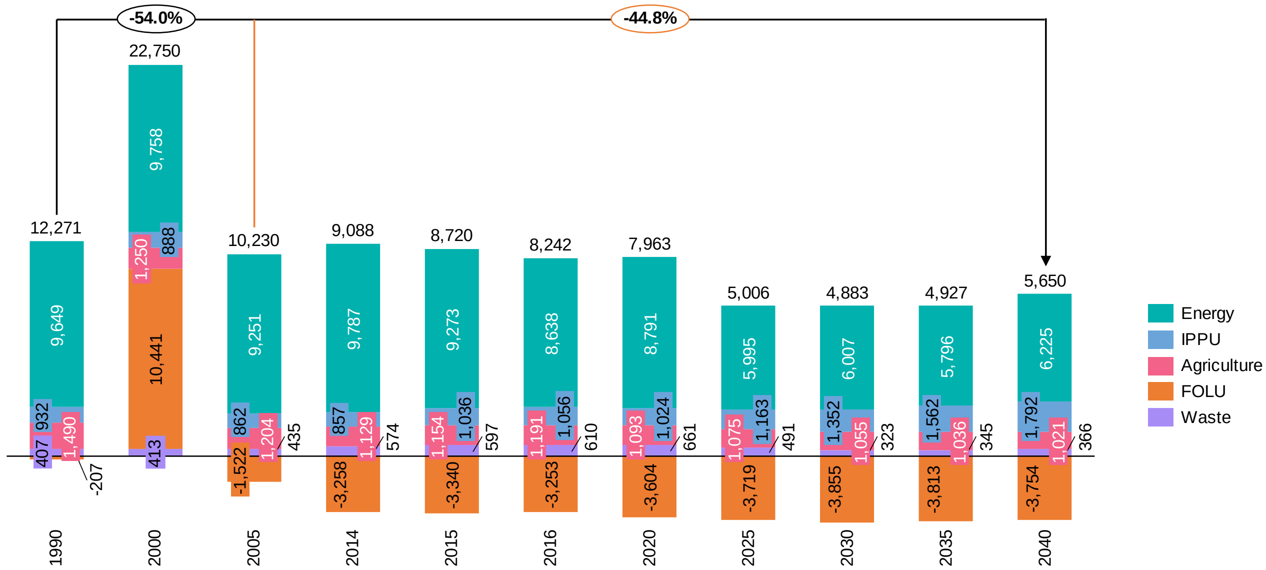

Figure 4-12: Total GHG emissions by sectors – WAM scenario (in Gg CO2-eq)

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

4.6.1 Economic Analysis of the WAM Scenario

For the realization of WAM scenario 18.411 billion EUR is needed, of which about 99% is investment in the energy sector. The investment in the other sectors are the same as in the WEM scenario. The average yearly investments in WAM are approximately 6.6% of the total average annual GDP of the same period.

For the implementation of the Mitigation measures in the Energy sector, investments of **18,259.2 mil. €** are needed, for the period from **2020 to 2040**. If the investments from the private sector are exempted, the remaining investments amount to around 3,280 mil. € or an average of 165 mil. € annually, (referring to the budget of the country, the local self-governments, the City of Skopje, JSC ESM). It is important to emphasize that these investments contribute to reducing the total system costs (€ 36,828 million discounted in 2012) compared to the reference scenario costs (€ 39,786 million), which is a reduction of 7.5%. If all of the measures are implemented in parallel and the "Energy efficiency first" principle is applied, then the total investment can be reduced by about 12%. Measures with the **most significant** potential for greenhouse gas emissions reduction are the **Large hydro power plants, RES without incentives and Phasing out of incandescent lights.**

4.7 Scenario with extended mitigation measures (e-WAM Scenario)

In the Extended Mitigation Scenario (e-WAM), 32 measures/policies were included in the Energy sector. As in the WEM and WAM scenarios, most of the measures are the same, but with different levels of ambitious. The proposed measures in the WEM scenario from the other sectors are also implemented in this scenario.

The main indicators by which the e-WAM scenario is described indicate the following outputs:

- 1.2% of the final energy or a total increase of 31.8% in 2040 (2.8 Mtoe) compared to 2017 (1.8 Mtoe);

- 1.6 % of electricity consumption or a total increase of 44.6% in 2040 (10 TWh) compared to 2017 (7.1 TWh);
- 3.7% of the total installed capacity or an increase of 130.4% in 2040 (3.8 GW) compared to 2017 (1.8 GW);
- 0.1% of the gross inland consumption or a total increase of 2.6% in 2040 compared to 2017;
- -2.4% of greenhouse gas emissions or a decrease of 42.2% in 2040 compared to 2017.

The implementation of all of the measures/policies selected under the e-WEM scenario results in the following outputs related to GHG emissions (

Figure 4-13).

- Reduction in the total GHG emissions by 55% in 2040 compared to 2005 (or by 62% compared to 1990).
- The largest amount of emissions remains in the Energy sector, with a share of 62% in 2040 (excluding the FOLU sector, where there are sinks).
- During the whole planning period 2017-2040, the category FOLU has absorption of emissions, which are increased by 15% compared to 2016 (or 147% compared to 2005).

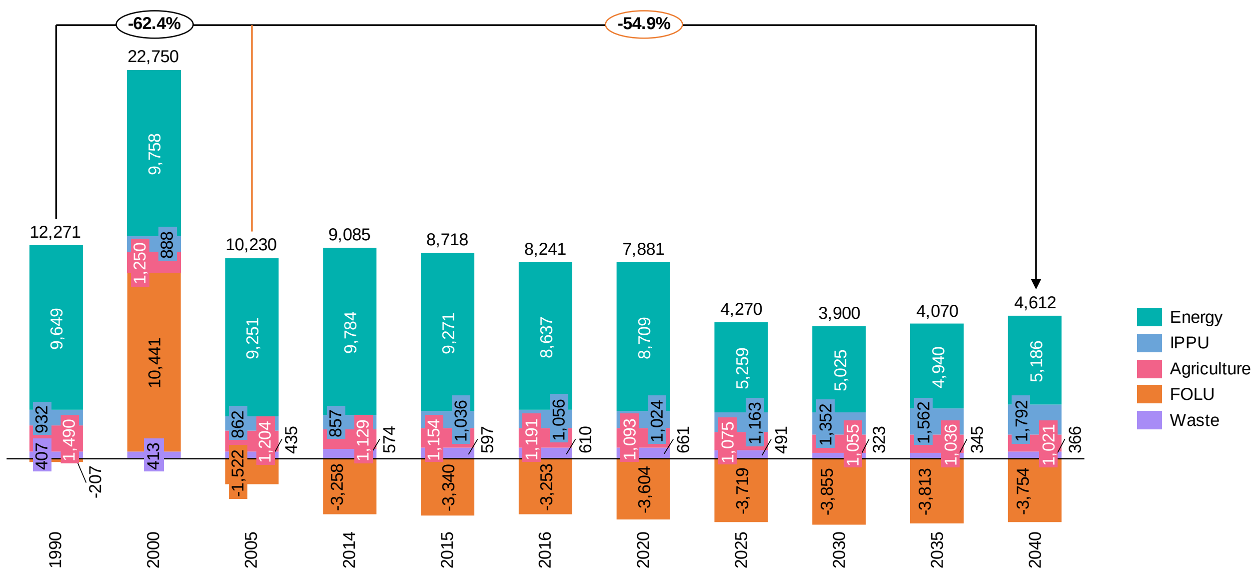

Figure 4-13: Total GHG emissions by sectors – e-WAM scenario (in Gg CO2-eq)

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

4.7.1 Economic Analysis of the e-WAM Scenario

For the realization of e-WAM scenario 21.348 billion EUR is needed, of which about 99% is investment in the energy sector. The investment in the other sectors are the same as in the WEM scenario. The average yearly investments in e-WAM are approximately 7.7% of the total average annual GDP of the same period.

For the implementation of the Mitigation measures in the Energy sector, investments of **21,196.0 mil. €** are needed, for the period from **2020 to 2040**. If the investments from the private sector are exempted, the remaining investments amount to around 3,570 mil. € or an average of 170 mil. € annually, (referring to the budget of the country, the local self-governments, the City of Skopje, JSC ESM). It is important to emphasize that these investments contribute to reducing the total system costs (€ 35,958 million discounted in 2012) compared to the reference scenario costs (€ 39,786 million), which is a reduction of 9.6%. If all of the measures are implemented in parallel and the "Energy efficiency first" principal is applied, then the total investment can be reduced by about 7%. Measures with the **most significant** potential for greenhouse gas emissions reduction are the **RES without incentives, Large hydro power plants and Phasing out of incandescent lights.**

4.8 Conclusions

4.8.1 Summary of Findings

When comparing the results from the different scenarios there are two approaches: one is relative to the reference scenario (WOM) and the other is relative to a base year. Since for Macedonia the base year is not yet defined, in this report 1990 and 2005 are used. On the other hand, the total GHG emissions are calculated using the IPCC methodology, but in addition, in order not to use the electricity import (MEMO item) as a mitigation measure, in this report the emissions from electricity imports are also considered. This is very important for adequately calculating the impact of each measure for Macedonia, as import dependent country. However, with the aim of comparing the result with other countries and for compatibility with the GHG Inventory, the results without the emissions from electricity import are presented.

In this regard, when comparing the results relative to the WOM scenario, the reduction of the total GHG emissions without MEMO are higher (78% in e-WAM in 2030, Figure 4-14) than in the case with MEMO (67% in e-WAM in 2030, Figure 4-15).

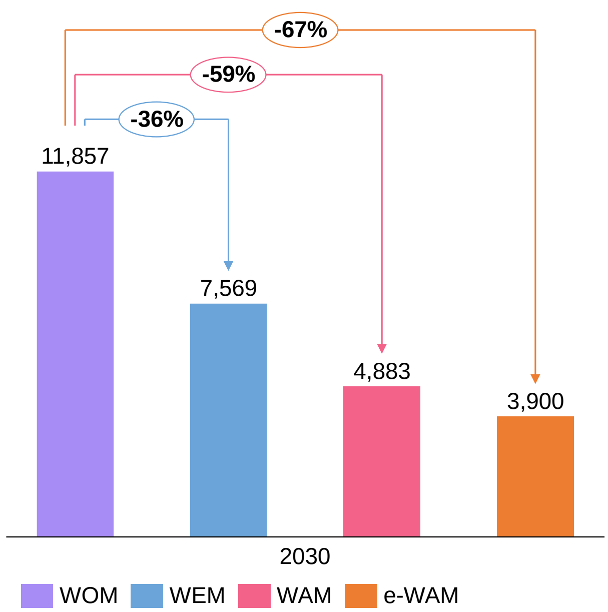

Figure 4-14: Comparison of total GHG emissions from all sectors in WOM, WEM,

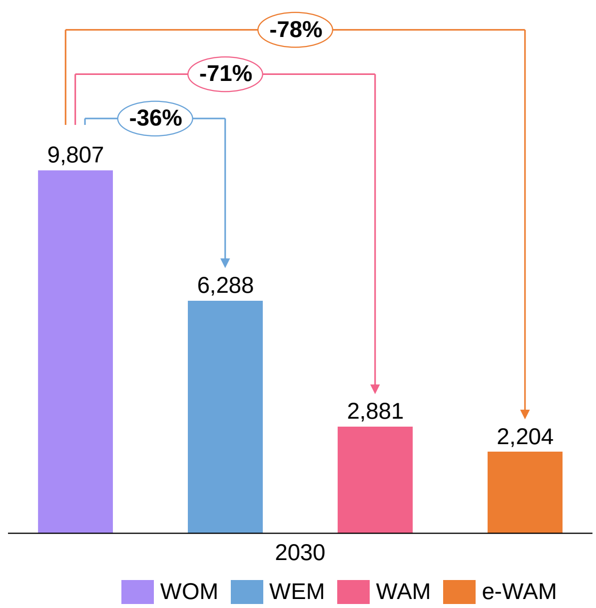

Figure 4-15: Comparison of total GHG emissions from all sectors without MEMO in

WAM and e- WAM scenarios, 2030 (in Gg CO_2-eq)

WOM, WEM, WAM and e- WAM scenarios, 2030 (in Gg CO_2-eq)

Regarding the comparison of the results relative to a base year, it can be concluded that 1990 is a more suitable year for the country, as there are more GHG emissions in this year compared to 2005, and therefore the reductions will be higher. The highest reduction of the GHG emissions that can be reached in 2030 is 82% (or 68% with MEMO) compared to the 1990 level and it is accomplished by implementing the e-WAM scenario (Figure 4-16, Figure 4-17).

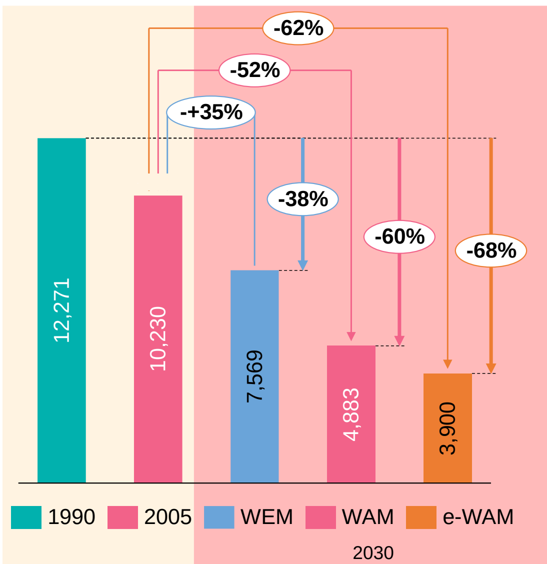

Figure 4-16: Total GHG emissions from all sectors in WEM, WAM and e- WAM scenarios in 2030 compared to 1990 and 2005 level (in Gg CO_2-eq)

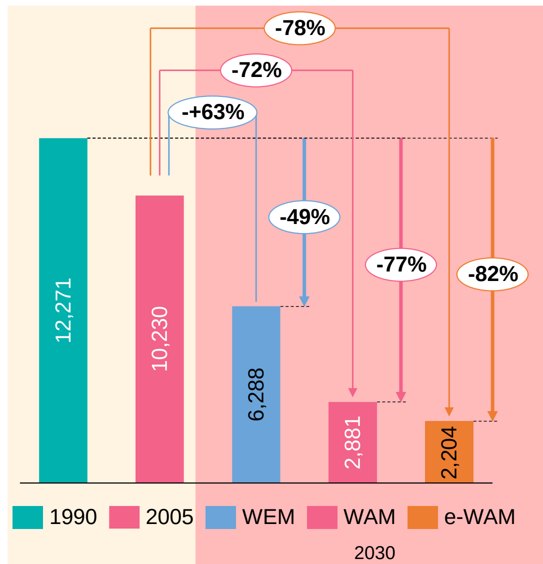

Figure 4-17: Total GHG emissions from all sectors without MEMO in WEM, WAM and e-WAM scenarios in 2030 compared to 1990 and 2005 level (in Gg CO2-eq)

For the realization of WEM scenario 13.308 mil. € are needed, of which about 99% are investment in the energy sector. WAM scenario requires additional 38%, while for the realization of e-WAM almost 60% more compared to WEM (Figure 4-1) The average yearly investments in WEM are approximately 4.8% of the total average annual GDP, while in the e-WAM is 7.7% (Figure 4-2). If all of the measures are implemented in parallel and the “Energy efficiency first” principal is applied, then the total investment can be reduced in the range from 7% to 19%.

4.8.2 Comparison of the mitigation scenarios with SBUR and the INDC

The more ambitious policies and measures proposed in the TBUR doubled the percentage of GHG reductions compared to the SBUR WOM scenario. In absolute terms, in 2030 the emissions in the SBUR WAM scenario were projected to 16,681 Gg CO_2-eq while in the TBUR e-WAM scenario to 3,900 Gg CO_2-eq (Figure 4-18). This WOM scenario is frozen to the 2017 level, which means that the measures implemented up to 2017 are included and is different compared to the

WOM scenario in the SBUR (which was frozen to 2012 level). Besides, the lower GDP growth rate in TBUR (3.3% annually) also plays an important role in the projected results. Furthermore the emissions from the waste sector in TBUR are almost six times lower compared to SBUR (Figure 4-19) because of the changes made in the calculation of the waste from the industry (waste generation rate as a percentage from GDP) as part from the GHG inventory preparation process.

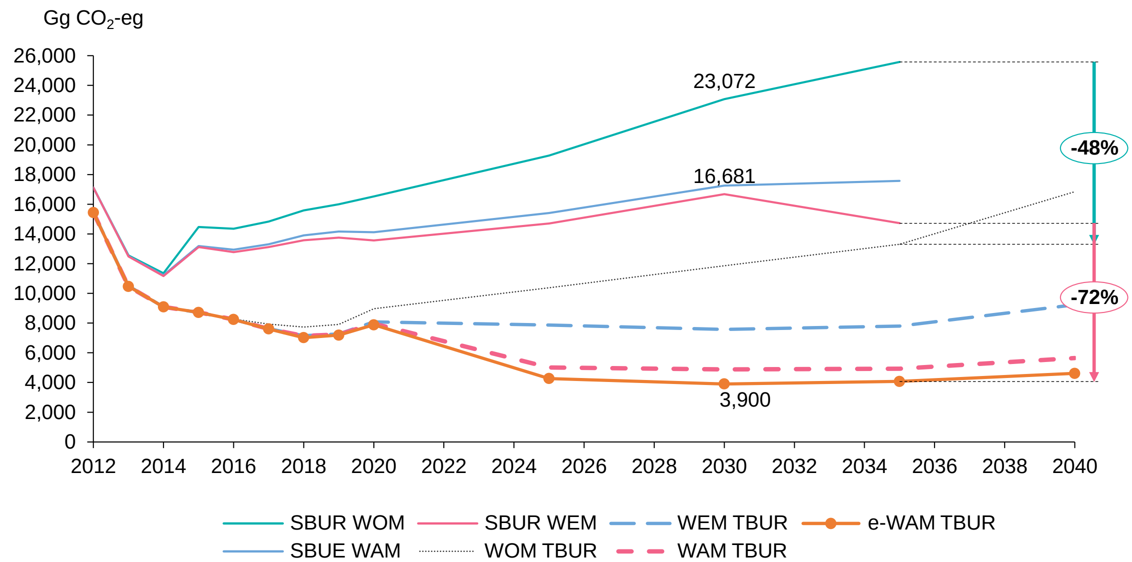

Figure 4-18: Comparison of the results from SBUR with TBUR

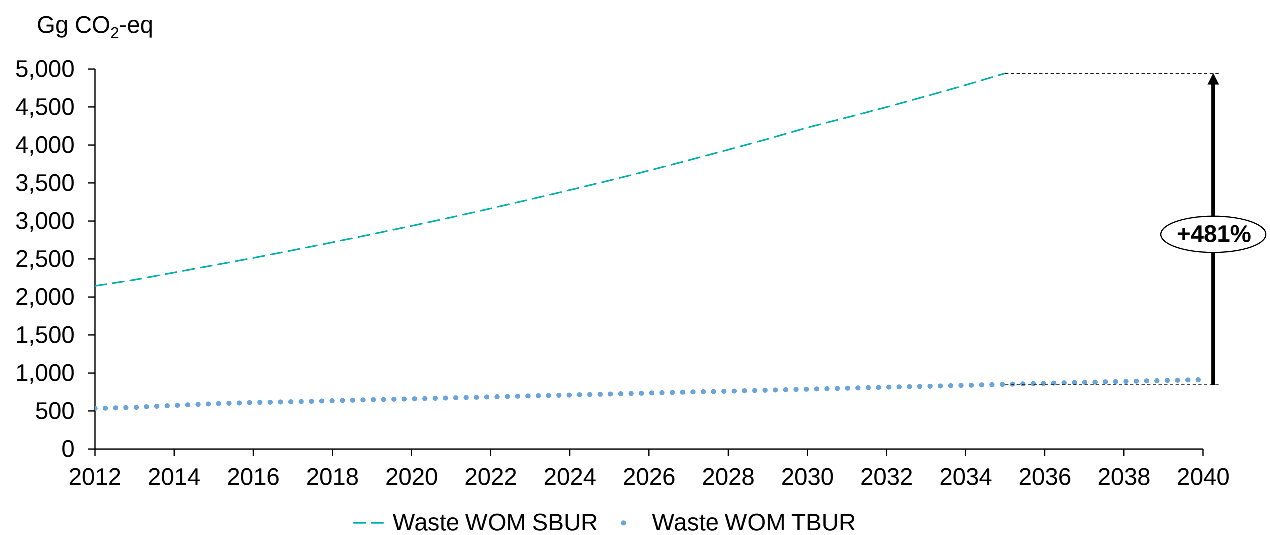

Figure 4-19: GHG emissions from the waste sector, comparison between SBUR and TBUR WOM scenario

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

- besides CO2 emissions TBUR takes into account the emissions of CH4 and N2O which were not included in the INDC
- an emission factor has been attributed to the import of electricity

- as a result of the changes in the modelling, the change of input parameters (prices of fuels, Gross Domestic Product (GDP) growth, population growth etc.) the Reference scenarios in the TBUR is different from the Reference scenario in the INDC.

If one was to make a realistic comparison with the INDC goals, only the CO2 emissions should be taken into account while the emissions related to electricity import should be disregarded. Additionally, a comparison with the INDC reference scenario should be made to assess the relative decreases with respect to that scenario. The results from the comparison are displayed in Figure 4-20 which shows that:

- in the year 2030 in TBUR the WEM is more ambitious than the mitigation scenarios defined in the INDC, as well as in SBUR.
- in TBUR WEM in 2030 the emissions are decreased by 60% compared to the referent Business-as-usual scenario defined in INDC,
- in the TBUR WAM scenario the emissions are decreased by 78% compared to the Business-as-usual scenario in INDC.
- in the TBUR e-WAM scenario the emissions are decreased by 83% compared to the Business-as-usual scenario in INDC.

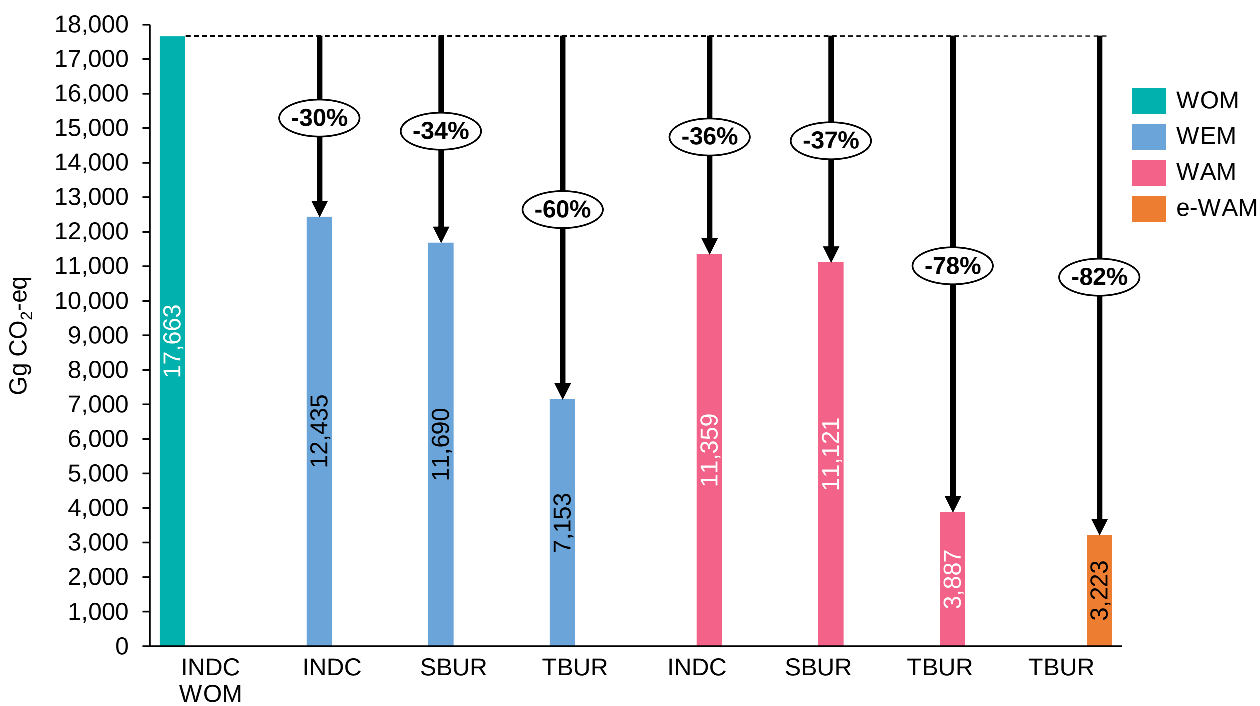

Figure 4-20 Comparison of the SBUR, INDC and FBUR, Mitigation and the Higher ambitious scenarios from the Energy sector with the INDC Reference scenario, 2030 (in Gg CO_2-eq)

4.8.3 UN Sustainable Development Goals and the WAM and WEM Scenarios

In addition to comparing the mitigation scenarios with the Republic of North Macedonia's INDCs, the mitigation team also analyzed the scenario results with respect to several **key indicators** for sustainable development related to climate change and energy. The contribution of the Republic of North Macedonia in global efforts for achieving sustainable development, in this report, is measured through the global indicator framework for Sustainable Development Goals (SDG). On one hand, SDG indicators are used to track the progress of implementation of each of the policies and measures proposed. On the other hand, in this chapter some of the indicators are used for comparing the Macedonian overall planned progress with the countries in the regions, as well as with some of the EU countries. With the proposed policies and measures six Sustainable Development Goals are covered. The relevant indicators that contribute towards achieving each of the goals are in compliance with the mapping made by EU and EUROSTAT (Table 4-3).

Table 4-3: SDG indicators used in TBUR

Goal	Code	Indicator
1 NO POVERTY	sdg_07_60	Population unable to keep home adequately warm by poverty status
	sdg_01_60	Population living in a dwelling with a leaking roof, damp walls, floors or foundation or rot in window frames of floor by poverty status
2 ZERO HUNGER	sdg_02_60	Ammonia emissions from agriculture
7 AFFORDABLE AND CLEAN ENERGY	sdg_07_10	Primary energy consumption
	sdg_07_11	Final energy consumption
	sdg_07_20	Final energy consumption in households per capita
	sdg_07_30	Energy productivity
	sdg_07_40	Share of renewable energy in gross final energy consumption by sector
	sdg_07_50	Energy import dependency by products
	sdg_07_60	Population unable to keep home adequately warm by poverty status*
	sdg_13_20	Greenhouse gas emissions intensity of energy consumption
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE	sdg_09_50	Share of buses and trains in total passenger transport
	sdg_09_60	Share of rail and inland waterways in total freight transport
	sdg_12_30	Average CO2 emissions per km from new passenger cars
11 SUSTAINABLE CITIES AND COMMUNITIES	sdg_11_60	Recycling rate of municipal waste
	sdg_09_50	Share of buses and trains in total passenger transport
12 RESPONSIBLE CONSUMPTION AND PRODUCTION	sdg_12_30	Average CO2 emissions per km from new passenger cars
	sdg_12_50	Generation of waste excluding major mineral waste by hazardousness
	sdg_07_10	Primary energy consumption
	sdg_07_11	Final energy consumption
	sdg_07_30	Energy productivity
	sdg_07_40	Share of renewable energy in gross final energy consumption by sector
13 CLIMATE ACTION	sdg_13_10	GHG emissions
	sdg_13_20	Greenhouse gas emissions intensity of energy consumption
	sdg_07_10	Primary energy consumption
	sdg_07_11	Final energy consumption
	sdg_07_40	Share of renewable energy in gross final energy consumption by sector
15 LIFE ON LAND	sdg_15_10	Share of forest area

4.8.4 Comparison with other countries

The following section compares Macedonian projected progress with other countries from the Western Balkan region (Serbia, Kosovo, Montenegro, Bosnia and Herzegovina and Albania), as well as, with some EU countries (Greece, Bulgaria, Croatia, Slovenia, Hungary, Austria and EU28).

In 2018, the share of **RES in the gross final energy consumption** in the Republic of North Macedonia is around 18%, which is similar to the RES share at EU28 level, but it has decreased compared to 2017, mainly as a result of the increased consumption in the transport sector. However, the projected investments in RES and energy efficiency will increase the share of RES in the gross final energy consumption up to 45% in the e-WAM scenario, which is 6 percentage points higher compared to the share of Montenegro in 2018 (a country with the highest share in the considered region).

It is projected that the **electricity generation** in the Republic of North Macedonia will be driven mainly by RES power plants. The investments mainly in PV and wind supported by the hydropower plants, biogas and biomass will significantly increase the RES share in electricity generation, leading to zero carbon from electricity generation. In 2040, this share will achieve 80% in e-WAM (25% in 2018), which is higher than the share of any of the considered countries in 2018 except Albania.

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

One of the indicators that is important for the security of supply is **Energy dependence**. The goal of the Energy development strategy up to 2040 is to maintain the energy dependence at the 2017 level (54%). The introduction of CO2 tax with a price higher than 30 EUR/t can significantly contribute to the decommissioning of the lignite power plants in the Republic of North Macedonia. That will increase the import dependence if the investments in RES are not realized. The realization of RES investment will decrease the import dependence to 55% in the e-WAM scenario. which is similar to the level of Croatia and Slovenia in 2018. Even if part of the existing lignite power plants is replaced with gas power plants, the import dependence will increase (62% in 2040).

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

The Republic of North Macedonia compared to EU countries has **lower GHG emissions intensity of energy consumption.** The results show that this indicator will be decreased to 35 % in 2040. In the worst case, the level of this indicator will stay almost the same as in 2014.

Another important indicator is **GHG emissions per capita** (CO_2-eq/capita), according to which the country has the **lowest value compared to the analyzed countries** (3.3 tCO_2-eq/capita in 2016). In the best scenario (e-WAM), GHG emissions in 2040 will be reduced up to 45% compared to the 1990 level, which leads to 3.4 tCO_2-eq/capita. In the worst scenario (WOM), the tCO_2-eq/capita in 2040 in the country will approach the Austrian 2017 level (9.6 tCO_2-eq/capita).

When the **GHG emissions are expressed relative to the 1990 level**, the country is again in a better position than the considered EU countries. However, if none of the proposed policies and measures are implemented, the GHG emissions maybe 50% higher than in 1990. In e-WAM, the GHG emissions in 2040 will be reduced up to 45% compared to the 1990 level, which leads to 3.4 tCO_2-eq/capita (4.5 tCO_2-eq/capita in 2018). In the worst scenario, the tCO_2-eq/capita in 2040 in the country will approach the Austrian 2017 level.

For the first time in the inventory report the **Forest land indicator** has been calculated. It is important to note that forest land influences to a high extent the overall GHG emissions mitigation potential. As a starting point for comparison, the percentage of forest land to total land in 2020 is around 40%. Compared to the EU28 countries, Macedonia is almost at the same level of forest land cover. The country with the highest forest land share is Slovenia with 63.4% followed by Croatia with 50.6% .If the proposed measures in the Forest sector are not implemented the share of the forest land will decline for around 7 percent in the Rep[ublic of North Macedonia. On the other hand, the proposed measures will contribute to maintain almost the same level as in 2020.

4.8.5 TBUR mitigation analyses changes relative to the SBUR

In the TBUR a few changes have been made relative to the SBUR that can be summarized as follows:

- The contribution of each measure for achieving the SDG goals is presented.
- With the help of the SDG indicators, the overall development of the country in terms of GHG emission reductions in monitored, which can be compared to other countries. In this regard, for the first time in this report, an indicator from the Forestry sector was presented, with the help of which the forests area in the country and its comparison with other countries was presented. Additionally, a new indicator in the Energy sector - Energy consumption in households per capita, was calculated and presented.
- For some measures in the energy sector are defined three different paths of implementation that correspond to a different scenario.
- Regarding the Energy sector, the ambitions of the proposed measures are much higher compared to those in SBUR. Several completely new measures have been introduced, the most important of which is the measure for the introduction of CO_2 tax, which significantly changes the penetration of other measures in the field of RES, energy efficiency, fuel switch, etc.
- Two completely new measures have been introduced in the AFOLU sector, Application of Biochar and Photovoltaic Irrigation and Manure management in small Dairy farms (up to 50 head, N_2O emission reduction).
- Regarding the waste sector, the changes that have been implemented in the waste sector within the GHG Inventory have been adequately incorporated into the mitigation model for

the waste sector, such as the data for waste generation rate in industry and composition of waste. Additionally, for the first time in TBUR, a forecast of waste incineration emissions based on historical data has been made. Also, historical data for value added data has been linked to total organic degradable material in the wastewater. Their connection, together with the value-added projections from the MARKAL model, has been used to calculate the projections of emissions from Industrial wastewater treatment. Furthermore, for the first time, a measure (Improved waste and materials management at industrial facilities) has been introduced in the category Solid Waste Disposal from Industry.

5 Constraints and Gaps, and Related Financial, Technical and Capacity Needs, including a Description of Support Needed and Received

5.1 Overview

This chapter presents an analysis of the Republic of North Macedonia's financial, technical and capacity needs for climate change management and the support required to meet the UNFCCC reporting obligations. This chapter provides an account of the support received for the implementation of programmes and projects that contribute to the management of GHG emissions. For the elaboration of this section, the guidelines established by the UNFCCC on biennial reporting (Annex III, Decision 2/CP17) were considered as a framework. The analysis in this section, which covers the time period 2018-2020, summarizes the results of a rapid assessment and stakeholder consultation process that was conducted as part of the preparation for this report and additional supplementary documents (Gecevska, V. 2020[10], European Commission, 2020).

In recent years, the country has made progress in developing climate change actions for adaptation and mitigation, through the articulation of strategies at the sectoral, national and regional levels. Despite these advances and the recognition of the problems facing the country's future, there are still some needs to be met and challenges to be overcome in terms of financing, capacity and technical assistance in the different areas of climate change management. Meeting these challenges will make it possible to increase the installed technical and financial capacities, the generation and implementation of public policies, and the enhancement of technical capacities. It will further improve the performance of the institutions in charge of managing the processes associated with climate change mitigation.

In the Strategy for energy development up to 2040 of North Macedonia, as well as in Third BUR there is a measure for introduction of CO_2 tax which will be the first step towards Carbon Market Mechanism. Energy Community Treaty works to integrate Contracting Parties into the EU energy market via harmonization of the legal and regulatory framework, but still the crucial element is missing – a carbon pricing mechanism. Initial analyses have been provided within an Energy Community study on carbon pricing for South Eastern Europe. However, this study is general and does not provide specific recommendation for Macedonia. Therefore, introduction of CO_2 tax shall be explored in more details within the development of the Macedonian enhanced NDC.

5.2 Financial, technical and capacity needs

The institutions in the Republic of North Macedonia have demonstrated progress and increased capacity in climate change management and monitoring activities to fulfil the UNFCCC's requirements. However, new needs and challenges have been identified that need to be overcome in order to optimize the development of the reporting mechanisms at the internal or national level. These needs include (i) capacity building, (ii) financial resources, and (iii)

[10] Rapid Assessment Report _ Current status of the research, development, innovation and technology transfer related to climate change in the Republic of Macedonia, part of the project TBUR, UNDP, January 2020.

technology transfer. The country continues to depend on international cooperation sources for the preparation of national reporting to UNFCCC.

The analysis of the institutional capacity needs is based on the outcomes of the European Commission Report (2020). The analysis looks at the internal organization and structures of the institutions and their capacity to perform monitoring and reporting. It also addresses aspects like coordination or cooperation, both within and between institutions.

The leading institution for climate action in the country is the Ministry of Environment and Physical Planning (MoEPP), which has a Unit for Climate Change under the Department for Sustainable Development and Investments. The MoEPP is the main institution responsible for policies, legislation preparation, planning, regulatory action, and reporting on the climate situation and climate action. The Ministry is also designated as the main institution responsible for coordinating inter-institutional cooperation for the preparation of the national plans on climate change and climate action, including the preparation of the GHG inventories and reporting obligations towards the UNFCCC.

The Macedonian Environmental Information Centre (MEIC), which forms part of the MoEPP, has an important role to play in monitoring and reporting. However, MEIC does not have a specific department or unit for climate action and the responsibilities are covered by the existing departments. Although MEIC is collecting, processing, and disseminating data, it is only regarding air quality and does not involve the National GHG inventories. Instead, the Research Centre for Energy and Sustainable Development, part of Macedonian Academy of Sciences and Arts (MANU – RCESD) often prepares the assessments required for the national reporting to UNFCCC (Biennial Update Reports, National Communication, GHG inventories and Nationally Determined Contributions). This engagement is project based, given that the country's reporting to the UNFCCC has been funded by GEF and is supported by UNDP.

At the government level, there is a lack of a permanent technical team for the development of the reports. Additionally, at regional and sectoral level, there is low capacity in the systematization of quality information and timely delivery for the reports. These are longstanding limiting factors, with regards to capacities for MRV. At present a draft proposal foresees a Senior Associate for the Preparation of a GHG Inventory from the Industry Sector and several other positions with tasks related to climate change management, monitoring and reporting (European Commission, 2020)[11].

As climate action is cross-sectoral, responsibilities need to be shared and effectively coordinated between ministries. The National Climate Change Committee (NCCC) is the coordination body, which provides high-level support and guidance for overall climate change policies in the country. The NCCC is an intergovernmental body that consists of representatives from all relevant governmental institutions, NGOs and academia. The NCCC has participated in the development of the three national communications and two biennial update reports submitted by the country so far. Generally, most of the relevant institutions are given mandates for climate actions meaning that they have responsibilities and tasks. While the existence of an inter-ministerial coordination mechanism on climate change is worthwhile, participating Ministries do not have units/departments dedicated to climate change. Therefore, the lack of adequate specific structures and resources in terms of sufficient and qualified staff, illustrates the constrained capacities of the Ministries on climate change. This is likely an obstacle to an effective cooperation in climate action matters in the government.

[11] a draft proposal for new staff in the MEIC was prepared in 2019 but is still not adopted.

Furthermore, the legal framework on climate change is still located within the Law on Environment, which does not provide a comprehensive foundation for long-term policy and strategic planning.

Table 5-1 presents a summary of the capacity, technical and financial needs related to the reporting, GHG emission reduction management and Monitoring, Reporting and Verification (MRV) and description of required support.

Table 5-1: Identified financial, technical and capacity needs and description of required support

Topic	Identified financial, technical and capacity needs	Type of support required	Description of the support
Development of National GHG Inventories	Training to government officials in specific methodological aspects for conducting National GHG Inventories.	Capacity building	Updating of the methodologies used, mainly in relation to issues such as uncertainty analysis, control and quality management of data and emission factors.
	There is a need to establish an expert technical group in MEIC or other entity responsible for the preparation of relevant studies for GHG Inventories.	Financial support	Consolidate a permanent team of professionals dedicated to activities related to GHG inventories (elaboration and updating, implementation of the improvement plan, strengthening of the MRV system, emission reference scenarios, elaboration of different reports, analysis of results, etc.). Ideally, this team should be made up of consultants and institutional employees including sector leaders, professional in statistics, support for quality control, specialist to integrate the gender approach, and a coordinator.
GHG emission reduction management	Public entities that form part of the NCCC need a clear institutional structure with units on climate change and qualified staff to be responsible for climate policy-making, regulatory functions, monitoring and reporting.	Capacity building Financial support	Establish climate change units or climate focal points in all institutions participating in the NCCC with a clear mandate for mainstreaming climate change in the relevant sectors.
	Technical assistance is required in designing efficient financial mechanisms for financing mitigation actions.	Capacity building Technical support	- More accurate costing of financing needs for mitigation measures at the sectoral, departmental and municipal levels. - The design of financial instruments to mobilize resources for climate change mitigation.
	Strengthen the public entities that will lead the components of	Capacity building	Enhance capacity for the collection of sectoral information for the calculation of

Monitoring, Reporting and Verification (MRV)	the MRV system (MoEPP – MEIC, other Ministries) by integrating support personnel to ensure the articulation, sustainability and operation of the MRV system.		baselines, projection of sectoral growth, identification of growth drivers and costs for national mitigation initiatives, among other.
	New sources of funding and cooperation need to be explored, allowing the development of the MRV-related activities in a constant way through time.	Financial support	- Define and establish budget allocation structures at the national level (sectoral and institutional), to ensure the financial sustainability of the MRV-related activities. - Create efficient mechanisms for the timely management of international resources to support the financial sustainability of MRV-related activities.

5.3 Technology Transfer, Research and Development

The legal framework comes from the directions provided by the Programme of the Government of the Republic of North Macedonia for the periods 2012-2015 and 2017-2020 that are dedicated to achievement of the overall goals for economic and sustainable grown with high quality education. The realization of the overall goals and their Research and Development (R&D) policy goals goes with the laws, the policies, the strategic documents and the measures.

The more focused R&D policy goals are specified it the following legal acts in the country:

- Law on the Scientific and Research Activities (2016) with National Programme for Scientific R&D Activities;
- Law on Encouragement and Support of Technological Development with National Programme for Encouragement and Support of Technological Development (2012-2015), repealed wit Law of Innovation Activity (2015);
- Law on Higher Education (2018), with National Strategy for Education (2018-2025).

Issues related to innovation and technology transfer (TT) policy goals are regulated by the following legal acts:

- Law of Innovation Activity of the Republic of North Macedonia;
- Innovation Strategy of the Republic of North Macedonia;
- Industrial Policy of the Republic of North Macedonia;
- Policy of Small and Medium Enterprises of the Republic of North Macedonia;
- Regional Strategy for Innovation R&D of Western Balkans.

Table 5-2 presents the key policy instruments relevant to innovation and TT and their role for achieving progress in the Republic of North Macedonia.

Table 5-2: Description of key policy instruments on Technology Transfer and Innovation in the Republic of North Macedonia

Policy instrument	Description
Law of Innovation Activity of the Republic of North Macedonia (Official Gazette 79/2013)	The Law determines the innovation activity, as well as principles for commercialization of the results of the innovation activity, the scientific research activity, the technical and technological knowledge and of the inventions. The law envisions establishment of a public body entitled Fund for Innovation and Technological Development (FITD), established in December 2013, which coordinates finance and logistically support the innovative projects in order to improve the competitiveness.
Innovation Strategy of the R. Macedonia for 2012-2020 (Official Gazette /2013)	The Strategy defines the four strategic objectives: (i) Strengthening of the propensity of business sector to innovate; (ii) Strengthening of the human resources to innovate; (iii) Strengthening of environment for innovation; (iv) Strengthening of knowledge transfer between innovation stakeholders. The Action Plan aims to establish Centers for Technology Transfer at the lead universities in the country to support industry – academia cooperation through knowledge transfer, technology transfer and straitening commercialization of R&D and innovation results.
Industrial Strategy of the Republic of Macedonia 2018-2027 with Action Plan[12] (Official Gazette /2018)	The Strategy is the biggest national strategic document for enhancing the innovation framework conditions for Macedonian industry and SME development in order to attracting the region for new investment and new jobs creation. The Strategy enforces development of the new national Smart Specialization Strategy (3S)[13], according to the European Platform for 3S, in order to detect the key potential technologies of national industry sector as a focus to fostering the economic grown of the country and the region. The Strategy envisions the FITD as the potential National Technology Transfer Office (NTTO).

The governmental body in charge of Research and Development (R&D) policy in the Republic of North Macedonia is the Ministry of Education and Science. The Ministry has the responsibility to

[12] Industrial Strategy of the Republic of Macedonia 2018-2027 with Action Plan. Available at: http://economy.gov.mk/Upload/Documents/Finalna%20Industriska%20Strategija.pdf

[13] European Platform for Smart Specialization Strategy. Available at: https://s3platform.jrc.ec.europa.eu/north-macedonia

organize, finance, develop and promote R&D, technological development and transfer, information systems as well as the international cooperation related to these issues.

The Government has not yet nominated a National Designated Entity (NDE) under the Technology Transfer (TT) mechanism of UNFCCC. The NDE should play a key role in promoting R&D and innovation activities into competitive products and processes, which help transform various sectors (e.g. energy, industry) towards green growth.

The Fund for Innovation and Technology Development (FITD) is established in December 2013 by the Government, is public legal entity for coordination of financing of innovation activities. The FITD provides technical assistance and consulting services for start-up and MSM enterprises in order to increase the investment in innovation, as well as financing and co-financing of research and innovative projects. The Fund is developed in two phases, the first funded solely by the Government, and the second phase additionally financed by the World Bank and IPA funding scheme. The FITD supports innovation and technology development in the country through five financial instruments, explained herewith above with realized support actions for period of five years[14]:

- **INS1** - commercialization of innovation in MSMEs for enlarging research& development activities in private sector, as well as cooperation with academia, in order development, transfer and implementation of new, innovative or improved technologies, processes and products (for micro and small-sized enterprises co-financing up to 70% of the project's budget and for medium-sized up to 60% with maximum amount of €325.000),
- **INS2** - grown of start-ups and spinoffs based on technology development and innovative activities (co-financing up to 85% of the project's budget, with maximum amount of €30.000),
- **INS3** -technology development and extension of SMEs with new technologies and processes (co-financing up to 30% of the project's budget, with maximum amount of €150.000),
- **INS4** - development and investment in business-technology accelerators (co-financing up to 75% of the project's budget, with maximum amount of €500.000), and
- **INS5** - new planned instrument for technology transfer in first phase supporting the private companies within the knowledge transfer in academia-industry cooperation (co-financing up to 70% of the project's budget, with maximum amount of €20.000).

Other relevant institutions for promoting technology transfer include:

- RCESD – Research Centre for Energy and Sustainable Development, part of Macedonian Academy of Sciences and Arts (MANU);
- CIRKO – Center for Research, Development and Continuing Education, at the Faculty of Mechanical Engineering (MFS), at Ss. Cyril and Methodius University in Skopje (UKIM);
- INNOFEIT – Center for Technology Transfer and Innovations, at the Faculty of Electrical Engineering and Information technology (FEIT), at Ss. Cyril and Methodius University in Skopje (UKIM);

[14] Rulebook on management of the support instruments of the Fund for innovations and technology development, FITR, 2019.

- Regional HUB for Social Innovation, at the Faculty of Computer Science and Engineering (FINKI), at Ss. Cyril and Methodius University in Skopje (UKIM);

CIPOZ - Centre for Applied Research and Permanent Education in Agriculture, at Ss. Cyril and Methodius University in Skopje (UKIM).The national and international NGOs structure has significant influence in the process of the establishment of the national innovation, TT and R&D infrastructure. The entities, NGOs, in this structure are mainly developed as results of successfully realized international projects and as instrument of its sustainability. Relevant initiatives in the country are outlined below:

- National Climate Change Platform (www.klimatskipromeni.mk)
- Innovation Lab in the City of Skopje
- Regional Environmental Centre (REC)
- Centre for Climate Change
- National Centre for Development of Innovation and Entrepreneurial Learning (NCDIEL);
- European Information and Innovation Centre of Republic of North Macedonia (EIICM)
- Foundation for Management and Industrial Research (MIR)

5.4 Support Received

Providing funding for climate activities on a consistent basis is essential. In this regard, international support for financing climate activities is crucial for the Republic of North Macedonia as a developing country and recognizes the enormous benefits of the inflow of foreign resources. As a non-Annex I country to the Convention, the Republic of North Macedonia is a recipient of international support and is therefore required to report the amount of support received in the subsequent two-year period. In the last two-year period, the bilateral support from the European Union, GEF and UNDP has the highest contribution to financing climate change activities. Much of the support that has been received has been used to finance projects predominantly to mitigate the effects of climate change. It must be emphasized that the amount of support received is far from sufficient to meet the needs of undertaking other significant mitigation and adaptation activities to achieve green and resilient development.

Also, as a developing country, the Republic of North Macedonia allocates a considerable amount of its own budget funds for financing climate activities, which is still below the required level.

This section presents information on the financial and technical support that the country has received from international cooperation and government budget for the development of initiatives related to climate change management. An assessment to estimate the international and domestic support received was prepared to inform the preparation of the TBUR.[15] In order to obtain this information, a document analysis and consultation process via survey was carried out. The information on support received covers the reporting period 2018 - 2019.

[15] UNDP, 2019. Finance, technology and capacity building needs and support received – Internal Report.

5.4.1 Estimation of international financial support received

Given that there is no single centralized system for automatic data collection of received support, amount of support and source (i.e. provider of support), the biggest challenge is the way to obtain relevant, reliable and comprehensive data so that accurate support assessment can be made. The approach used to collect data on international support received was through a survey that was sent to all potential support users (government institutions, line ministries, municipalities, NGOs, etc.). Therefore, much of the data was collected from research on the websites of beneficiaries of the international support, and in particular from the websites of funders (donors and lenders). One tool that was particularly useful was the Organization for Economic Co-Operation and Development OECD statistics website[16].

Most of the support received was in the form of project financing, so support for climate activities was assessed at project level. This approach of assessing the climate finance from support received is used by all countries that have already published a third BUR, although many of those do not report anything about climate finance. All of the information provided covers all active and ongoing projects, most by the amounts received and spent in this two-year reporting period, where such information was not available, the committed amount was used.

In the period 2015 and 2020, a total of 297 climate-related projects are funded with international support. A detailed overview of all projects is given in Annex 11: International financial support received for 2015 – 2020. The directed support to the Republic of North Macedonia (as beneficiary institutions) committed / received during this period is estimated at USD 846,796,137 million. The directed support to the Republic of North Macedonia (as beneficiary institutions) received during this period is estimated at USD 127,196,732.00 million, for 103 climate-related projects. Total amount of international support with national co-financing, received during this period is estimated at USD 719,599,405 million, for 182 climate-related projects under IPA I, III, CBC, Balkan Med and H2020). Of these 297 climate-related projects, 198 projects are climate specific (CS) projects, accounting for as much as USD $661,347,782.60 million, which is 78.1% of the total support received. The remaining USD 185,448,354.40 million, or 21.9 %, relates to climate relevant (CR) projects.

The Republic of North Macedonia is a beneficiary of funds from the EU Instrument for Pre-Accession Assistance. For these EU IPA funded projects, which relate to funding two or more countries, the amount committed / spent for each project is estimated.

Table 5-3 shows the international funding received for climate-specific (CS) or climate-relevant initiatives for the period 2018 – 2019.

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[16] See: https://stats.oecd.org/Index.aspx?DataSetCode=RIOMARKERS#

Climate relevance	Amount (USD)
Climate-specific (CS)	15,602,294
Climate-relevant (CR)	9,543,118
Total	**25,145,413**

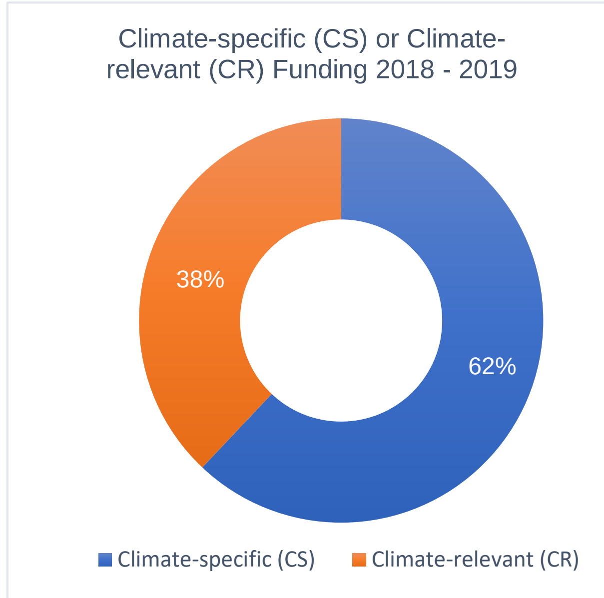


Table 5-3: Climate-specific (CS) or Climate-relevant (CR) Funding 2018 – 2019.

Table 5-4 shows the amount of financial support received by source of funding. Most of the support has been received from the European Union. The largest share of 54%, according to the sources, is the support received from IPA cross-border cooperation funds. The second largest support provider is the Global Environment Facility (GEF) of 19%.

Funding organization	Amount (USD)
EU	13,566,181
Germany	1,355,824
Global Environment Facility (GEF)	4,858,638
Green Climate Fund (GCF)	300,000
Switzerland	2,614,360
UNDP	2,258,990
World Bank	191,419
Total	**25,145,413**

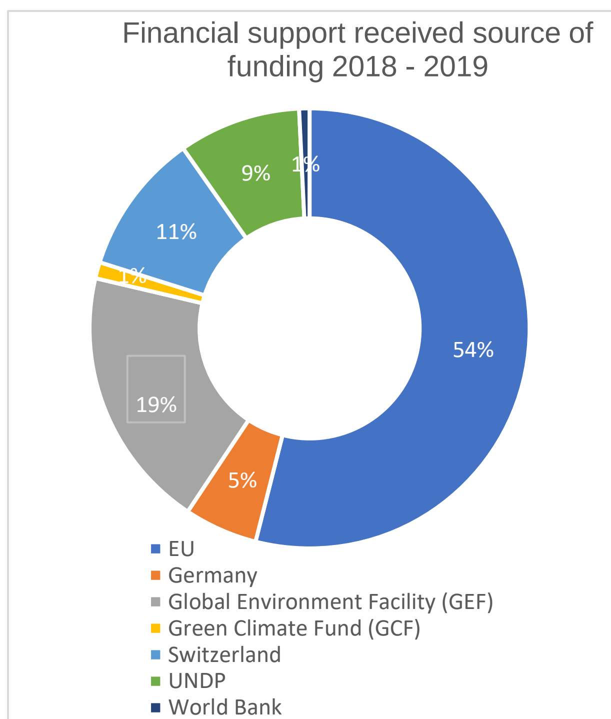


Table 5-4: Financial support received per source of funding for 2018 – 2019.

Almost the entire amount, or more specifically 98.8% of the support received, is in the form of grants (USD 24,8 million) and only 1.2% (USD 0.3 million) is in the form of loans. Here we point out that JSC Power Plants of the Republic of North Macedonia has contracted two large loans with the German KfW Bank to finance two major energy projects that will greatly contribute to climate change mitigation: i) Project: District Heating of Bitola, Mogila and Novaci - first stage, total budget 46.3 mil. EUR (EUR 39 million from KfW and EUR 7,3 million own funds), and ii) Extension of the Wind Park – Bogdanci, phase II, with a total budget of EUR 21 million. EUR (EUR 18 million from KfW and EUR 3 million own funds). Despite the signed loan agreement, the projects have not yet started in this two-year period we are reporting on, and therefore have not been included.

Table 5-5 illustrates the financing received according to the purpose of the financing (mitigation, adaptation, cross-cutting). There is almost an equal division between them.

Purpose of funding	Amount (USD)
Mitigation	8,289,508
Adaptation	7,328,659
Cross-cutting	6,778,944
Other	2,748,302
Total	**25,145,413**

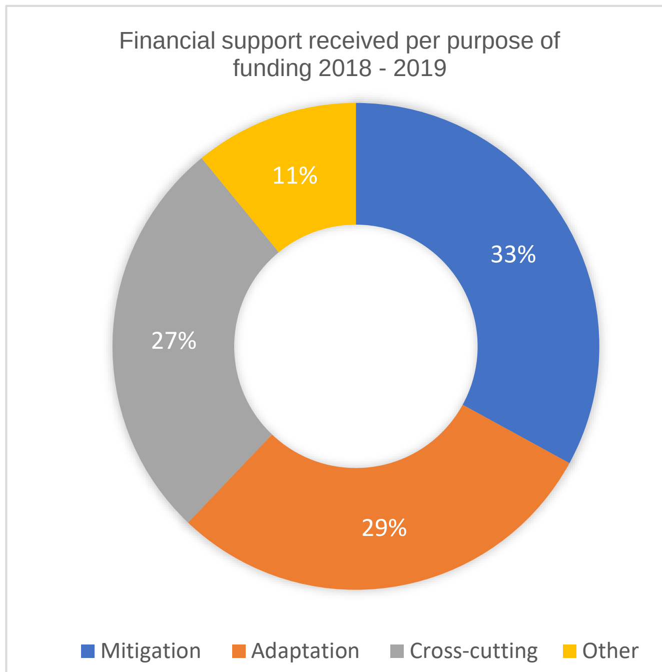


Table 5-5: Financial support received for mitigation, adaptation and cross-cutting initiatives for 2018 – 2019.

Table 5-6 and Table 5-7 presents the amount of bilateral and multilateral financial support received for 2018 – 2019. It shows that the majority is bilateral support, amounting to USD 17.5 million which is 70%. The remaining 30% is multilateral support of USD 7.6 million.

Funding country	Amount (USD)
EU	13,566,181
Germany	1,355,824
Switzerland	2,614,360
Total	**17,536,366**

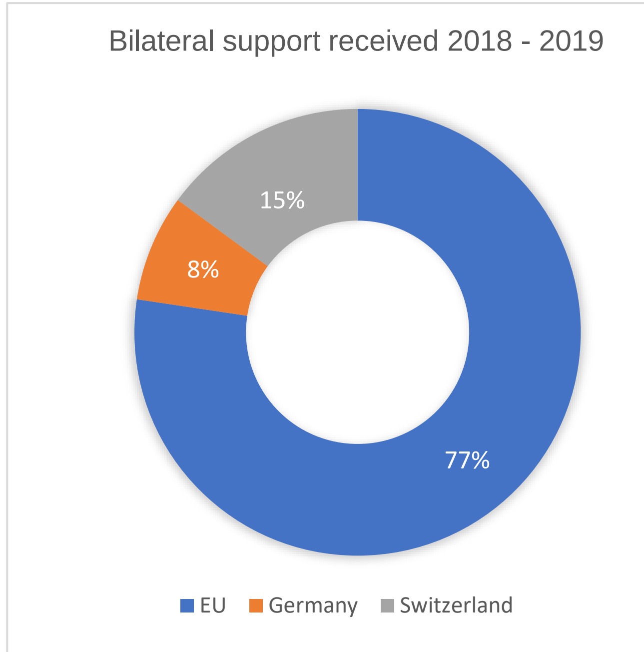


Table 5-6: Bilateral financial support received for 2018 – 2019.

Funder	Amount (USD)
Global Environment Facility (GEF)	4,858,638
Green Climate Fund (GCF)	300,000
UNDP	2,258,990
World Bank	191,419
Total	**7,609,047**

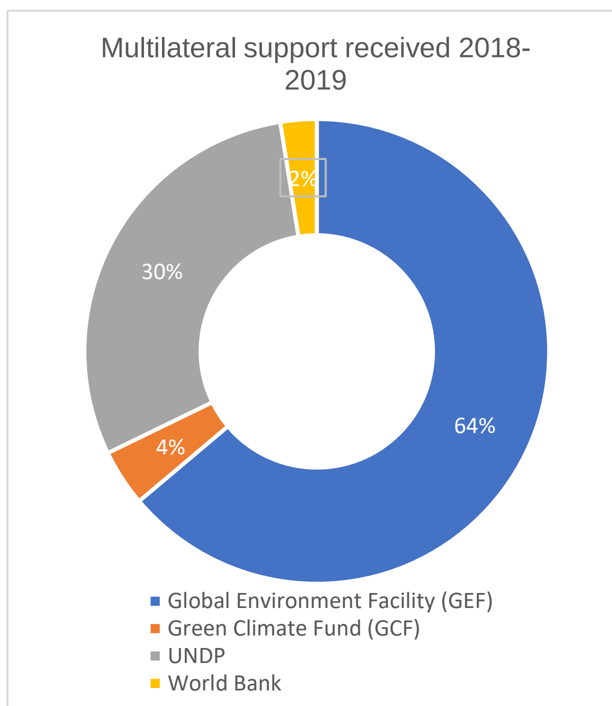


Table 5-7: Multilateral financial support received for 2018 – 2019.

The structure of the distribution of the international support according to the sectors is shown in Table 5-8 . The sector definition used in this analysis is according to the OECD DAC Rio Markers methodology. Analysis of the sector structure shows that most of the international support received is in the sector - General environmental protection, followed by the sector Energy generation, distribution and efficiency. In fact, a great deal of emphasis is now being placed on strengthening energy efficiency in the Republic of North Macedonia.

Sector	Amount (USD)
Communications	138,935
Energy generation, distribution and efficiency	7,685,864
General environmental protection	13,604,286
Government and civil society	1,970,255
Transport	191,419
Water and sanitation	1,554,654
Total	**25,145,413**

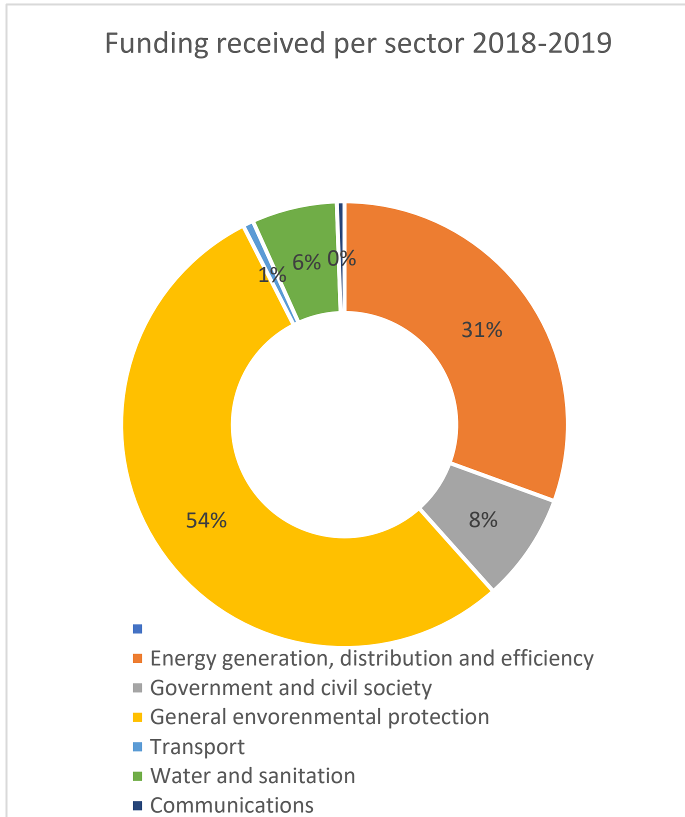


Table 5-8: Financial support received per sector for 2018 – 2019

5.4.2 Technical and capacity building international support received

The Republic of North Macedonia also received non-monetary support in the form of capacity building, technical support and technology. There are 14 projects registered in this category. The summary of non-monetary international climate support received for the period 2018-2019 is shown in the following Table 5-9.

Table 5-9: Non-monetized support received in the Republic of North Macedonia in 2018 – 2019

INFORMATION ABOUT THE PROJECT						PURPOSE OF FUNDING					
Type of funding	**Donor**	**Implementing organization**	**Project name**	**Description of the project (Specific purpose of funding)**	**Implementation period / Start and closing date**	**Mitigation**	**Adaptation**	**Capacity Building**	**Technical Support**	**Technology support**	**General**
Technical assistance	EBRD	Ministry of Economy	Review of primary Energy Efficiency Law and Article 7 policy support	Review of primary Energy Efficiency Law and Article 7 policy support	2018/2019				X		
Technical assistance	EBRD	Ministry of Economy	ESCO Project Pipeline preparation in the public sector in the Western Balkan countries, except Croatia	In order to meet requirements as defined in Article 18 of the Directive on energy efficiency for promotion of the energy services market, it was developed energy service contract. Additionally, the municipalities will engage ESCO companies for public lighting and district heating services trough open tenders.	2019/2020			X	X		

INFORMATION ABOUT THE PROJECT						PURPOSE OF FUNDING					
Type of funding	Donor	Implementing organization	Project name	Description of the project (Specific purpose of funding)	Implementation period / Start and closing date	Mitigation	Adaptation	Capacity Building	Technical Support	Technology support	General
Technical Cooperation	Food and Agriculture Organization (FAO)	Ministry of Agriculture, Forestry and Water Economy	Assessment of agriculture production through NAEZ and LRIMS and scenario development in the Republic of North Macedonia	The main goal of the project TCP/MCD/3602 is to improve agricultural production and increase the adaptive capacity of the Republic of North Macedonia, by establishing National Agro-Ecological Zoning (NAEZ), a Land Resources Information Management System (LRIMS) and Scenario Development to better inform policy at national level, and reduce climate risk through adaptation at local level.	2019		X		X		

INFORMATION ABOUT THE PROJECT						PURPOSE OF FUNDING					
Type of funding	**Donor**	**Implementing organization**	**Project name**	**Description of the project (Specific purpose of funding)**	**Implementation period / Start and closing date**	**Mitigation**	**Adaptation**	**Capacity Building**	**Technical Support**	**Technology support**	**General**
Technical assistance	GIZ	Ministry of Economy	Open Regional Fund for South-East Europe - Energy Efficiency	Development of the forth National Energy Efficiency Action Plan	2019/2020	X			X		
Technical assistance	GIZ	Ministry of Economy	Open Regional Fund for South-East Europe - Energy Efficiency	Development of the National Energy and Climate Plan	2019/2020	X			X		
Technical assistance	GIZ	Ministry of Economy	Open Regional Fund for South-East Europe - Energy Efficiency	Development of the Rulebook for MVP and organizing trainings for the municipalities in order to meet requirements as defined in the Directive on energy efficiency	2019/2020				X		
Technical Cooperation	Japan International Cooperation Agency (JICA)	Crisis Management Center Public Enterprise Macedonian Forests Ministry of Agriculture, Forestry and	The Project on Capacity Building for Ecosystem Based Disaster Risk Reduction through Sustainable Forest Management in	By Eco-system based Disaster Risk Reduction (Eco-DRR) measures and activities in synergy with sustainable forest management,	2017 - 2022		X		X		

INFORMATION ABOUT THE PROJECT						PURPOSE OF FUNDING					
Type of funding	Donor	Implementing organization	Project name	Description of the project (Specific purpose of funding)	Implementation period / Start and closing date	Mitigation	Adaptation	Capacity Building	Technical Support	Technology support	General
		Water Economy	the Republic of North Macedonia	disaster risk of floods, landslides, soil erosion and forest fire on a long-term basis is reduced in the Republic of North Macedonia.							
Technical assistance	UK Embassy	Ministry of Economy	Strategy for Energy Development of the Republic of North Macedonia until 2040	Development of the Strategy for Energy Development of the Republic of North Macedonia until 2040	2019	X			X		
Technical assistance	UNIDO	Ministry of Economy	Overview and Policy Recommendations for Transposition of Articles 8 and 16 EED	Development of the Energy Efficiency Law	2018/2019				X		
Technical assistance	USAID	Ministry of Economy	USAID Energy Sector Legal Reform Project	Development of the Energy Efficiency Law	2018/2019				X		
Technical assistance	USAID	Ministry of Economy	USAID Energy Sector Legal Reform Project	Development of the Energy Law	2018/2019				X		

INFORMATION ABOUT THE PROJECT						PURPOSE OF FUNDING					
Type of funding	Donor	Implementing organization	Project name	Description of the project (Specific purpose of funding)	Implementation period / Start and closing date	Mitigation	Adaptation	Capacity Building	Technical Support	Technology support	General
Technical assistance	USAID	Ministry of Economy	USAID Energy Sector Legal Reform Project	Development of the Renewables energy sources bylaws	2018/2019				X		
Technical assistance	USAID	Ministry of Economy	USAID Energy Sector Legal Reform Project	Development of the tender procedures for PV and off taker	2019				X		
Technical assistance	USAID	Ministry of Economy	USAID Energy Sector Legal Reform Project	Development of the bylaws for NEMO designation	2019				X		

5.4.3 Domestic Financial Flow for Climate Change Response Actions

The capital of the Republic of North Macedonia, the City of Skopje, has in recent years placed more emphasis on investing in environmental protection, with special emphasis on investments in tackling and adapting to the adverse effects of climate change. For this purpose, each subsequent year allocates an increasing amount of funds in its own budget for the implementation of climate activities. The UNDP Office in Skopje has a particularly important role to play in supporting and identifying and implementing a range of climate activities.

In the period 2018 – 2019, the City of Skopje has implemented 37 climate related projects, 17 projects in 2018 and 20 projects in 2019. The total amount of own source funds allocated in these projects was USD 5,608,527. Climate finance in 2018 was USD 2,302,659 and represents 4.65% of total budget expenditure in that year. Whereas, in 2019, climate finance was USD 3,305,869, representing 5.17% of total spending in its own budget. This high growth, in the scope of projects and activities, indicates the strong commitment of the City of Skopje to address climate change.

Table 5-10 gives a clear overview of the City of Skopje climate finance for 2018 and 2019, in total, and separately by mitigation and climate change adaptation finance. It is obvious that the amount of climate finance mitigation is higher in both years and is 57% in 2018 and 68% in 2019.

Table 5-10: Climate Finance of the City of Skopje in 2018 – 2019 (in USD)

Climate Finance of the City of Skopje	2018	2019	TOTAL
Climate finance (mitigation)	1,313,268	2,236,896	**3,550,164**
Climate finance (adaptation)	989,391	1,068,973	**2,058,363**
TOTAL	**2,302,659**	**3,305,869**	**5,608,527**

Figure 5-1 shows the climate finance movement of the City of Skopje for the two consecutive years analyzed.

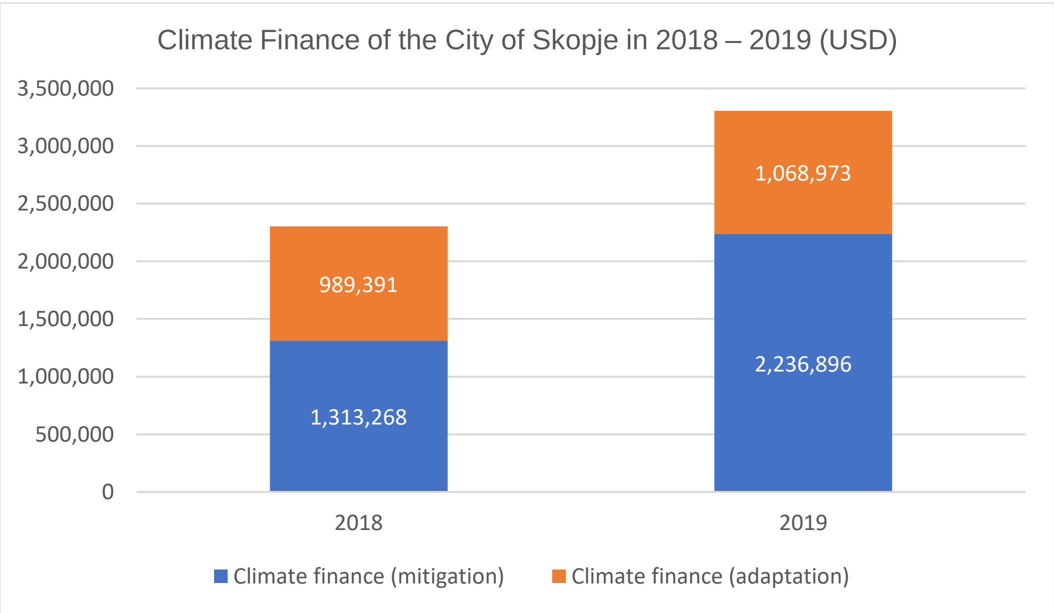


Figure 5-1: Climate finance of the City of Skopje for 2018 – 2019.

Most of the climate finance is implemented through two programs: the parks and greenery program and the environmental protection program. Table 5-11 shows an overview of climate finance by individual programs for the two years separately and in total.

Table 5-11: Climate Finance of the City of Skopje in 2018 - 2019 (in USD)

Budget program title	Climate finance	
	Mitigation	Adaptation
Supporting local economic development	966	0
Communal activities (construction of public lighting)	23,860	0
Parks and greenery (capital expenditure)	1,704,024	1,004,079
Education (capital expenditure)	331,502	0
Environmental protection	1,489,812	1,054,284
Total	**3,550,164**	**2,058,363**

The analyzed period 2014-2020 is characterized by a lack of supporting activities in research where **Ministry of Education and Science (MoES)** haven't opened national calls for supporting the national science and development activities through R&D projects.

Despite several bilateral programmes for scientific cooperation, only biannual calls of two bilateral scientific and development cooperation programmes between North Macedonia-Austria and North Macedonia-China were opened. Analysis the priority areas of two bilateral programmes, almost all covering climate change as one of the focal areas. The priorities are related to environment, energy efficiency, renewable energy resources, new technologies and materials where the research can be connected directly or indirectly to climate change. Analysis of dataset for supported projects has shown funding of 25 climate change projects in research, innovation and technology development, with biannual budget of €6.500,00 or with total funding of €162.500,00.

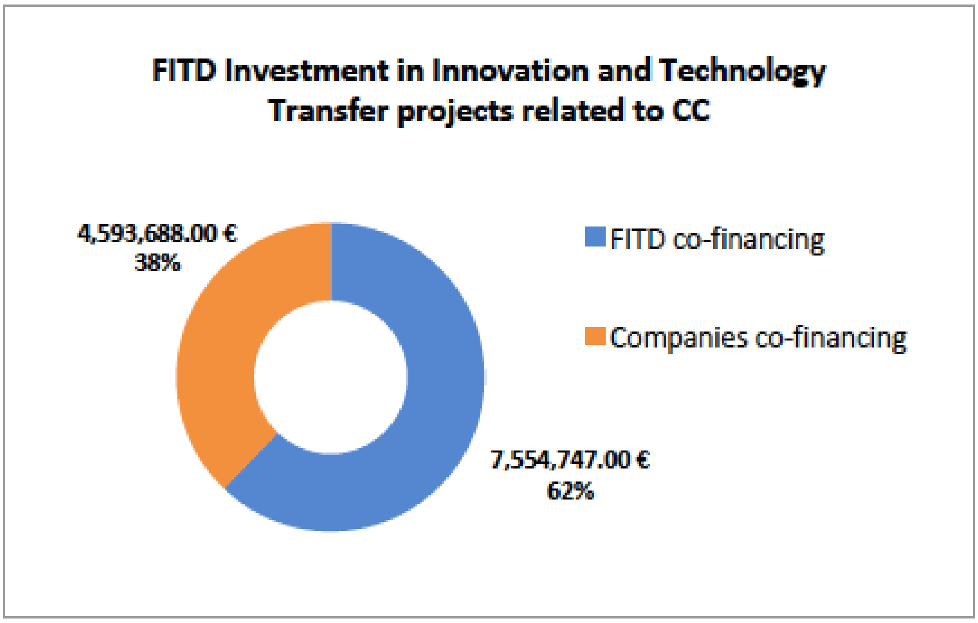
Starting from 2013, "**Ss. Cyril and Methodius" University** in Skopje has allocated financial resources in own fund for supporting research and development activities of the faculty's members. At the annual basis, there are supported 25 research projects, each with duration of one year and funding of about €4.000,00. For the period 2014-2020, there are financed in total 150 projects in all scientific fields with total allocated budget of €600.000,00. According to analysis of the dataset for the period 2014-2020, there are financed in total 22 research, development, innovation and technology development projects related to climate change in fields of technical and natural sciences with allocated budget of €88.000.

Fund for Innovation and Technology Development (FITD), established in December 2013, supports innovation activities in micro, small and medium-size enterprises (MSMEs) in order to achieve technological development based on the knowledge transfer, technology transfer, research and development and innovation that contribute to economic grown and job creation, while developing competitive capabilities of the companies. The Fund's operations are based on financial support from the state budget and World Bank lending schemes.

Support instruments of FITD are co-financed grants with following funding opportunities:

- INS1 - commercialization of innovation in MSMEs for enlarging research& development activities in private sector, as well as cooperation with academia, in order development, transfer and implementation of new, innovative or improved technologies, processes and products (for micro and small-sized enterprises co-financing up to 70% of the project's budget and for medium-sized up to 60% with maximum amount of €325.000),
- INS2 - grown of start-ups and spinoffs based on technology development and innovative activities (co-financing up to 85% of the project's budget, with maximum amount of €30.000),
- INS3 -technology development and extension of SMEs with new technologies and processes (co-financing up to 30% of the project's budget, with maximum amount of €150.000),
- INS4 - development and investment in business-technology accelerators (co-financing up to 75% of the project's budget, with maximum amount of €500.000), and
- INS5 - new planned instrument for technology transfer in first phase supporting the private companies within the knowledge transfer in academia-industry cooperation (co-financing up to 70% of the project's budget, with maximum amount of €20.000).

Starting from 2015, FITD has opened set of call for the above mentioned instruments through co-financing schemes and supported 340 projects in MSMEs with allocated co-financing budget of about €55M. According to analysis of data set for co-financed projects in regard to climate innovation and technology transfer projects, the FITD has financed 63 climate change related projects mainly under instruments of innovation with commercialization (INS1), technology development (INS3) and grown start-ups (INS2), with financial contribution and co-financing of €7.554.747,00. The companies have participated for those projects with own co-financing budget of €4.593.688,00 (Figure 5-2).



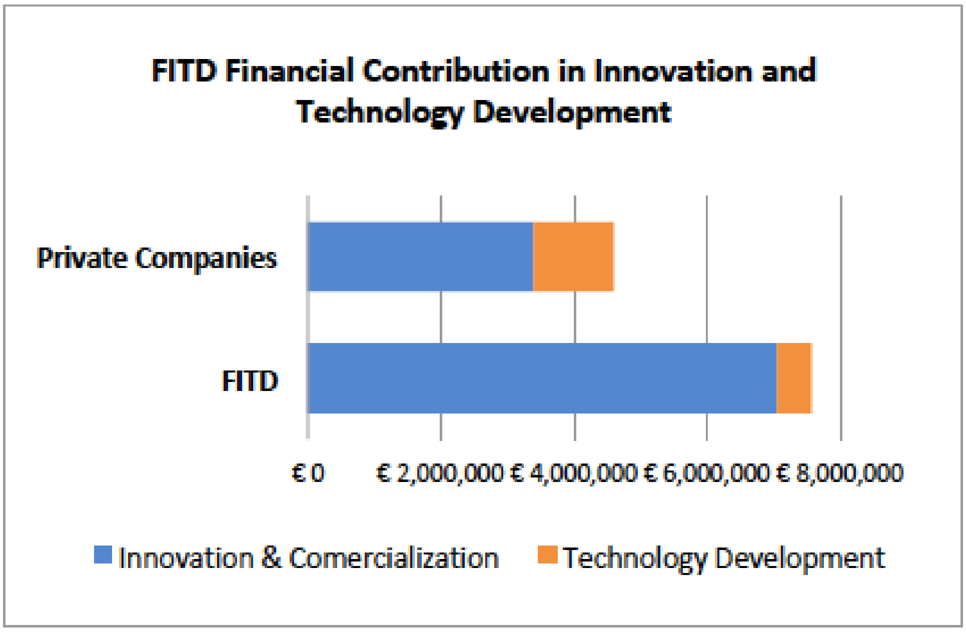


Figure 5-2: FITD Investment in Innovation and Technology Transfer projects related to CC

Under the instrument for development and investment in business-technology accelerators (INS4), FITD has co-funded establishing of first three accelerators in the country: BAU-Business Accelerator UKIM, X Factor Accelerator and Seavus Accelerator. Under FITD financing, the accelerators are established at the beginning of 2019 and work on pre-feasibility and investment programmes in innovative business ideas in order to support sustainable grown and development of the economy.

It is proposed that the procedure for tracking, monitoring and streamlining Climate Change finances in the Republic of North Macedonia uses the scoring system methodology of OECD/DAC, the “Rio Marker definitions for climate change adaptation and climate change mitigation” for identification of the level of CC action relevancy is applied.

Under the Rio markers, data collection on the climate markers is based on a scoring system with three values:

- principal objective (2);
- significant objective (1);
- not targeted to the policy objective (0).

For most activities (projects/programmes), the OECD/DAC Rio Markers are used to provide an approximate quantification of domestic climate finance:

- If an activity is marked as “principal” for mitigation or adaptation, 100% of the support is considered and reported as climate finance.
- If an activity is marked as “significant” for mitigation or adaptation, 40% of the support is considered and reported as climate finance. Together with other donors, we consider this percentage to be a reasonable estimate of the average climate contribution by projects that have climate change adaptation or mitigation as a significant objective.

If more than one climate Rio Marker is assigned to an activity, double counting is avoided as follows:

- If an activity has 2 “principal” markers, both are counted for 50%.
- If an activity has 2 “significant” markers, both are counted for 20%.
- If an activity has 1 “principal” and 1 “significant” marker, the “principal” marker is counted for 60% and the “significant” marker for 40%.

5.5 Recommendations

Based on the conducted analyses of the current country status of the research, development, innovation and technology transfer related to climate change on one hand, and the possibilities offered by the utilization of the UNFCCC technology mechanism on the other, it is more than evident that the country will benefit greatly from the utilization of this mechanism, which will significantly affect the development of the areas of environment and climate change in a very positive direction.

Therefore, it is highly recommended the selection and nomination of the National Designated Entity (NDE) as a focal point for the Technology Transfer (TT) mechanism as soon as possible. Establishing the NDE will serve as a national focal point with goal to provide continuous information about financing through donor programmes for R&D and Innovation activities related to the climate change actions. Also, NDE will develop networking between implementers and beneficiaries (end users as are companies and industry) for technology transfer providing. As a main financial source for facilitating the NDE’s functioning and operability, the EU Green Deal’s Investment Plan should be considered. For the establishing and reaching full operability of the NDE, it is necessary to be considered the following 6 main recommendations:

1. Development of a central **platform (portal)** with a comprehensive dataset of the projects by donors and implementing agencies, with mechanisms for updating and reporting. NDE should establish a portal for logging, tracking and reporting of all implemented and ongoing environmental and climate change projects. The system should be consisted of a database where the list of implemented/ongoing projects on a national level will be maintained and a user friendly interface which will facilitate the NDEs staff and/or implementing organizations to insert the required data for the projects. In addition to this, the portal should be equipped with certain number of functionalities that will enable manipulations with the records and generating different views and reports, such as filtering the projects per time period, theme/area, amount, region, type of action, programme etc., extracting the data of interest in various formats, such as word, excel, pdf, also providing certain analysis presented in NDE should **raise national funds for co-financing the**

donor financial opportunities. Majority of the donor programmes for projects and grants require co- financing, which in most of the cases refers to the implementer's own funds. Often, the national authorities in charge for the specific area provide national contribution that covers the co-financing part. It is recommended to establish a collaboration between the NDE and the Ministry of Environment and Physical Planning to ensure the national co-financing funds.

2. NDE should **maintain list with various funding opportunities** that are available and forthcoming calls for proposals, which are either dedicated to addressing environmental and climate change issues, or beside the call primary objectives, also encourage activities that might tackle the environmental and climate change issues. Furthermore, the NDE should promote the calls widely and ensure that various types of organizations from different parts of the country participate in the project proposals, as well as to assist the beneficiaries in networking and selecting the most appropriate partner organizations.
3. One of the key activities of the NDE is having a role of a **gateway to different climate-specific advanced practices and technologies** from the modern societies. For achieving this, it is highly recommended that the NDE will **establish and maintain intensive collaboration with a wide range of relevant initiatives** from various parts of the world. As a result, the NDE should keep up with the novel technologies implemented for climate change and should be able to provide assistance and advice to the national organizations in adopting these technologies and adjusting them to the local conditions and particularities.
4. The NDE should be a **strategic partner of the Macedonian Government** in its strategic goal to enhance the development of the environment and address climate change, environmental protection and pollution, as well as sustainable development goals. The NDE should act on a strategic manner by collaborating with the major stakeholders and national authorities, such as the Ministry for environment and physical planning.
5. In addition to this recommendation, due to the interdisciplinary nature of the relevant area, the NDE should also **boost and promote the inter-sectoral collaboration** among various national, regional and local authorities, as well as among organizations from different societal spheres: citizenship, private, public and educational sectors to synergize their efforts in achieving better environment and society.

Establishing the NDE will serve as a national focal point with goal to provide continuous information about financing through donor programmes for R&D and Innovation activities related to the climate change actions. Also, NDE will develop networking between implementers and beneficiaries (end users as are companies and industry) for technology transfer providing. In order to be more efficient in utilization of the international financing funds for climate change-related projects, the NDE should engage with the following initiatives:

- Engage with the Climate Technology Center & Network (CTCN) of the UNFCCC Technology Mechanism (at macro level), in order to receive technical assistance;
- To communicate with the National Designated Authority (NDA) (mezzo level), as an official point in the country for contact and communication with the Green Climate Fund and for facilitation the country to have national and global impact and streamline a sustainable and green aspect to its economic development;
- To establish cooperation, partnership and networking (micro level) between the potential stakeholders for CC actions providing, that are end users in the country, using different instruments as innovation hubs, CC hubs, Cleantech hubs, Agri TT Centers in order to support businesses and start-ups development in clean technologies areas and to promote research, innovation and TT for CC technologies;
- To apply and be active member in European Green Deal as a main future coming donor programme with contribution to the development of EU funded project related to climate change and sustainable development.
- The most common used approach for definition and classification of CC related activities i.e. finances, is through the OECD Development Assistance Committee (DAC) Climate

markers i.e. Rio markers. It is proposed that the procedure for tracking, monitoring and streamlining CC finances in the Republic of North Macedonia uses the scoring system of the Rio markers for identification of the level of CC action relevancy.

6 Level of Support Received for the BURs

6.1 Level of Support Received for the BURs

To assist the Republic of North Macedonia in the preparation of its **First Biennial Update Report** to the UNFCCC, which was submitted in 2015, the GEF provided support in the form of an Enabling Activity grant in the amount of USD 321,461. For the Second Biennial Update Report, which was submitted in 2017, the GEF provided support in the form of an Enabling Activity grant in the amount of USD 352,000.

For the preparation of this **Third Biennial Update Report**, the GEF provided support in the form of a grant in the amount of USD 324,550 for an Enabling Activity project that also included USD 100,000 in co-financing. In-kind co-finance was from the Ministry of Environment and Physical Planning at 10,000. UNDP also provided support for stakeholder inclusion, planning, and identifying innovative approaches to data collection and modelling inputs. The project team also utilized technical and administrative support from the Global Support Programme for National Communications and Biennial Update Reports.

6.2 Scope of Activities Supported

The grants and in-kind support received under the GEF Enabling Activity project allowed the project team to undertake the following activities, which form only a partial list of improvements in the preparation process and subsequent SBUR.

- Information on national circumstances and institutional arrangements relevant to the preparation of the biennial update reports revised and updated, especially in terms of implementation of the recommendation from the FBUR and SDG agenda. Gender disaggregated data included to the extent possible.
- New inventories for 2015 - 2016 developed and the quality of the whole series 1990-2014 improved.
- Mitigation scenarios developed within the SBUR updated as per the revised energy balances, supplemented with socio-economic research and with additional scenario that shall reflect the mitigation potential of the actions induced by the private sector to the extent possible
- The technology, financial and capacity needs for mitigation updated and recommendations with government priorities updated.
- The process of establishment of the domestic Measurement, Reporting and Verification arrangements supported
- Third Biennial Update Report adopted and submitted in according to the guidelines contained in Annex III of Dec.2/CP. 17

7 Domestic Measurement Reporting and Verification Systems

7.1 Overview

Establishing a sustainable and robust measurement, reporting and verification system for GHG emissions, including data collection, sorting, processing and the legal and regulatory frameworks necessary represents a challenge and the basis of all climate policies in the Republic of North Macedonia.

Identifying institutions, data flow and preparing schemes for each sector individually (energy, industrial processes, transport, waste, agriculture, forestry and other land use) is part of the CBIT project and data transparency for climate change actions in the country.

The main objective of the MRV report prepared for the TBUR was to provide an overview of the current situation of the national MRV system of greenhouse gas emissions by sector and the following approach has been used:

- Desk research on existing publications regarding MRV systems (First Biennial Report on Climate Change, Second Biennial Report on Climate Change and other documents) and relevant national legislation
- Informal consultations and webinars with responsible stakeholders in institutions and organizations involved in the process of inventory preparation

PROJECT OVERVIEW: ***"Strengthening institutional and technical Macedonian capacities to enhance transparency in the framework of the Paris Agreement"***

The objective of the project between the Ministry of Environment and Physical Planning and UNDP is to meet enhanced transparency requirements as defined in Article 13 of the Paris Agreement by strengthening institutional and technical capacity for measuring and reporting on emissions, mitigation and adaptation activities, and support received.

The Paris Rulebook and new requirements regarding MRV and transparency present an opportunity to put into place solid frameworks that can also support other reporting requirements, such as, Energy Community requirements to align the MRV system with the EU MMR (which itself is in the process of reformulation for 2021) and alignment with the climate acquis.

The project has three outcomes:

1. National institutions for MRV are strengthened and transparency activities are aligned with country priorities
2. Organizations and individuals have the necessary training and tools to conduct MRV activities
3. Arrangements for data collection, analysis, and reporting shift from a project-based cycle to a continuous process

The CBIT project is implemented with financial and technical support form GEF and UNDP.

The process of developing National Energy and Climate Plans (hereafter referred to as NECPs) in accordance with Regulation (EU) 2018/1999 of the European Parliament and of the Council has started in 2018, with the establishment of the Working Group consisted of representatives of key stakeholders in the country. The Ministry of Economy and the Ministry of Environment and Physical Planning lead the whole process, as institutions with the ultimate responsibility for implementing the NECP. Macedonia has prepared a draft version of its NECP in May 2020. The process is still ongoing until the Government adopts the final version of the document.

Based on the analysis, the country context and legal and regulatory context for MRV, systems for data collection including electronic systems and the shortcomings and obstacles of the inventory process preparation are outlined and recommendations are provided.

7.2 Country context for MRV

The Republic of North Macedonia is in a unique situation when it comes to its international obligations regarding monitoring, reporting and verification. Namely, the country is a Party to the UNFCCC, but it is not part of Annex I; i.e., it does not have quantified commitments. Despite the fact that Republic of North Macedonia is not an Annex I Party, it is voluntarily attempting to incorporate Annex I reporting principles as much as possible into the framework of its National Communications and Biennial Update Reports. As a country that has also began begun the process of EU pre-accession, it must now also adhere to EU Climate and Energy Policy.

Finally, the Republic of North Macedonia is a Contracting Party of the Energy Community (EnC), which is rapidly implementing many policies that are directly related to the issue of MRV.

7.3 Legal and regulatory context

As a candidate for EU membership the transposition of EU regulations on accurate monitoring, reporting and regular evaluation of greenhouse gas emissions are currently the main objectives of the project Preparation of a long-term strategy and Law for climate action funded by the EU within the IPA 2014-2020. The relevant EU legislations includes the following regulations:

- Regulation 525/2013 of the European Parliament and of the Council defines the establishment of accurate monitoring, reporting and regular evaluation of greenhouse gas emissions.
- Regulation 666/2014 which establishes the key requirements for the Union's inventory system, taking into account changes in global warming potential and internationally agreed inventory guidelines.
- Commission Implementing Regulation (EU) No 749/2014 of 30 June 2014 on structure, format, submission processes and review of information reported by Member States pursuant to Regulation (EU) No 525/2013 of the European Parliament and of the Council..

In regard to the national context, The Law On Environment[17] currently regulates the issue of monitoring of anthropogenic emissions by sources and sinks of greenhouse gases. According to the Law on Environment, The Ministry of Environment and Physical Planning is obligated to collect data and to cooperate with several bodies of the state administration, namely, the State Statistical Office, Ministry of Economy, Ministry of Agriculture, Forestry and Water Economy and Ministry of Interior. Strengthening the institutional cooperation for data exchange relevant for the preparation of the inventory is considered a key issue that would enable easy and successful preparation of the national reports.

According to the Law on Environment, the Ministry of Environment and Physical Planning (MOEPP) should establish, develop, manage and coordinate a national system for inventory of greenhouse gas emissions. This system will provide the necessary data for the preparation of the Greenhouse Gas Inventory, as well as for the monitoring of the implementation of the National Climate Change Plan. However, the Law does not regulate in detail the issue of monitoring, reporting and verification of policies and measures.

Sectoral laws and strategies provide some guidance on monitoring and reporting on policies and measures in several key areas:

[17] “Official Gazette of the Republic of Macedonia ”53/2005, 81/2005, 24/2007, 159/2008, 83/2009, 48/10, 124/10, 51/11, 123/12, 93/13, 42/14 and 44/2015)

Energy Sector

- In the energy sector, the **Law on Energy**[18] regulates, albeit incompletely, the issues of monitoring, reporting and verification of the implementation of strategic documents, including institutional competence.
- The **National Strategy for Energy Development up to 2040** (Energy Strategy) (Article 10, Law on Energy) is adopted every five years and refers to the next 20 years was adopted in December 2019 is currently in force.3 There is a chapter of this Strategy, "The manner of monitoring the realization of the Program," that prescribes the structure of the annual report and the requirements for information in it. Annex 1 of the document also establishes indicators for evaluating the use and the effects of its implementation, as well as the competence to monitor each individual indicator.
- **The Strategy for the Use of Renewable Energy Sources and Strategy for Energy Efficiency provide** a legal basis for regulating these energy sub-sectors, as well as energy markets and energy balance preparation as outlined in the Action Plan for Renewable Energy Sources and the National Energy Efficiency Action Plan (NEEAP). However, the content, manner and deadline for submitting the data required for the preparation of the two-year report for the implementation of the Action Plans is not prescribed by law or by-law. instead, it takes place on the basis of a long-standing mutual cooperation between institutions or memoranda of cooperation. Furthermore, as a response to the obligation of the Republic of North Macedonia to the Energy Community Treaty, the report is prepared according to a template recommended by the European Commission in accordance with Article 22 of Directive 2009/28/E[19].

Transport sector

- The **Law on Vehicles[20]** regulates the issues of market release and start of operation of vehicles, registration and roadworthiness, as well as the data registry for vehicles, which is run by the Ministry of Interior. Unfortunately, although the law has been in force for almost a decade, the by-law that should prescribe the form, the content and the manner of keeping the registry, and the manner of input and release of data, has not yet been enacted.
- The **new Energy Law** ("Official Gazette of the Republic of North Macedonia", No. 96 of 28.5.2018) complements the requirements for national standards for fuel quality in Article 150. This Article obliges the Government, upon the proposal of the Ministry of Environment, to adopt a Regulation on the quality of liquid fuels. The decree was passed to a public hearing but has not been adopted yet.
- In the context of light vehicle emissions, it is important to mention Regulation 443/2009 / EC. Given the fact that the country will have to report to the EU on the structure of imported (new) vehicles, the establishment of a database of the vehicle fleet and its fuel economy will be a good basis for this reporting to the EU in the future.
- Rail transport is regulated by the Law on the Railway System6. From the viewpoint of the measures envisaged in INDC, it is important to establish that they originate from the National Transport Strategy for the period 2007 - 2017 and the National Program for Railway Infrastructure for the period 2014-20167 (Article 26, Law on Railway System). A three-year National Program is adopted by the Parliament, and the public enterprise Macedonian Railways - Infrastructure (PE MZ-I) prepares an annual program for railway infrastructure financing that is adopted by the Government. In the context of monitoring

[18] "Official Gazette of the Republic of Macedonia "16/2011, 136/2011, 79/2013, 164/2013, 41/2014, 151/2014, 33/2015, 192/2015, 215/2015, 6/2016 and 53/2016

[19] Pursuant to Article 15 of the EC Decision (2012/04/EnMC), the country is obliged to prepare a two-year progress report on the promotion and use of energy from renewable sources

[20] Official Gazette of the Republic of Macedonia"140/2008, 53/2011, 123/2012, 70/2013, 164/2013, 138/2014, 159/2015, 192/2015 and 39/2016)

and reporting, the law stipulates a responsibility for PE MZ-I to report to the Macedonian Government on the implementation of its annual program during the first quarter of the year. However, it should be noted that the Law does not stipulate any methodology for preparing the annual report or for establishing a system for monitoring and reporting on implementation of the annual program for financing the railway infrastructure.

Waste Sector

- While there is no law or governing by-law that stipulates any methodology for preparing reports or for establishing a system for monitoring and reporting on waste measurement for GHG emissions, a new Draft Law on Waste Management is currently being drafted. Waste data is collected from a number of sources. The Ministry of Environment and Physical Planning is the competent authority to collect waste sector data on: Waste sector Solid Waste Disposal, Biological Treatment of Solid Waste, Incineration and Open Burning of Waste and Wastewater Treatment and Discharge.

IPPU sector

- According to the **Law on the Environment** industrial plants/installations may operate with previously obtained environmental permits. It states that A-integrated environmental permit is issued by the body of the state administration responsible for environmental affairs or B-integrated environmental permit issued by the municipality or the city of Skopje or the body of the state administration responsible for the affairs in the field of environment when it comes to installation located in a protected area, which is regulated by Article (123) of the same law. The notification to the State Statistical Office comes from legal obligation, defined by the Law on State Statistics.[21] Theoretically, while report creators should have easy and detailed access to the information needed to create those GHG emissions reports, the practical implementation of these laws and regulations is not always monitored, so contact with the industrial installations usually has to be made.
- An additional obligation to report on ambient air emissions from stationary sources is defined by a rulebook. The Rulebook was adopted on the basis of Article 45 paragraph (4) of the Law on Ambient Air Quality[22]

Agriculture, Forestry and Other Land Uses

- In the Agriculture and Land use sectors data is collected from the field from legal and individual entities who have obtained a license for performing agricultural activities. Information from the field is submitted in the form of an LPIS format. Other legal bodies that collect information from which GHG emissions are reported include the Agency for Financial Support of Agriculture and Rural Development, the Food and Veterinary Agency and the customs administration through the tate Statistical Office. However, legal and individual entities, who have a license to perform agricultural activities are obliged to deliver a large amount of data due to lack of interest. Unfortunately, no data is collected for the area "Land use.
- Forests can be privately or state-owned, which is registered in the state real estate cadastre, which is regulated by a rulebook, from which the information about the situation with the forest territory is drawn. The law defines the conditions for forest management, defining national inventory according to which data on forest condition will be collected. Forest operations are controlled under several legal articles and defined rules, including that forest users and owners are required to carry out special plans and programs, to

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[21] "Official Gazette of the Republic of Macedonia" no. 54/1997, 21/2007, 51/2011, 104/2013, 42/2014, 192/2015, 27/16, 83/18, 220/18, 31/20.

[22] “Official Gazette of the Republic of Macedonia” No. 67/04, 92/07, 35/20 and 47/11), published in the Official Gazette of RM no. 79 of 13.06.2011.

conduct an inventory of forests and forest land and report it. State owned forests have a legal obligation with the statistical law to submit information to the State Statistical Office (SSO).

In conclusion, as reported in the SBUR, though national legislation clearly indicates that monitoring systems should be established, and several systems are under development or testing, none of the responsible institutions have comprehensive, fully operational systems in place. At present, these institutions partially carry out their responsibilities for the preparation of certain reports that are prepared on the basis of available data and information, which is collected on an ad-hoc basis or pursuant to the legal competences, but may also be based on certain engineering estimates and calculations in cases where data and information are missing.

7.4 Electronic systems for monitoring and reporting

Several systems are relevant to monitoring and reporting sectoral data related to climate change commitments and activities. The following systems are under construction or are being tested:

Energy Sector:

- **MVP Software:** The web monitoring and verification platform (MVP) software is a tool developed in 2016 to enable the Ministry of Economy and the Energy Agency to effectively monitor the implementation of measures and activities of the National Action Plan for Energy Efficiency (NAPEE). This platform enables monitoring of energy efficiency and plans to reduce CO2 emissions at different policy levels; both national and municipal plans. It is intended to serve as a registry for the implemented projects and to contain the following data: general data, energy savings [KWh] and CO2 [t], as well as costs and data from calculations. This software has not yet been put into use, but the legal basis for its use and maintenance is expected to be introduced in the bylaws of the Law on Energy Efficiency that are being prepared.
- **ExCITE software:** The ExCITE software was installed on the Information Platform of the Association of Local Self-Government Units (ZELS), and trainings for its usage were conducted for employees in the municipalities and institutions of the central government. This tool enables the collection of data on the physical characteristics of public buildings such as: doors, windows, wall structure, total heating area, lighting, etc., i.e. continuous monitoring of energy consumption, which would facilitate the process of planning and implementation of energy efficient measures as well as verification of the ones already implemented, as well as to access to aggregated data, and the calculation of greenhouse gas emissions. Following amendments to the Energy Law from 2013, UNDP provided additional support to the Ministry of Energy for the development of a new version that was fully tailored to the Rulebook on Information Systems. Although the ExCITE software opens the possibility to generate various reports, including: indicators for specific CO2 emissions (kgSO2 / m2), general and individual report for greenhouse gas emissions from a building or construction unit, public lighting, etc., however, this software is not functional at the moment.
- **Web platform for monitoring the functioning of energy markets:** In 2016 the Energy Regulatory Commission developed a special tool for monitoring the energy market in the country. The tool is based on a Microsoft® Excel spreadsheet program, and its use is supported by a web platform interface. The method of using the tool for collecting and processing relevant data is in accordance with the Rulebook on the manner and procedure for monitoring the functioning of energy markets (2019)

Industrial processes and production use sector:

- **Emission Monitoring in Industry (EMI):** software was developed partly under the TNC, but entirely within the FBUR (Figure 33: Screenshot of the Emissions Monitoring in Industry (EMI) Software). It enables industry to meet its legal obligations for reporting annual emissions of greenhouse gases and air pollutants in accordance with the IPCC using CORINAIR methodology The EMI portal was developed with the help of a Java software platform (Enterprise Edition) and MySQL database, and it is installed on an Apache Geronimo open source server. It is an operational database, designed to provide links and to systematize collection of data from the industrial sector to prepare the three inventories that are the responsibility of MOEPP: the greenhouse gas inventory, the cadaster of air pollutants, and the cadaster of pollutants.

Road transport Sector:

- **COPERT:** the greenhouse gas inventory from the road traffic was prepared for the period 2014-2018 according to TIER 3 methodology with the use of the software tool COPERT. COPERT is a s an MS Windows software program aiming at the calculation of air pollutant emissions from road transport. The technical development of COPERT is financed by the European Environment Agency. However, shortcomings arising from the inventory preparation process generally arise from poor data quality and availability**.**
- **Vehicles registry database:** the current system for monitoring the status of the car fleet, is an outdated, complex and closed system. However, the existing system provides a great deal of technical information, including information on factory-specified (i.e. measured) emissions of CO2. A new electronic register of vehicles is envisioned that will collect data from the registration process, including technical inspections, as well as data from the approvals procedure and identification

7.5 Inventory schemes for detailed MRV processes and data flow in each inventory sectors

The diagrams in the following section present the various proposed inventory schemes for detailed MRV processes and data flow in each of the inventory sectors.

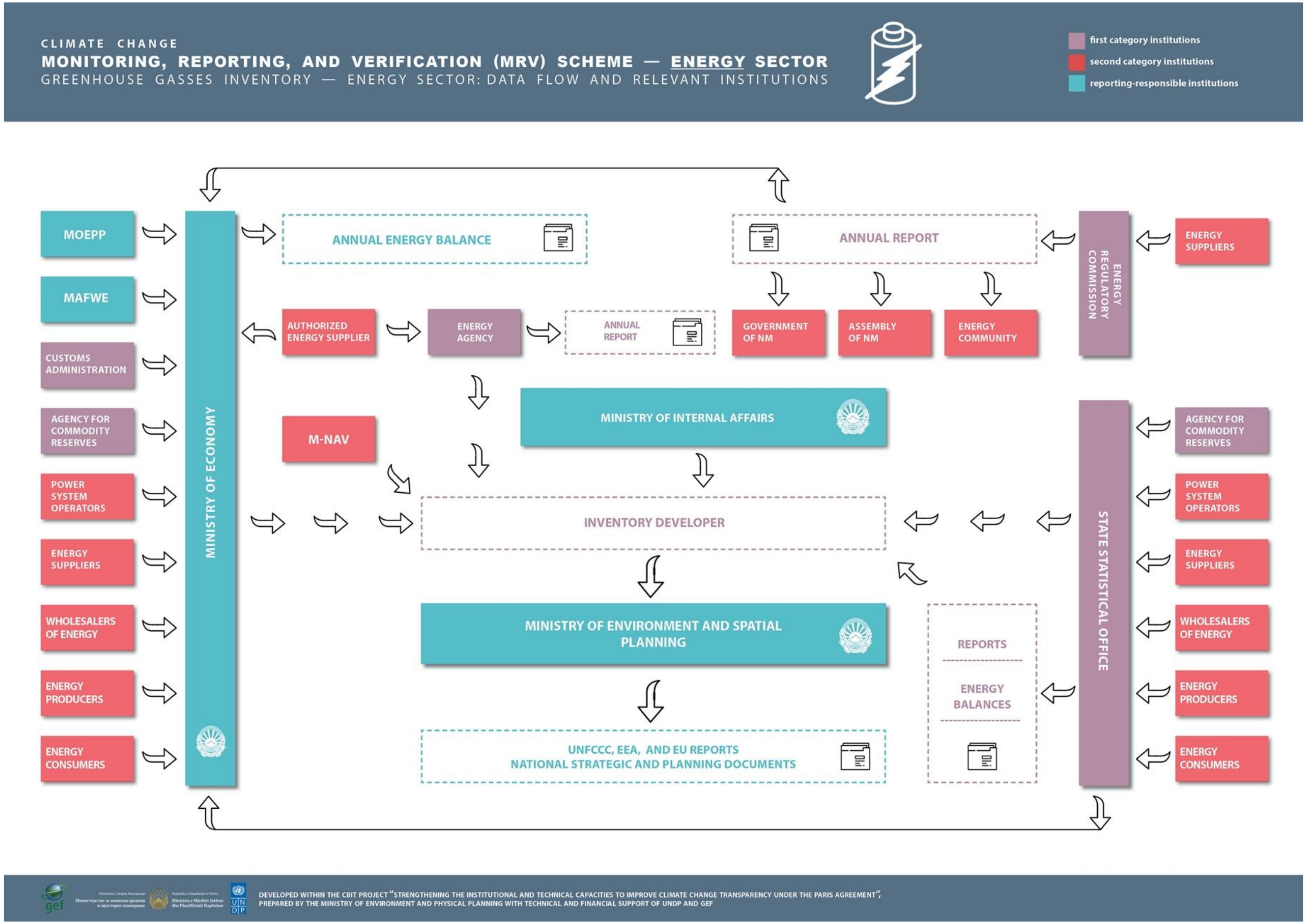


Figure 7-1: MRV Scheme – Energy Sector

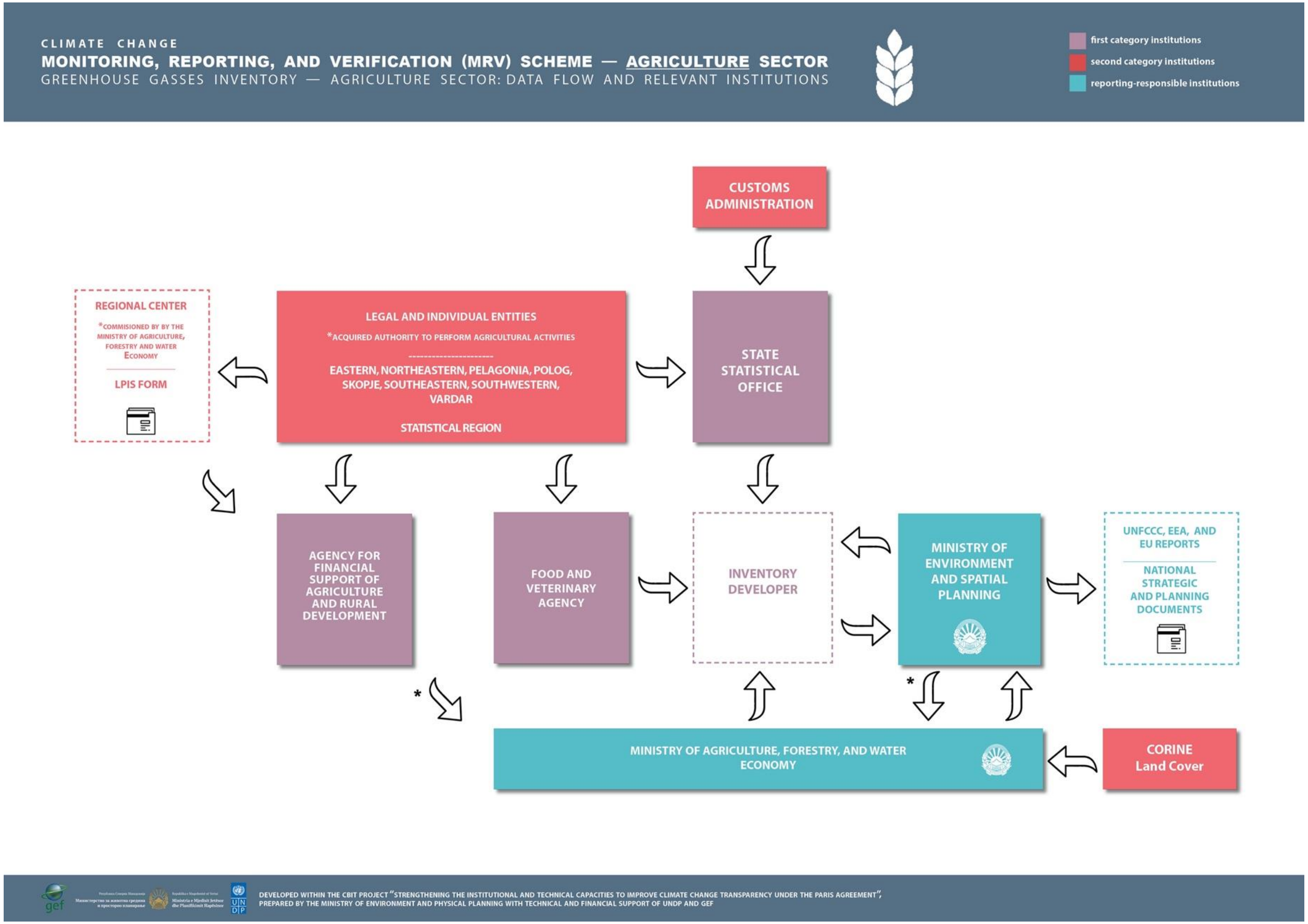


Figure 7-2: MRV Scheme – Agricultural Sector

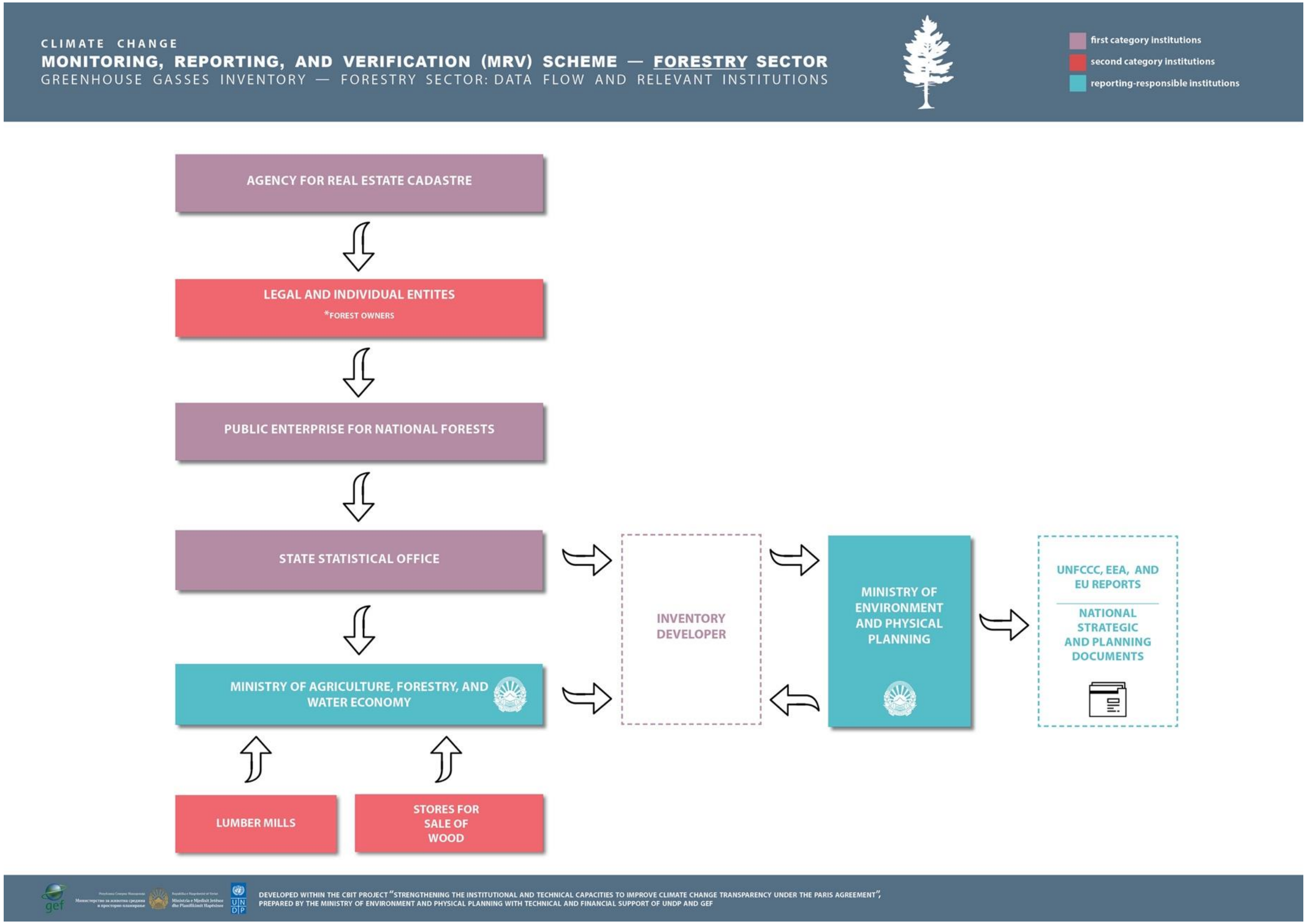


Figure 7-3: MRV Scheme – Forestry Sector

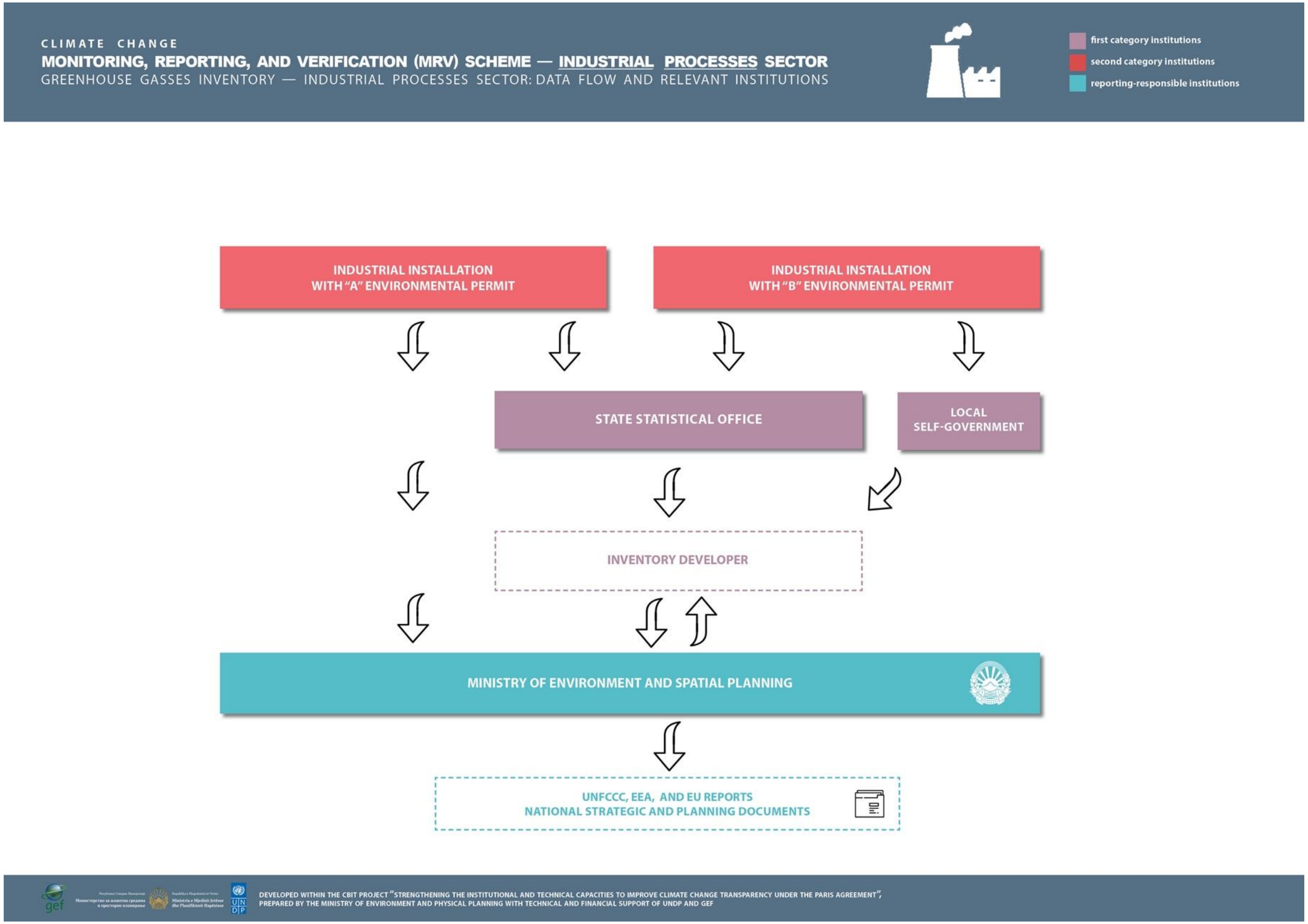


Figure 7-4: MRV Scheme – IPPU Sector

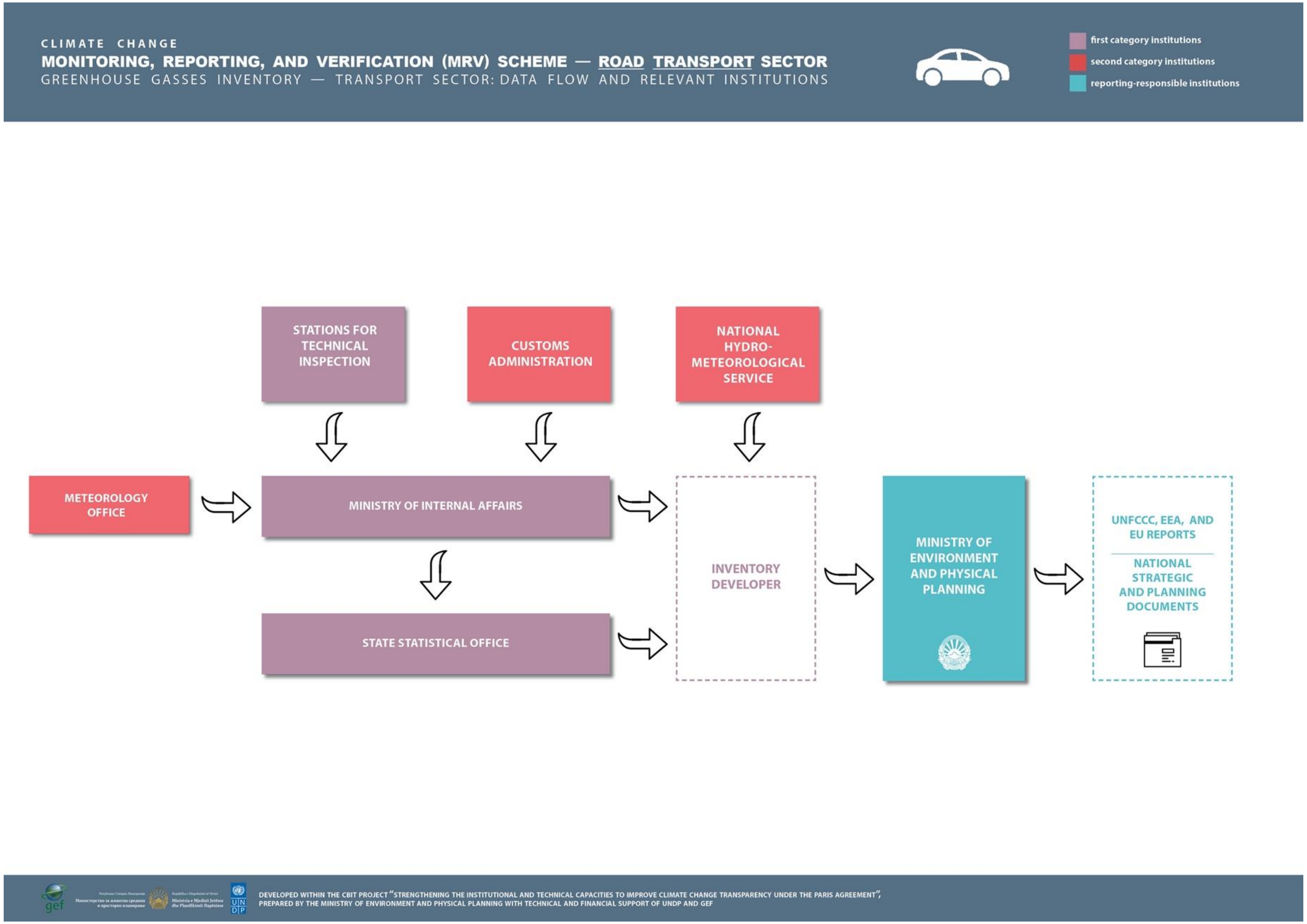


Figure 7-4: MRV Scheme – Road Transport Sector

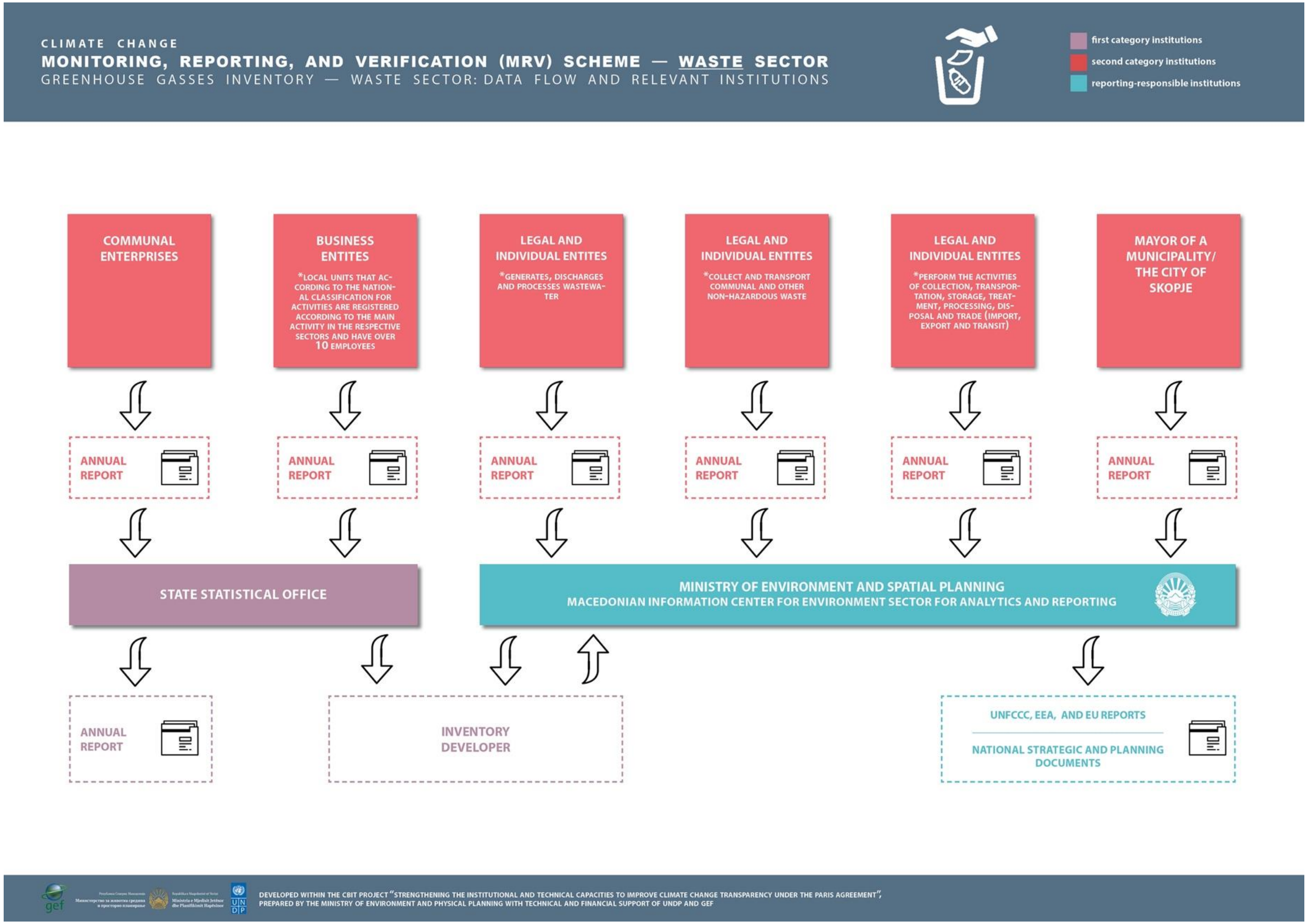


Figure 76: MRV Scheme – Waste Sector

7.6 The Monitoring Mechanism Regulation (MMR)

Regulation (EU) No 525/2013 on mechanisms for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change (the MMR) revises and strengthens the EU's greenhouse gas monitoring and reporting framework in order to provide a better platform for EU action to tackle climate change. The main goals of the MMR are to improve the quality of the data reported, to enable the implementation of the Climate and Energy package by accurately tracking the progress of the Union and EU Member States towards meeting their emission targets for 2013-2020, and to incorporate periodic updates at the international level of metrics (global warming potentials) and methodologies (IPCC guidelines) in the determination of greenhouse gas inventories.

The MMR implements a new review and compliance cycle, which was established under the Effort Sharing Decision, for member states' binding annual emissions targets. They incorporate enhanced reporting on several topics, including land use, land-use change and forestry (LULUCF), maritime transport, climate adaptation, non-CO2 impacts of aviation, and the use of revenues from auctioning of carbon allowances under the revised EU Emissions Trading System (EU ETS) Directive. They also introduce reporting on financial and technology support provided to developing countries, which would most likely go beyond the new UNFCCC reporting requirements on support.

7.7 Recommendations for MRV

Given Macedonia's status as a non-Annex I Party to UNFCCC, a Candidate Country for EU membership, and a Contracting Party of the EnC, the MMR Regulation of the EU can be seen as a common denominator for MRV activities. While the country has begun to adjust its national legislation in order to adopt the provisions of the MMR, there are remain man gaps in the legislative frameworks which require the collection of data and the way in which data is collected. There are many similarities in the shortcomings in the way data is collected by all relevant institutions across GHG emitting sectors, as well as similarities in the opportunities for improving the process of collection of data and preparation of the GHG inventory.

North Macedonia's SBUR proposed an integrated law on climate action, which would incorporate the provisions of the adjusted Regulation 525/2013, while secondary legislation would adopt the provisions of Regulation 749/2014. The project Preparation of a long-term strategy and Law on climate action funded by the EU within the IPA 2014-2020 is currently ongoing in the country, which aims at transposing the EU regulations on accurate monitoring, reporting and regular evaluation of greenhouse gas emissions. Recommendations from SBUR related to GHG inventories related to institutionalizing the GHG inventory have been also implemented.

The **following measures** are recommended for a national MRV system that will comply with UN and EU requirements as well as reflect the Paris Agreement and the Macedonian NDC (which serves as its primary target under SDG13). These recommendations cover all three aspects of MRV in this context: 1) GHG inventories; 2) Mitigation policies and measures and emissions projections; and 3) Adaptation.

7.7.1 Recommendations for GHG Inventories

(Required in: UN reporting – NCs and BURs; EU MMR – reporting on GHG emissions; tracking the SDG13 implementation)

Below is provides short summary of recommendations for GHG Inventories:

- Maintain the current practices of inventory preparation;
- Enhance the reporting on land use, land-use change and forestry (LULUCF);
- Enhance the process of collecting data for GHG inventory

The issues on collecting data for GHG inventory for each sector is elaborated in more detail in the National MRV Report prepared in preparation of the TBUR.

The process for collecting data for the preparation of the greenhouse gas inventory from the **energy sector** indicates the need for a legal basis for regulating and systematizing this process. The numerous laws and bylaws governing the collection of data needed to prepare the inventory are complex given the breadth of the sector and complicate the collection and compilation of data. These issues could be resolved through digital collection by all relevant institutions in the energy sector.

The harmonized digital collection of the necessary **energy sector** data explained in this chapter would facilitate the work of all stakeholders involved in the process and would provide improved and more accurate data. Recommendations for improving this process consist of:

1. Establishment of a legal basis for the process of preparation of the inventory by the energy sector (it is expected to be regulated by the Law and the bylaws for climate action that are in preparation);
2. Creation of a functional web platform that can be used by all relevant institutions and stakeholders who prepare and collect energy data for the needs of the preparation of the above-mentioned reports, energy balance and the greenhouse gas inventory. The web platform would allow for:
    a. Facilitated data collection;
    b. Double reporting by some energy entities would be avoided;
    c. Provide accurate, timely and consistent data in the relevant units of measures needed to prepare the various reports, energy balances and the inventory;
    d. Increased, strengthened and joined capacities for data verification by several institutions and stakeholders; and
    e. Facilitated storage, and further analysis, processing and reporting of data for the appropriate national and international needs (and reporting) of the country.

One of the main obstacles to providing the necessary data in the **road traffic** sector is the vehicle register. Under the current register, there is no technical possibility to provide accurate and timely data, although there is a legal basis for such reporting. The proposals from the National MRV Report prepared in preparation of the TBUR concluded that improving the quality of processing and sorting the data from the database of vehicles. It is important to note that the following suggestions offer a short-term solution:

1. Automatic data processing and sorting
2. Improving the interface application of the Ministry of Interior for entering and accessing the data from the database of the vehicle register
3. Adding a new category - past kilometers of the vehicle, and specifying three subcategories - CNG, electric and hybrid vehicles in the vehicle type category

In the **waste sector**, the proposals for improving the current situation are in the direction of:

1. Digitization of data
2. Additional requirements in the form for submission of data for monitoring the discharged wastewater
3. Additional requirements in the Annual Report on Utilities of the SSO

For the **industrial sector** the following recommendations are proposed:

1. Legal obligation for digital reporting instead of electronic
2. Use of existing software tools designed for industrial installations
3. Support and assistance of industrial installations for digitalization and simplification of the reporting process

For the **AFOLU sector** the following recommendations are proposed agriculture, forestry and land use and management

1. Expanding the LPIS template in order to increase the inventory database from the field
2. Expanding the LPIS template in order to include the land use and management sector.
3. Digitization and inter-institutional alignment between ministries, agencies and the statistical office, to unify a universal template that will be digitally filled by first and foremost individuals, in order to facilitate the process and reduce the confusion in collecting data.
4. Improving the inter-institutional framework through which ministries, agencies and the statistical office communicate, in order to achieve a coherent picture of the current situation in the country, as well as to ensure precision in the preparation of data inventories.
5. Creating a forests inventory.

7.7.2 Recommendations for mitigation policies and measures and emissions projections

(Required in: UN reporting – NCs and BURs; MMR reporting on mitigation policy and measures and projections; tracking the NDC implementation; tracking the SDG13 implementation)

- Create an enabling environment for the implementation of mitigation measures (de-risking);
- Facilitate and encourage leadership by sub-national and private actors such as cities, regions, business and civil society in NDC implementation and future revisions;
- For each of the identified mitigation measures elaborate an MRV system, which should be in compliance with the EU MMR and include procedures and institutional arrangements that best reflect the specific conditions of the country and its mitigation obligations and that will enable tracking progress toward the mitigation target and attracting international climate financing for domestic mitigation measures. Start with the highest priority measures (with highest mitigation potential and lowest specific costs);
- Develop mechanisms for tracking investments in CC mitigation;
- Maintain the extensive analytical work for scenario development and emissions projections, creating a solid analytical base for future revisions;
- Include evaluation of the co-benefits of mitigation measures and use them among the criteria for prioritization

7.7.3 Adaptation policies and measures

(Required in: UN reporting – NCs; MMR reporting on adaptation; tracking the SDG13 implementation)

- Adopt a National Adaptation Plan at the government level;
- Develop an MRV scheme for adaptation measures, starting with measures addressing the most vulnerable sectors;
- Develop mechanisms for tracking investments in CC adaptation;
- When developing the Adaptation chapter in NCs, follow the MMR guidance on adaptation
- Facilitate and encourage leadership by sub-national and private actors, such as cities, regions, business and civil society;
- Submit an updated government climate pledge, including vulnerability and adaptation components.

8 Other Relevant Information

The following section presents noteworthy new developments and planned activities related to climate change in the Republic of North Macedonia, particularly activities related to education, gender inclusion, sustainable development and public awareness related to climate change relevant to Article 6 of the UNFCCC. The primary information portal for climate change information in the country is the national climate change platform (www. klimatskipromeni.mk).

8.1 Climate change knowledge and perceptions

The UNDP and the Ministry for Environment and Physical Planning of the Republic of North Macedonia, in the frame of the project for development of the Macedonian Third Biennial Updated Report on Climate Change, conducted an online survey in October 2019 to assess the public perception and awareness level regarding climate change. The survey is built upon previous surveys conducted in 2014 and 2016 as part of the "Third National Communication on Climate Change" and the "Second Biennial Update Report on Climate Change".

The present survey focuses on new data on the awareness level of the public regarding gender aspects of the climate change, the similarities and differences between the air pollution and the climate change, the main sources of climate change related information, the visibility of climate change in the media and the visibility of different campaigns and projects.

The survey was distributed on-line via social platforms and pre-identified mailing lists and received 1158 responses. Compared to the 583 received for the survey in 2016, this shows that the interest for the issue has substantially increased. The majority of the respondents (71%) live in the ten municipalities of the City of Skopje, and the rest live in 52 other municipalities represented in the sample. The respondents belong to different age groups, of which mostly represented are the people aged 25-39 (37.56%), but those over 65 years were also represented (2.07%). Approximately 18.48% more women than men, responded to the survey. Majority of the respondents (75%) have higher education such as bachelor or master's degree.

The survey showed that the respondents detected corruption, crime and the lack of clean water as biggest social problems, while climate change is seen as third most serious threat to the society (Figure 8-4). However, compared to previous findings, the respondents consider that they have higher knowledge regarding climate change. 51.9% from the respondents think that they are well informed for the different influences and consequences of climate change, while 40.3% of them stated that they are informed to a certain extent. Extreme temperatures and the change in seasonality and precipitation are recognized as most visible effects of climate change. In that regard, the respondents stated that the issue of climate change is more present in the media compared to the previous surveys. It is believed that this is possibly a result of the raise of the public awareness and interest in the issue, rather than the increased occurrence of extreme weather events. Also, the survey shows that 68% of the citizens perceive the connection and the differences between climate change and air pollution.

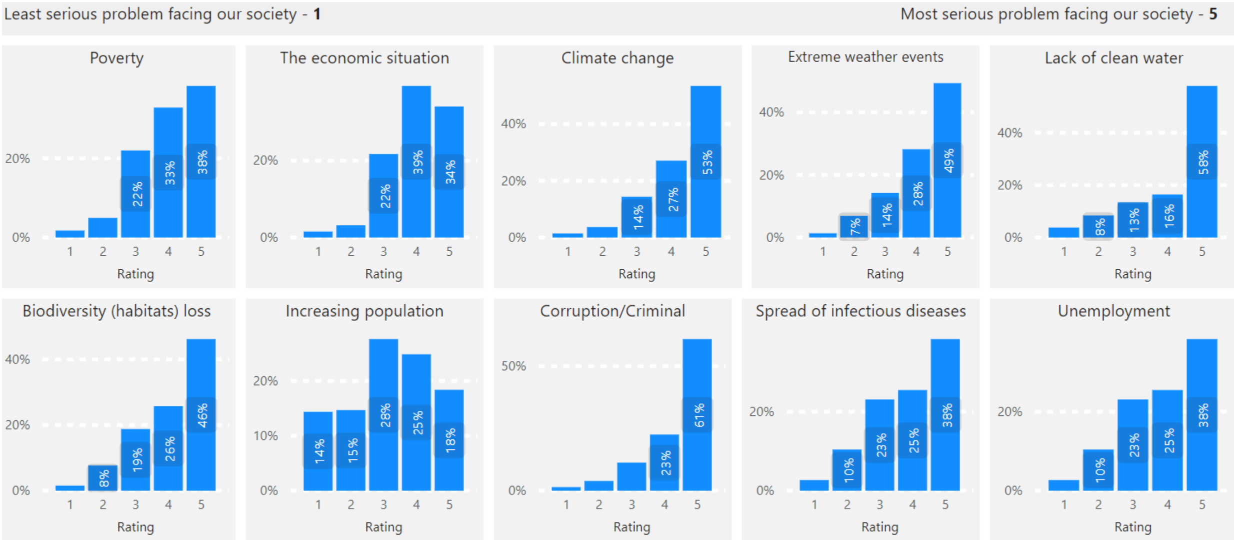


Figure 8-1: Ranking of the seriousness of the possible threats for the society

The survey demonstrates that the majority of the respondents are not content with the manner in which the public administration, companies and the industry, and even the citizens themselves, contribute to address the effects of climate change (Figure 8-5). 74% of the respondents think that the companies and the industry do not put enough efforts for the adaptation and mitigation of climate change. 72% of the respondents consider that the local authorities are not doing enough and 69% of the respondents think that the central authority is not doing enough. 66% of the respondents think that the citizens themselves are not doing enough to protect the environment. This survey shows that citizens' awareness regarding individual contribution to climate change mitigation and adaptation has increased. Beside this, it is encouraging that the respondents show motivation to start undertaking activities towards protection of the environment and almost all of them are ready to use renewable energy. The main motivation for the protection of the environment is the desire to live in healthy and clean environment. Most of the respondents think that an individual change of behavior can greatly influence climate change.

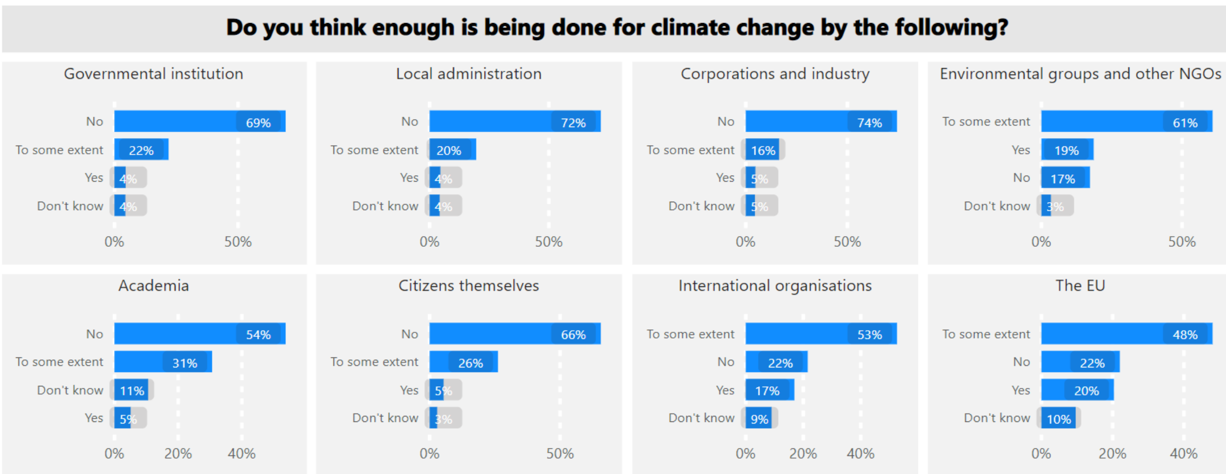


Figure 8-2: Respondents' perception on engagement of the different stakeholders regarding climate change

The survey demonstrates that the citizens still do not have enough knowledge about adaptation actions to climate change (Figure 8-3). Additional efforts and attention are needed in order for the best practices of adaptation to be promoted and the development of concrete measures to be supported. The internet and social media remain the best way for sharing data, but this survey showed that the number of those who read reports and studies (12.7%) and read specialized magazines (7.9%) has increased. The respondents are acquainted with the climate change campaigns organized by the non-governmental organizations for protection of the environment and by the international organizations, especially UNDP and USAID, and with the campaigns of MOEPP.

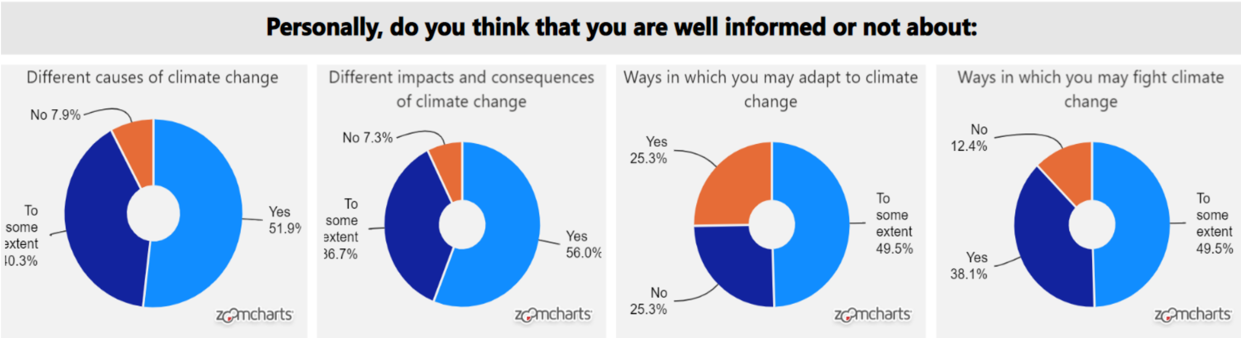


Figure 8-3: Respondents' perception on their knowledge of different issues regarding climate change

The results of the survey are available via the interactive on-line platform (http://anketa2019.klimatskipromeni.mk/index-en.html) which provides combination of different parameters that can give a clearer perspective of the needs and manners of perception, but also of the behavior of different target groups regarding undertaking #ClimateAction. The platform provides information about what can and should be taken into consideration during policy processes and climate actions initiatives.

8.2 Mainstreaming gender in climate change

The Global Support Programme for National Communications and Biennial Update Reports (in short, GSP), supported the integration of gender equality considerations into climate reporting, in accordance with UNFCCC's guidance and GEF's gender policy and action plan In December 2017, GSP started a pilot initiative by providing a combination of regional and national support to Western Balkan and Lebannon on gender and climate change, in order to enhance understanding of the interconnection of the two issues and to build the institutional capacity in this regard Such start coincided with the adoption of the UNFCCC Gender Action Plan by COP 23, which served to GSP as a conceptual framework going forward.

The pilot program went from December 2017 to February 2020 and had two components: a regional and a national one Within the regional component, three regional workshops were conducted - on December 5-6, 2017 in Skopje (North Macedonia), on November 14-15, 2018 in Belgrade (Serbia) and on February 12-13, 2020 in Podgorica (Montenegro) The national component consisted provision of targeted technical assistance to countries in integrating gender considerations in NCs, BURs and CBITs in line with the Lima Work Program on Gender and the Gender Action Plan. UNFCCC gender focal points from EU countries, other UN entities working on gender dimension of climate change, as well as national gender experts, were also invited to support exchanges of knowledge and good practices

The MOEPP, through the project "Macedonian Forth National Communication and Third Biennial Update Report on Climate Change", actively participated in this initiative. The first Macedonian Gender and Climate Change Action Plan, hereinafter "the Plan" (Annex 5), has been developed and implemented.

The Plan foresees step by step activities to make the Macedonian NCs and BURs gender responsive and to strengthening the institutional capacities on gender and climate change on several levels. As a result:

- Ms. Elena Grozdanova from the Ministry of Labor and Social Policies has been nominated as UNFCCC Gender and Climate Change Focal Point;
- The Ministry of Labor and Social Policy (MLSP) has been actively involved in climate change relevant activities on local, national and regional level;
- Training manuals for key administrative stakeholders on gender and climate change/environment has been developed (implementation is underway).
- Gender and climate change intersection in the existing and planned national strategic and legal framework in both areas (gender and climate change)
- The degree of institutional (inter/intra) cooperation on gender mainstreaming in climate change planning processes has been assessed.
- Gender and climate change intersections have been placed on the highest decision-making level (in the Macedonian Parliament)
- A model for efficient implementation of the Plan has been provided i.e. a body responsible for coordinating the implementation of the Plan
- Incorporating Climate Change into the new Gender Equality Strategy is underway, as well as gender considerations into the Law and Strategy on Climate Action(under development).

Based on the introduction of the plan into the new Gender Equality Strategy, through the use of an open coordination method or a multi-stakeholder method, the plan should be subject to revision and upgrading if this is found to be necessary when developing the Strategy.

With the adoption of the new Gender Equality Strategy, the specific strategic objective of Gender Equality and Climate Change will list all institutions responsible for implementing, monitoring, evaluating activities within this objective.

The establishment of a sub-group within the Inter-Departmental Group is a proposed body responsible for monitoring the implementation of the plan, more precisely now a specific strategic objective in the Gender Equality Strategy (Figure 8-4). This would avoid duplication of several strategic documents and synchronize and upgrade the existing document, i.e. putting it into operation at both the policy level and the new implementation level.

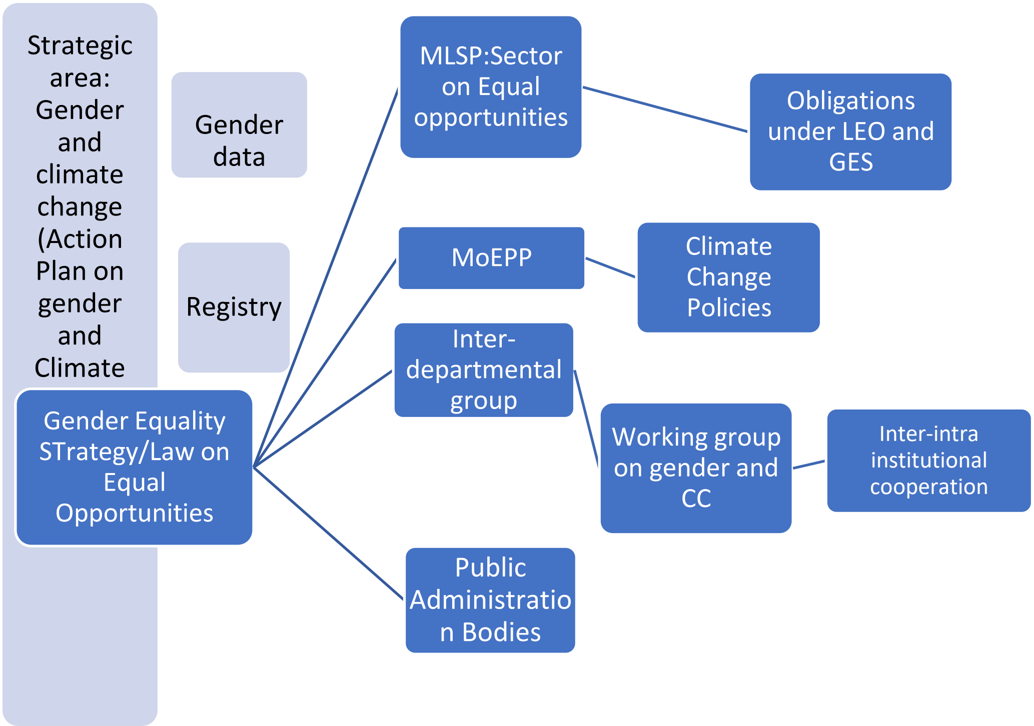


Figure 8-4: Proposed model for establishing a body responsible for coordinating the implementation of the Action Plan on Gender and Climate Change

Key good practices and knowledge products on gender and climate change are presented in Table 8-1.

Table 8-1: Good practices and knowledge products on gender and climate change

	Good practices	**Knowledge products**
1	Analysis “Strengthening the implementation of the Action Plan on Gender and Climate Change”	An analysis on the inclusion of the gender perspective into the national climate change policies was conducted, with a view to international standards, national institutional set-up, an overview and analysis of the gender based roles, needs, challenge and barriers of women and men in 4 sectors: Energy use in households, Transport, Agriculture and ICT (information and computer technologies). The research also provides a plan to strengthen the implementation of the Draft Action Plan on Gender and Climate Change was developed. The purpose of the analysis was to assess all the points where actions are needed in order to strengthen the implementation of the Plan.
2	First systematic qualitative insight conducted with a view to the following: Gender and climate change intersection in the existing and planned national strategic and legal	- A questionnaire to support the implementation of the Gender and Climate Change Draft Action Plan was submitted to the Coordinators for Equal Opportunities in the Public Administration Bodies relevant to the area of climate change. The purpose of this questionnaire was to gain insight into the level of (1) Coordinators 'awareness on existing climate change policies of their institutions, (non) inclusion of a gender perspective, (2) insights into the level of Coordinators' awareness of gender-based differences of the climate change negative impacts, the different opportunities, obstacles, needs

	Good practices	Knowledge products
	framework in both areas (gender and climate change), and The degree of institutional (inter/intra) cooperation on gender mainstreaming in climate change planning processes	and roles in climate-related sectors, as well as (3) identifying the needs of Coordinators in order to effectively implement the Plan and create a Training Module. - Interviews with the State Secretary and State Counselor for Equal Opportunities at the Ministry of Labor and Social Policy (MLSP), State Counselor for Climate Change at the Ministry of Environment and Physical Planning (MoEPP), Consultation with the State Secretary at the MoEPP, Interview with Inter Coordinator of the Inter- Departmental consultative and advisory group on equal opportunities (h.a. Inter-Departmental group). - Questionnaire submitted to the National Committee on Climate Change (NCCC) for the purpose of (1) inspecting the extent to which the NCCP incorporates gender into their work for purpose of undertaking for further action aimed at the effective integration of a gender perspective into climate change policies as well as at an effective level of implementation , and - Questionnaire submitted to the members of the Inter-Departmental Group on Equal Opportunities. The purpose of this questionnaire was to (1) review the group's work on gender and climate change as well as (2) identify methods for involving the group in supporting the implementation of the Plan
3	Fostered implementation the Action Plan on Gender and CC	Work Plan to strengthen the implementation of the Action Plan on gender and Climate Change/ is developed. Proposed Work Packages with Methods to Support Implementation of the Gender and Climate Change Action Plan were developed and implemented within this project taking into consideration the mentioned current situation with regard to the degree of gender responsiveness of climate change policies was taken into account, as well as the degree of incorporation of the concept of mitigation / adaptation processes into gender equality policies. Model for institutionalization of the Action Plan on Gender and CC developed and accepted by the relevant Ministry. Recommendations for strengthening the implementation of the Action Plan on Gender and Climate Change were developed and presented with all the relevant stakeholders at national level from the relevant institutions.
4	Issue on gender and CC for the first time is put on the political agenda of the Parliament	Recommendations for strengthening the implementation of the Draft Action Plan on Gender and Climate Change given at the Public Debate of the Parliamentary Commission on Equal opportunities
5	Established base for strengthening the administrative	A training module on gender and climate change was developed. The module provides methods and content for trainings for the gender machinery and institutional

	Good practices	Knowledge products
	capacities on gender and CC	representatives working in the field of climate change. By that, all the relevant national stakeholders will be able to gain knowledge on the gender perspective in CC and the methods of implementation of the Draft Action Plan on Gender and CC. Training of all the relevant stakeholders on this issue is one of the crucial and basic steps in purpose of effective implementation of the Plan. So far, the gender machinery in the country and the representatives working in the field of CC are not familiar with the intersection of the gender and climate change. Terms of Reference is respectively developed for implementing the trainings.
6	Developed Model for implementing the Action Plan	The implementation of the Plan and its formal status is solved by its formal inclusion in the new Gender Equality Strategy and the Law on Equal Opportunities on Women and Men (Both documents have to be revised in 2020). That enables synchronized and systematic implementation of the Plan by the system, and does not cause repetition of documents. Based on the introduction of the plan into the new Gender Equality Strategy, through the use of an open coordination method or a multi-stakeholder method, the Action plan should be subject to revision and upgrading if this is found to be necessary when developing the new strategy. With the adoption of the new Gender Equality Strategy, the specific strategic objective of Gender Equality and Climate Change will list all institutions responsible for implementing, monitoring, evaluating activities within this objective. The establishment of a Permanent sub-group within the Inter-Departmental Group is a proposed body responsible for monitoring the implementation of the plan, more precisely now a specific strategic objective in the Gender Equality Strategy. This would avoid duplication of several strategic documents and synchronize and upgrade the existing document, ie putting it into operation at both the policy level and the new implementation level.
7	Gender data	The Study “Applying a Gender Lens to the Third National Communication on Climate Change”, provides a comprehensive set of indicators adapted to the Macedonian context for the gender perspective on climate change to be collected by relevant institutions.
8	GHG Inventory	The GHG Inventory cannot reflect the gender dimension, due to the absence of official statistical gender disaggregated data in the analyzed sectors: Energy, Industrial Processes and Product Use (IPPU), Agriculture, Forestry and Other Land Use (AFOLU) and Waste, disaggregated by categories and subcategories on the percentage of female and male participation in the production of the GHG.

	Good practices	Knowledge products
		Feminization of poverty and social vulnerability take a significant part in the climate change processes. For example, 65+ women who live alone and have low monthly income uses firewood as the primary energy source for heating the household in 62.2% out of which 46.7% said that the most important criteria for selection of heating it is monthly cost.[1] Therefore gender component is a significant element of the climate change processes, and thus should be an integral part of the GHG Inventories.

8.3 Education and climate change

An assessment prepared within the project "Macedonia's Fourth National Communication and Third Biennial Update Report on Climate Change under the UNFCCC" shows that although there is evidence that climate change and sustainable development issues are to an extend integrated in the educational curricula, it is not done with a systemic approach for the national educational system.

There are four state universities, "Ss. Cyril and Methodius" University in Skopje, "St. Kliment Ohridski" University of Bitola, University "Goce Delcev" of Stip and State University of Tetovo, that have study programmes or subjects to undergraduate, postgraduate or PhD degree level relevant to climate change and sustainable development issues. The courses are offered at different faculties at each of mentioned universities. However, the subjects of the education curricula are directly or indirectly related to climate change. Table 8-2 below shows the information for study programmes and subjects relevant to climate change in different faculties at "Ss. Cyril and Methodius" University in Skopje.

Table 8-2: "Ss. Cyril and Methodius" University in Skopje, Faculty of Mechanical Engineering – Skopje

Education level	Study programme	Subject in different study programmes
Faculty of Mechanical Engineering		
Undergraduate level	Energy and Ecology	Environmental Management Energy Efficiency Sustainable Development Eco-Products Risk Management for SD
Postgraduate level	Sustainable Energy and Environment Energy and Ecology Management of Product Lifecycle Management Engineering of Environment and Natural Resources	Sustainable Development Energy Efficiency Circular Economy Cleaner Production Eco Sustainability Energy Management Intelligent Transport
PhD level	Different subjects at the study programmes: Mechanical Engineering	Environmental Management Energy Efficiency Sustainable Development Product Lifecycle Management

Education level	**Study programme**	**Subject in different study programmes**
	Industrial Engineering and Management	
Faculty of Electrical Engineering and Information Technologies		
Undergraduate level	Power engineering, automation and renewable energy	Energy and Sustainable development Photovoltaic systems Renewable energy sources Wind Power Plants Smart grids Energy Efficiency and Environmental Management
Postgraduate level	Renewable Energy Sources	
	Energy Efficiency, Environment and Sustainable Development	
PhD level	Different subjects at the study programme: Electrical Engineering and Information Technologies	Eco-Legislation Energy Efficiency Environment Protection from Energy Systems Energy Sustainable Development
Faculty of Technology and Metallurgy		
Undergraduate level	Inorganic Engineering and Environment Protection	Environmental Protection Impact of CC on the water and soil characteristics Pollutants Cleaner Production Chemistry of atmosphere Energy and Environment Industry Zero Emission
Postgraduate level	Environmental Engineering	
	Inorganic Engineering and Environment Protection	
PhD level	Different subjects at the study programmes: Technology Metallurgy	Energy and Environment, Environment Impact Assessment, Industry Ecology, Processes in Environment Engineering, Sustainable Development, Air Pollution and Prevention
Faculty of Agricultural Sciences and Food		
Undergraduate level	Eco Agriculture	Ecology Agro Climatology
Postgraduate level	Management of Renewable Sources and Environment	
PhD level	Management of Renewable Sources and Environment Protection in Agriculture	Bio Climate Analysis Bio Technologies
Faculty of Natural and Mathematical Sciences		
Undergraduate level	Ecology	Environmental Protection
	Biology	Climatology and Climate Changes

Education level	Study programme	Subject in different study programmes
	Geography	Plant ecology
Postgraduate level	Ecology and bio-systems	
	Geographic Information Systems	

Results of the assessment of other universities across the country show similar level of integration of climate change and sustainable development aspects in the education curricula. Therefore, effective mechanisms and strategies should be put in place to enhance the educational program and foster an enabling environment for research on climate change issues.

Informal educational initiatives are committed to raising awareness about the importance of sustainable development goals, as well as to acknowledge the role of young people in achieving positive change in society. That is why in 2018, sustainability camps were organized and the "School for Sustainable Development" was established.

School for Sustainable Development

The “School for Sustainable Development” promotes learning about the SDGs, with high school students taking part in sustainability camps and learning about the 2030 Agenda through numerous activities, interactive tools, educational games and modules. The main goal is to educate and motivate students to contribute with solutions to various socio-economic and environmental problems in their community. More information is available here: School for Sustainable Development

8.4 Advances on achieving the Sustainable Development Goals

Since its independence in 1991, the Republic of North Macedonia has made significant progress towards sustainable development and the rational use of natural resources. This process was guided by the fundamental values enshrined in its Constitution, legal framework and strategic policy documents such as the National Development Plan 2007-2009, National Strategy for Sustainable Development 2009-2030, Strategy for Regional Development 2009-2019, etc. In 2015, the Government reaffirmed its commitment to sustainable development by pledging “to leave no one behind” and agreeing to implement the 2030 Agenda. Figure 8-5 shows the major milestones to achieving the SDGs for the country.

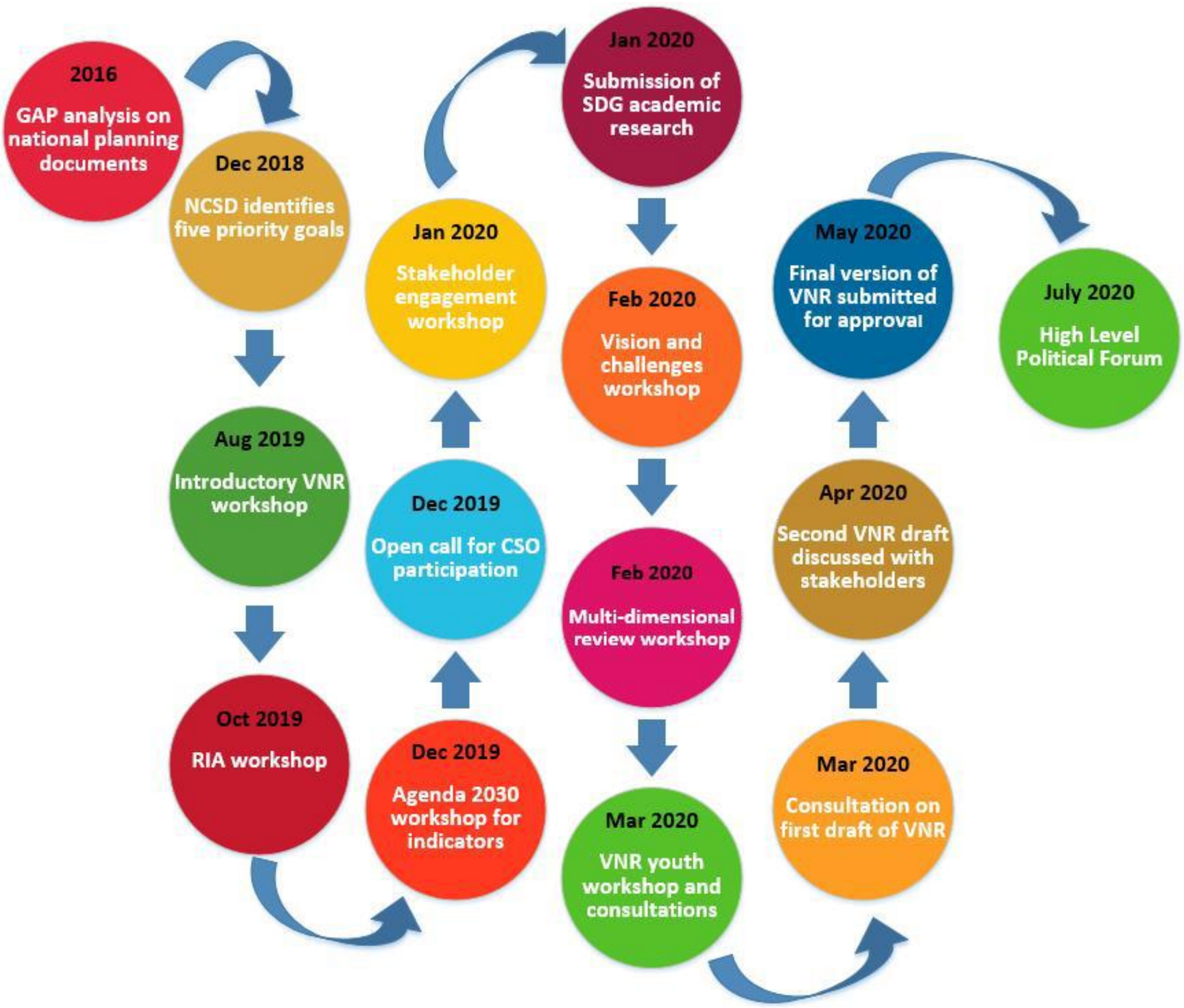


Figure 8-5: Major milestones for the Republic of North Macedonia towards the achievement of the SDGs

The following are the major milestones in North Macedonia's journey towards the achievement of the SDGs:

- In 2016, a ***Gap Analysis*** was conducted to assess the degree to which SDGs are incorporated into national planning documents for sustainable development.
- In December 2018, the ***National Council for Sustainable Development*** identified SDG 1, SDG4, SDG8, SDG 13 and SDG16 as five priority goals for the period 2018-2020, based on priority activities and measures defined in the ***Government Programme*** (2017-2020) and the five pillars of the UNDAF for the period 2016-2020.
- In August 2019, an **Initial workshop National Voluntary Review** was organized by the UNDP for the technical working group to be introduced with the process of National Voluntary review.
- In October 2019, a **Preparatory workshop Rapid Integrated Assessment** was held for the experts from the central and local government.
- In December 2019, an "**Agenda 2030 Indicator Framework"** workshop was organized by the ***UN Resident Coordinator Office*** with the participation of 80 representatives from government and UN agencies. Participants and the State Statistical Office endorsed the proposed indicator framework of 100 indicators.

- In December 2019, an open call was launched for ***Civil Society Organizations*** (CSO) to apply for participation in the VNR process. About 30 CSOs applied and expressed their views on challenges and potential solutions related to the country's sustainable development.
- In January 2020, a two-day **"Stakeholder engagement**" workshop was organized by "***Partners for Review***" and the ***Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH*** on the VNR process. About 40 representatives from academia, chambers of commerce, civil society and Government attended.
- In January 2020, a call was launched for ***academia*** to submit publications and research projects related to SDGs.
- In February 2020, a workshop was organized jointly with the ***Organization for Economic Cooperation and Development*** and the ***Swedish Embassy*** to present and discuss the Republic of North Macedonia's "**Multi-dimensional Review**".
- In March 2020, a two-day **consultation process for the first draft *of the VNR report*** was organized.
- In March 2020, a ***Youth Forum/Consultation*** was organized on the VNR.
- In April 2020, the ***second draft of the VNR report*** was broadly consulted with stakeholders.
- In May 2020, the ***final version of the VNR report*** was completed and was submitted for Government approval.
- In July 2020, ***the Republic of North Macedonia's VNR report*** is presented to the UN High Level Political Forum.

The results of the voluntary assessment of the

SDG 1 – No Poverty

In the last few years, the focus of the social protection system has been on social services for vulnerable groups. The *Ministry of Labor and Social Policy* (MoLSP), with support from the *UN*, is introducing the practice of case management in social protection and social welfare, which is expected to enhance further the country's efforts to eliminate poverty. The 2019 reform, which started with the adoption of the *Law on Social Protection*, the *Law on Social Security for the Elderly* and the amendment of the *Law on Child Protection*, has streamlined and expanded social assistance programmes.

SDG 2 – Zero Hunger

With support from the EU and FAO, the implementation of the *National Strategy for Land Consolidation* is currently underway and envisages the implementation of more complex land consolidation projects, including infrastructure investments. Furthermore, with support from the UN, the Government is improving the *Land Tenure Governance Framework*, which includes reforms in the legal framework to promote women's access to ownership and control over land as a crucial resource for poverty reduction, food security and rural development. Other key activities in the agriculture sector include support for young farmers, restoring machinery, support for women in rural areas, investing in rural infrastructure, sewerage, water networks, green markets and restoring cultural landmarks in rural areas. Another ongoing initiative is the operation of 50 public kitchens that serve about 4,000 people. The state budget allocates annual funds in their support, but due to limited resources about 90 percent of the people in need of support defined as vulnerable groups in the *Law on Social Protection* are not covered by this law.

SDG 3 – Good Health and Well-Being

The Ministry of Health is committed to e-Health and further upgrades of the "*Moj Termin*" system. Further development of e-health is ongoing through the preparation of the National e-Health Strategy. Additional measures are being taken to improve cancer screening. The *National Cancer Registry* will be established and the *Strategy for Malignant Diseases* will be prepared. The Government has increased funding for *rare diseases* from 3,455,989 Euro in 2017 to 8,550,734 Euro in 2020. Three new medicines were procured for the treatment of Gaucher's disease, idiopathic pulmonary fibrosis and spinal muscular atrophy.

The preparation of key strategic documents such as *National Health Strategy* 2030 and *National Master Plan for Perinatal Care in ongoing.* Additionally, the Government is planning to expand the *home-visit programme* for vulnerable populations which is currently operating in two cities.

Programmes targeting the *Roma people* are being implemented, especially through Roma health mediators working in nine municipalities with predominant Roma populations.

SDG 4 – Quality Education

The Government is paying particular attention to the social inclusion of the Roma population, especially in the education sector. To this end, the Government has developed a strategy and action plans for reforms. Since 2015/2016, over 200 scholarships have been awarded to Roma in public and private higher education institutions and the completion rate among these students is 100 percent.

The "Sustainable Development School" promotes learning about the SDGs, with high school students taking part in sustainability camps and learning about the 2030 Agenda through numerous activities, interactive tools, educational games and modules. The main goal is to educate and motivate students to contribute with solutions to various socio-economic and environmental problems in their community.

SDG 5 – Gender Equality

MoLSP and the ***Employment Service Agency*** (ESA) have developed services to increase the competitiveness of the workforce, with a special focus on the equal participation of men and women. The ***Operational Plan for Active Employment Programmes and Measures*** (2019) comprises a package of employment programmes and measures in support of unemployed citizens, including women. The participation of women in active employment programmes and measures and services has been increasing. The ***Self-employment Programme*** has helped reduce female unemployment. The Ministry of Economy is implementing the ***Strategy for Women's Entrepreneurship*** (2019-2023), which promotes the economic empowerment of women by creating a favorable business environment and supporting their entrepreneurial potential. Progress has also been made in mainstreaming gender into the public financial management system requesting that the budget for Local Self-Government Units should include specific budget line for gender equality.

With support from ***UN Women*** and the ***European Institute for Gender Equality***, the Republic of North Macedonia has developed its first ***Gender Equality Index***, a tool that shows progress achieved towards gender equality in the EU.

SDG 6 – Clean Water and Sanitation

Preparatory work is underway to join the Protocol on Water and Health and a working group under the Ministry of Health and the Ministry of Environment and Physical Planning deal with the technical aspects. In 2016, the country prepared a report on the assessment of equitable access to water and sanitation in the framework of the protocol. the Republic of North Macedonia is also coordinating with other countries the management of transboundary water resources. The project "*Strumica River Basin – Implementation of the Strumica River Basin Management Plan*" will introduce measures that will help restore Strumica River Basin's socio-ecological functions and its overall resilience against the complex pressures resulting from human activities and global changes.

However, major investment programmes and advanced planning are required for the effective management of wastewater and for improving the quality of drinking water. The implementation of the ***Water Framework Directive*** requires heavy preparatory work and a robust institutional set-up.

SDG 7 – Affordable and Clean Energy

The Government is currently revising the *Nationally Determined Contribution on Climate Change* and is developing a new *Strategy on Climate Action, which will include the clean energy aspects.*

Currently, excise taxes are levied on energy products such as engine fuels and heating fuels. In 2018, the tax rate on gasoline as a heating fuel was doubled, and during this same time, the Government used excise taxes to steer consumption away from unleaded petrol and toward diesel as a cleaner alternative.

SDG 8 – Decent Work and Economic Growth

The Government is modernizing the labor laws to introduce a new employment structure and improve the hiring process for both employers and job seekers. The *National Strategy for Social Enterprises and Action Plan* is being revised to promote the growth of social enterprises. Various initiatives, such as the *Youth Guarantee Scheme* and *Self-employment Programme*, to support job creation and reduce unemployment are underway.

Additional strategic and legislative frameworks adopted in recent years to promote SMEs and entrepreneurship include:

- *SME Development Strategy 2018-2023 and Action Plan,* implemented by relevant ministries and chambers of commerce, and *Law on SMEs*, which defines the legislative and institutional framework for SME support and development.
- *Strategy for Women Entrepreneurship Development with an Action Plan* 2019-2023.

SDG 9 – Industry, Innovation and Infrastructure

With the implementation of the *Economic Growth Plan*, 314 domestic companies have been supported through the *Fund for Innovation and Technology* development instruments and measures and 220 by the *Law on Investment Financial Support.*

In support of research and development, the *Innovation Vouchers* programme is offering additional funding resources to academic institutions and private companies. To promote growth and innovations among MSMEs, the *Midterm Programme of the Fund for Innovation and Technology Development for MSMEs 2018-2020* has been launched to support MSMEs and offer additional resources for innovation and technology development activities.

SDG 10 – Reduced Inequality

The *Law on Prevention and Protection against Discrimination* has professionalized the *Commission for Protection against Discrimination*, which now has its own Professional Service, intending to be more efficient in the prevention and protection against discrimination. Additionally, the implementation of the *Strategy for One Society for All is in progress and is* aimed at fostering unity and social inclusion for all.

SDG 11 – Sustainable Cities and Communities

The Government is implementing a programme on *Sustainable and Inclusive Balanced Regional Development* to decrease disparities between the eight planning regions. The city of Skopje has established an *Innovation Lab* in support of sustainable development. The lab is designing solutions for a wide range of problems, including air pollution, public services like waste management, and transforming Skopje into a smart city. The city of Skopje is also implementing two projects to promote sustainable city development:

- *Resilient Skopje: Scaling-up for Sustainability, Innovation and Climate Change* (with UNDP), which aims to further develop the city's resilience to climate change and other environmental threats.
- *Tackling Air Pollution in the City of Skopje,* which aims to demonstrate multi-pronged intervention for dealing with air pollution generated by the residential heating system.

SDG 12 – Responsible Consumption and Production

The *Law on Extended Producer Responsibility (EPR)* and *Law on Additional Waste Streams in the EPR System* were drafted with EU support. The Law on EPR, which is expected to be adopted in 2020, aims to create incentives for producers to minimize waste production, take environmental consideration in the product design stage and support recycling practices.

SDG 13 – Climate Action

The Republic of North Macedonia is a party to the *UNFCCC*, ratified the *Kyoto Protocol* and has associated itself with the *Copenhagen Accord* (2009). With regard to the *Paris Agreement* (2015), the country has submitted its Intended Nationally Determined Contributions for Climate Change (INDC).

Within the national plans on climate change, vulnerability and adaptation assessments have been prepared for the sectors of agriculture, forestry, water resources, health, biodiversity, crisis management, tourism and cultural heritage protection. The country has created a *National Climate Change Committee with representation from all relevant ministries.*

However, a remaining challenge is that the Republic of North Macedonia does not have comprehensive legislation for addressing climate change, and a national strategy is not available either. The country is also planning to develop a *National Energy and Climate Plan, a* national adaptation plan in response to climate change covering all relevant sectors; and a national disaster risk reduction strategy in line with the Sendai Framework for Disaster Risk Reduction.

SDG 15 – Life on Land

The Republic of North Macedonia has established a sound legal framework for nature protection and the most recent developments include the adoption of the *National Strategy for Nature Protection and Action Plan for the period 2017–2027* and the *National Biodiversity Strategy and Action Plan for the period 2018–2023*. At the moment, the sixth national report to the *Convention on Biological Diversity* is under preparation. Furthermore, the development of the *National Action Plan to Combat Desertification* is one of the initial steps the Government has taken towards implementing the *UN Convention to Combat Desertification*.

SDG 16 – Peace, Justice and Strong Institutions

The Government recognizes the importance of greater transparency for democratization and economic development and is committed to improving transparency through public administration reforms. Among the most recent achievements is the adoption of the Strategy for Transparency 2019 – 2021 that aims to strengthen citizens' trust in public institutions.

To advance the quality and availability of public services, the government launched in 2019 a *national portal for e-services* (*uslugi.gov.mk*). To enhance fiscal transparency and education of taxpayers and citizens, the Ministry of Finance has established the following online platforms:

- *Capital expenditures per budget user* - provides an overview of budget users regarding the realization of capital expenditures.
- *Open finance* – enables the public access to information about public payments.
- *Public debt* - provides information on public debt and serves as a good analytical and educational tool for students and journalists.

SDG 17 – Partnerships for the Goals

The Republic of North Macedonia participates in many regional initiatives, including the *Regional Cooperation Council (RCC)* for Western Balkans. The country has also established a long-standing partnership with the United Nations system, which has been key for the progress towards the achievement of the SDGs. The current *Partnership for Sustainable Development 2016-2020 (PSD)* was officially signed between the UN and the Government of the Republic of North Macedonia in October 2016 and a new cooperation programme is currently under preparation.

8.5 Open Government Partnership Activities

By accessing the global voluntarily initiative for Open Government Partnership (OGP), Macedonian Government has committed and reaffirms its commitment to the continuous improvement of its work based on open, transparent, liable and efficient government institutions that communicate and collaborate with the civil society. The responsible institution in the country for realization of the project Open Data under this initiative is the Ministry of Information Society and Administration (MISA).

The country has joined the global OGP initiative in 2011. Following the responsibilities under this initiative, the Government adopted four action plans in 2012, 2014, 2016 and 2018 for the subsequent two years, respectively. The country was among the seven pioneers in the world that has included Climate Change Action within OGP Action Plan, thus confirming its commitment to put as much as possible open data sets relevant to climate change on the newly established national open data portal.

In 2018, an Open Data Strategy was adopted, introducing open data standards and licenses, along with guidelines and a methodology to support the submission of relevant datasets from every institution and municipality in the country. Opening of the data will allow for enhanced cooperation between the public sector and the business and civil society sector and will contribute to a more constructive exchange between them. This collaboration will also increase public participation and improve the quality of data the government will publish; at the same time, it will contribute to improving the quality of its policies.

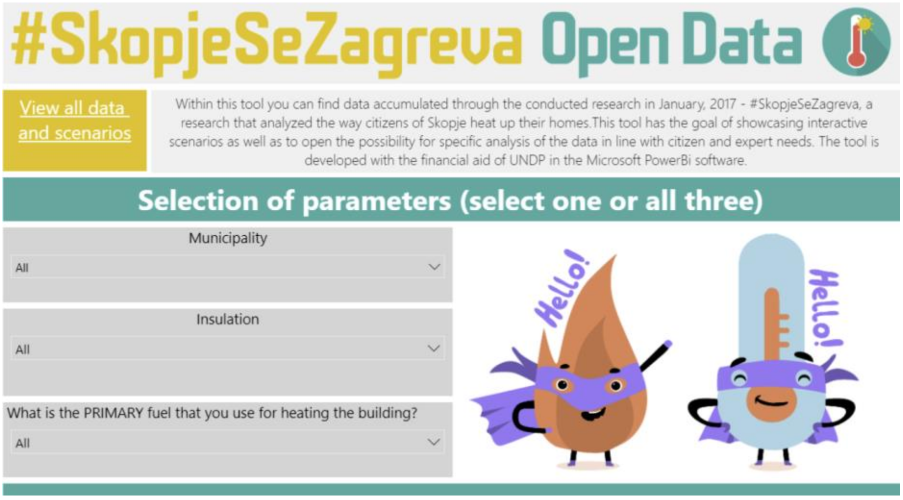
The Ministry of Information Society and Administration (MISA) has created a central government open data portal (https://data.gov.mk/), where all state institutions in the country will make their open datasets available electronically at no cost to the public. This provides the users with a single point access to all open public data.

With the fourth Open Government Partnership National Action Plan 2018-2020 (OGP NAP4), the Government of the Republic of North Macedonia continues its commitment for active work on the priorities related to access to information, integrity and good governance, fiscal transparency, open data and transparency at a local level. The latest Action Plan continues the good practice of linking the commitments of the Open Government Partnership Agenda with the objectives set out in the Agenda for Sustainable Development by 2030, by identifying more specific links with five development objectives and eight targets. Of specific interest for this assignment are the links with Objective 13 “Climate action” (Target 13.3 “Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction, and early warning”) and Objective 11: “Make cities and human settlements inclusive, safe, resilient and sustainable” (Target 11.6 “By 2030, reduce the per capita environmental impact of cities, by paying particular attention to air quality, municipal and other waste management”).

Examples of Open Data knowledge products on climate change related issues are presented below.

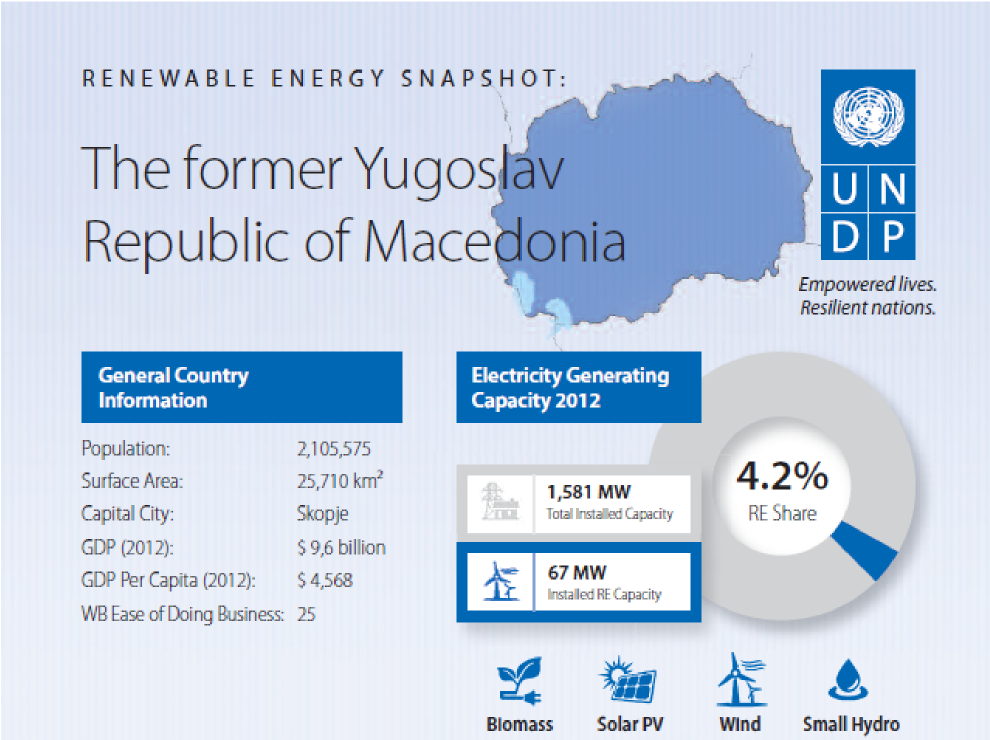
Visualization of Open Data — The future of decision-making in the public sector

An open data platform was created as part of a UNDP initiative and financial support to provide user-friendly access to information from a conducted research on climate change mitigation for Skopje. The platform was created by Start-up and offers data-visualization, using PowerBI, to present specific analysis of data for the needs of the experts, as well as the citizens. All this precise data is being used to gain insight into the socio-economic factors which influence the consumer habits. The platform can be accessed here: www.skopjesezagreva.mk



Renewable Energy Snapshots

UNDP is leading an initiative to provide knowledge products on renewable energy to better inform policy makers, academia and the public on most recent development in the sector. The collection of snapshots provide an overview for 29 countries and territories in the Europe and CIS region on the investment climate, current legislation and policies, institutional arrangement and where to find further information for investment in sustainable energy. The Renewable Energy Snapshot for North Macedonia can be found here: [RE Snapshot]



	Biomass	Solar PV	Wind	Small Hydro
Installed Renewable Electricity Capacity 2012 in MW	0	7.1[1]	0	59.6
Technical Potential for Installed Renewable Electricity Capacity in MW	500	24,000	400	200

Sources: Pavlovic et al. (2013); Lalic et al. (2011); Mijakowski and Mijakowski (2013); EVN Macedonia (2013); Energy Agency (2013); Government of the Republic of Macedonia (2010); EWEA (2013); World Bank (2014); Renewable Facts (2013); EIA (2013); Hoogwijk and Graus (2008); Hoogwijk (2004); JRC (2011); and UNDP calculations.

Key information about renewable energy in the former Yugoslav Republic of Macedonia

Macedonia has huge technical potential for renewable energy electricity generation. To exploit this potential, in 2007 the Government of the former Yugoslav Republic of Macedonia introduced feed-in tariffs for renewable energy plant operators. Eligible renewable energy developers receive the feed-in tariffs via a power purchase agreement with the market operator that is valid for 20 years for wind farms and for 15 years for other technologies. Although the official currency is the Macedonian Denar, all tariffs are in Euros. Despite the favourable legislation, the increase in installed renewable energy capacity in recent years has remained low. The main reasons include the bureaucracy and complexity involved in obtaining permits for construction, land use and electricity generation (Mijakowski and Mijakowski, 2013). The former Yugoslav Republic of Macedonia performs well in the World Banks' Ease of Doing Business index, where it is ranked in 25th spot (IFC & World Bank, 2014). The country would therefore appear to offer a promising

Annex 1. Detailed tables of the GHG Inventory

Table A- 1: GHG Inventory table for 1990

Categories	Emissions (Gg)			Emissions CO2 Equivalents (Gg)					Emissions (Gg)			
	Net CO2*	CH4	N2O	HFCs	PFCs	SF6	Other halogenated gases with CO2 equivalent conversion factors	Other halogenated gases without CO2 equivalent conversion factors	NOx	CO	NMVOCs	SO2
Total National Emissions and Removals	9978.11	69.61	1.55	NO	91.65	NA, NE			24.99	41.47	17.69	96.47
1 - Energy	9339.25	10.27	0.18	NA					23.98	38.09	11.16	95.97
1.A - Fuel Combustion Activities	9333.63	2.77	0.18						23.98	38.09	5.58	95.97
1.A.1 - Energy Industries	6179.59	0.07	0.08						13.51	0.54	0.09	88.96
1.A.2 - Manufacturing Industries and Construction	1788.77	0.10	0.02						9.18	6.47	0.92	5.99
1.A.3 - Transport	771.48	0.25	0.04						0.02	0.00	0.00	NO
1.A.4 - Other Sectors	568.58	2.34	0.03						1.24	30.87	4.56	0.82
1.A.5 - Non-Specified	25.20	0.00	0.00						0.04	0.21	0.02	0.20
1.B - Fugitive emissions from fuels	5.62	7.51	NA								5.58	0.00
1.B.1 - Solid Fuels	5.62	7.48									5.58	NO
1.B.2 - Oil and Natural Gas	NO	0.03									NO	0.00
1.B.3 - Other emissions from Energy Production	NO	NO									NO	
1.C - Carbon dioxide Transport and Storage	NO	NA										
1.C.1 - Transport of CO2												
1.C.2 - Injection and Storage												
1.C.3 - Other												
2 - Industrial Processes and Product Use	839.27	0.05	NO,NA		91.65	NO,NA			0.78	1.35	0.02	0.49
2.A - Mineral Industry	333.10	NA							0.74	0.88	0.01	0.22
2.A.1 - Cement production	293.75								0.67	0.79	0.01	0.20
2.A.2 - Lime production	33.72								0.06	0.09	NO	0.02
2.A.3 - Glass Production	0.33								0.01	NO		0.00
2.A.4 - Other Process Uses of Carbonates	5.30								NO			
2.A.5 - Other (please specify)	NO											
2.B - Chemical Industry	NO, NA	NO,NA	NO,NA	NA					NO, NA			
2.B.1 - Ammonia Production	NO	NA	NA									
2.B.2 - Nitric Acid Production	NA		NO									

2.B.3 - Adipic Acid Production										
2.B.4 - Caprolactam, Glyoxal and Glyoxylic Acid Production										
2.B.5 - Carbide Production	NO	NO	NA							
2.B.6 - Titanium Dioxide Production		NA								
2.B.7 - Soda Ash Production										
2.B.8 - Petrochemical and Carbon Black Production		NO								
2.B.9 - Fluorochemical Production	NA	NA								
2.B.10 - Other (Please specify)	NO	NO								
2.C - Metal Industry	506.17	0.05	NA	NA	91.65	NA	0.04	0.47	0.01	0.27
2.C.1 - Iron and Steel Production	24.75	NA					0.04	0.47	0.01	0.02
2.C.2 - Ferroalloys Production	264.32	0.05	NA							
2.C.3 - Aluminium production	8.78	NA			91.65	NA			0.00	NA
2.C.4 - Magnesium production	NO, NA									
2.C.5 - Lead Production	22.09	NA								0.11
2.C.6 - Zinc Production	186.23	NA								0.15
2.C.7 - Other (please specify)	NO									
2.D - Non-Energy Products from Fuels and Solvent Use	NO,NA	NA								
2.D.1 - Lubricant Use	NO									
2.D.2 - Paraffin Wax Use										
2.D.3 - Solvent Use	NA									
2.D.4 - Other (please specify)	NO									
2.E - Electronics Industry	NA			NA, NO						
2.E.1 - Integrated Circuit or Semiconductor										
2.E.2 - TFT Flat Panel Display										
2.E.3 - Photovoltaics										
2.E.4 - Heat Transfer Fluid										
2.E.5 - Other (please specify)										
2.F - Product Uses as Substitutes for Ozone Depleting Substances	NA			NO	NA, NO	NA	NA			
2.F.1 - Refrigeration and Air Conditioning										
2.F.2 - Foam Blowing Agents										
2.F.3 - Fire Protection										
2.F.4 - Aerosols										
2.F.5 - Solvents										
2.F.6 - Other Applications (please specify)										
2.G - Other Product Manufacture and Use	NA				NE	NA				
2.G.1 - Electrical Equipment										
2.G.2 - SF6 and PFCs from Other Product Uses										
2.G.3 - N2O from Product Uses										
2.G.4 - Other (Please specify)										
2.H - Other	NA				NO, NA	NA				
2.H.1 - Pulp and Paper Industry										
2.H.2 - Food and Beverages Industry										
2.H.3 - Other (please specify)										

3 - Agriculture, Forestry, and Other Land Use	-203.26	44.45	1.26	NA	0.11	NA	5.91	NA
3.A - Livestock	NA	42.36	0.16	NA	0.11	NA	5.87	NA
3.A.1 - Enteric Fermentation		36.33	NO		NA			
3.A.2 - Manure Management		6.03	0.16		0.11	NA	5.87	NA
3.B - Land	-206.31	NO						
3.B.1 - Forest land	-206.31	NO						
3.B.2 - Cropland	NE	NA						
3.B.3 - Grassland								
3.B.4 - Wetlands								
3.B.5 - Settlements								
3.B.6 - Other Land								
3.C - Aggregate sources and non-CO2 emissions sources on land	3.74	2.09	1.09	NA			0.05	NA
3.C.1 - Emissions from biomass burning	NA	NO	NO	NA			0.05	NAO
3.C.2 - Liming	NO	NA	NA	NA				
3.C.3 - Urea application	3.74	NA	NA	NA				
3.C.4 - Direct N2O Emissions from managed soils	NA	NA	0.71					
3.C.5 - Indirect N2O Emissions from managed soils	NA	NA	0.28					
3.C.6 - Indirect N2O Emissions from manure management	NA	NA	0.11					
3.C.7 - Rice cultivations	NA	2.09	NO					
3.C.8 - Other (please specify)	NO							
3.D - Other	-0.69	NO						
3.D.1 - Harvested Wood Products	-0.69	NO						
3.D.2 - Other (please specify)	NO							
4 - Waste	2.86	14.83	0.11	NA	0.12	2.03	0.60	0.00
4.A - Solid Waste Disposal	NA	10.62	NA				0.55	NA
4.B - Biological Treatment of Solid Waste	NO							
4.C - Incineration and Open Burning of Waste	2.86	0.24	0.00	NA	0.12	2.03	0.05	0.00
4.D - Wastewater Treatment and Discharge	NA	3.97	0.11	NA				
4.E - Other (please specify)	NO							
5 - Other	NE, NO							
5.A - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3	NE							
5.B - Other (please specify)	NO							
Memo Items (5)								
International Bunkers	15.77	0.00	0.00	NA	NE			
1.A.3.a.i - International Aviation (International Bunkers)	15.77	0.00	0.00	NA	NE			
1.A.3.d.i - International water-borne navigation (International bunkers)	NO			NA	NO			
1.A.5.c - Multilateral Operations	NO							

NO - Not occurring, NA – Not Applicable, NE – Not Estimated

CO_2 net emissions (emission minus removals)

Table A-2: GHG Inventory table for 2000

Categories	Emissions (Gg)			Emissions CO2 Equivalents (Gg)					Emissions (Gg)			
	Net CO2*	CH4	N2O	HFCs	PFCs	SF6	Other halogenated gases with CO2 equivalent conversion factors	Other halogenated gases without CO2 equivalent conversion factors	NOx	CO	NMVOCs	SO2
Total National Emissions and Removals	20696.50	62.84	1.39	4.77	62.86	NA, NE, NO			22.33	42.66	31.53	102.96
1 - Energy	9423.60	11.16	0.19						21.26	39.20	11.86	102.41
1.A - Fuel Combustion Activities	9417.55	3.08	0.19						21.26	39.20	5.84	102.41
1.A.1 - Energy Industries	6969.22	0.10	0.09						15.05	0.74	0.11	96.07
1.A.2 - Manufacturing Industries and Construction	1075.61	0.07	0.01	NA					4.24	5.99	0.71	5.63
1.A.3 - Transport	986.11	0.24	0.05						0.01	0.02	0.00	NO
1.A.4 - Other Sectors	258.95	2.39	0.03						1.01	31.80	4.72	0.56
1.A.5 - Non-Specified	127.66	0.29	0.00						0.95	0.65	0.30	0.14
1.B - Fugitive emissions from fuels	6.05	8.08									6.01	0.00
1.B.1 - Solid Fuels	6.05	8.06	NA								6.01	NA
1.B.2 - Oil and Natural Gas	NO	0.02									NO	0.00
1.B.3 - Other emissions from Energy Production	NA											
1.C - Carbon dioxide Transport and Storage												
1.C.1 - Transport of CO2												
1.C.2 - Injection and Storage	NO	NA										
1.C.3 - Other												
2 - Industrial Processes and Product Use	819.76	0.04	NO	4.77	62.86	NE, NA,NO			0.84	1.25	0.02	0.54
2.A - Mineral Industry	361.83	NA							0.82	0.97	0.01	0.25
2.A.1 - Cement production	348.77								0.80	0.94	0.01	0.24
2.A.2 - Lime production	11.17	NA							0.02	0.03	NA	0.01
2.A.3 - Glass Production	0.05								0.00	NA		
2.A.4 - Other Process Uses of Carbonates	1.85								Na			

2.A.5 - Other (please specify)	NO						NO			
2.B - Chemical Industry	NO, NA	NA,NO								
2.B.1 - Ammonia Production	NO	NA								
2.B.2 - Nitric Acid Production										
2.B.3 - Adipic Acid Production	NA	NA	NO							
2.B.4 - Caprolactam, Glyoxal and Glyoxylic Acid Production										
2.B.5 - Carbide Production		NO		NA			NA, NO			
2.B.6 - Titanium Dioxide Production	NO	NA	NA							
2.B.7 - Soda Ash Production		NA								
2.B.8 - Petrochemical and Carbon Black Production		NO								
2.B.9 - Fluorochemical Production	NA									
2.B.10 - Other (Please specify)	NO									
2.C - Metal Industry	457.93	0.04	NA		62.86	NA, NO	0.02	0.29	0.01	0.30
2.C.1 - Iron and Steel Production	15.15	NA					0.02	0.29	0.01	0.01
2.C.2 - Ferroalloys Production	195.36	0.04	NA							
2.C.3 - Aluminium production	6.02	NA			62.86	NA				
2.C.4 - Magnesium production	NO									
2.C.5 - Lead Production	22.97	NA								0.12
2.C.6 - Zinc Production	218.43	NA								0.17
2.C.7 - Other (please specify)	NO									
2.D - Non-Energy Products from Fuels and Solvent Use										
2.D.1 - Lubricant Use										
2.D.2 - Paraffin Wax Use	NO	NA								
2.D.3 - Solvent Use										
2.D.4 - Other (please specify)										
2.E - Electronics Industry										
2.E.1 - Integrated Circuit or Semiconductor										
2.E.2 - TFT Flat Panel Display	NA			NO, NA			NA			
2.E.3 - Photovoltaics										
2.E.4 - Heat Transfer Fluid										
2.E.5 - Other (please specify)										
2.F - Product Uses as Substitutes for Ozone Depleting Substances	NA			4.77	NO,NA	NA				
2.F.1 - Refrigeration and Air Conditioning	NA			4.77	NA	NA				

2.F.2 - Foam Blowing Agents											
2.F.3 - Fire Protection											
2.F.4 - Aerosols	NA			NO	NO	NA					
2.F.5 - Solvents											
2.F.6 - Other Applications (please specify)											
2.G - Other Product Manufacture and Use											
2.G.1 - Electrical Equipment											
2.G.2 - SF6 and PFCs from Other Product Uses	NA				NE		NA				
2.G.3 - N2O from Product Uses											
2.G.4 - Other (Please specify)											
2.H - Other											
2.H.1 - Pulp and Paper Industry	NO			NA				NO			
2.H.2 - Food and Beverages Industry											
2.H.3 - Other (please specify)											
3 - Agriculture, Forestry, and Other Land Use	10449.95	36.64	1.09	NO				0.10	NA	19.05	NA
3.A - Livestock		35.74	0.14					0.10	NA	5.18	NA
3.A.1 - Enteric Fermentation	NA	29.88	NO	NA				NA			
3.A.2 - Manure Management		5.85	0.14					0.10	NA	5.18	NA
3.B - Land	10441.56										
3.B.1 - Forest land	9159.83										
3.B.2 - Cropland	657.48										
3.B.3 - Grassland	480.96	NA									
3.B.4 - Wetlands											
3.B.5 - Settlements	126.48										
3.B.6 - Other Land	16.81										
3.C - Aggregate sources and non-CO2 emissions sources on land	9.09	0.91	0.94	NA						13.87	NA
3.C.1 - Emissions from biomass burning	NA	NO		NA						13.87	NA
3.C.2 - Liming	NO	NA									
3.C.3 - Urea application	9.09	NA									
3.C.4 - Direct N2O Emissions from managed soils	NA		0.62								
3.C.5 - Indirect N2O Emissions from managed soils	NA		0.23								
3.C.6 - Indirect N2O Emissions from manure management	NA NA		0.10	NA							
3.C.7 - Rice cultivations	NA	0.91	NA								

3.C.8 - Other (please specify)	NO								
3.D - Other	-0.70	NO							
3.D.1 - Harvested Wood Products	-0.70	NO							
3.D.2 - Other (please specify)	NO								
4 - Waste	3.20	15.00	0.12	NA, NO		0.13	2.21	0.60	0.00
4.A - Solid Waste Disposal	NA	11.98	NA					0.56	NA
4.B - Biological Treatment of Solid Waste	NO								
4.C - Incineration and Open Burning of Waste	3.20	0.26	0.00	NA		0.13	2.21	0.05	0.00
4.D - Wastewater Treatment and Discharge	NA	2.77	0.12	NA					
4.E - Other (please specify)	NO								
5 - Other	NE, NO								
5.A - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3	NE								
5.B - Other (please specify)	NO								
Memo Items (5)									
International Bunkers	88.05	0.00	0.00	NA	NE, NO				
1.A.3.a.i - International Aviation (International Bunkers)	88.05	0.00	0.00	NA	NE				
1.A.3.d.i - International water-borne navigation (International bunkers)	NO			NA	NO				
1.A.5.c - Multilateral Operations	NO			NA	NO				

NO - Not occurring, NA – Not Applicable, NE – Not Estimated

**CO_2 net emissions (emission minus removals)*

Table A-3: GHG Inventory table for 2005

	Emissions (Gg)			Emissions CO2 Equivalents (Gg)					Emissions (Gg)			
Categories	Net CO2*	CH4	N2O	HFCs	PFCs	SF6	Other halogenated gases with CO2 equivalent conversion factors	Other halogenated gases without CO2 equivalent conversion factors	NOx	CO	NMVOCs	SO2
Total National Emissions and Removals	8170.70	60.38	1.50	102.84	0.33	NA, NE, NO			23.56	48.51	18.04	103.45
1 - Energy	8930.51	10.58	0.19	NA					22.37	43.23	11.83	103.16
1.A - Fuel Combustion Activities	8924.97	3.18	0.19						22.37	43.23	6.32	103.16
1.A.1 - Energy Industries	5913.37	0.07	0.09						14.25	0.56	0.09	94.80
1.A.2 - Manufacturing Industries and Construction	1349.75	0.09	0.01						4.65	7.90	0.98	7.32
1.A.3 - Transport	1021.52	0.28	0.05						0.01	0.00	0.00	
1.A.4 - Other Sectors	228.16	2.57	0.03						0.85	34.09	5.06	0.54
1.A.5 - Non-Specified	412.17	0.18	0.00						2.63	0.68	0.19	0.50
1.B - Fugitive emissions from fuels	5.54	7.40	NA						0.00	0.00	5.50	0.00
1.B.1 - Solid Fuels	5.54	7.38							NA	NA	5.50	NA
1.B.2 - Oil and Natural Gas	NA	0.02							0.00	0.00	0.00	0.00
1.B.3 - Other emissions from Energy Production	NO								NO			
1.C - Carbon dioxide Transport and Storage	NO	NA										
1.C.1 - Transport of CO2												
1.C.2 - Injection and Storage												
1.C.3 - Other												
2 - Industrial Processes and Product Use	756.70	0.07	NO	102.84	0.33	NA, NE, NO			0.92	2.08	0.04	0.29
2.A - Mineral Industry	368.05	NA							0.84	0.98	0.01	0.25
2.A.1 - Cement production	355.32								0.81	0.95	0.01	0.25
2.A.2 - Lime production	11.13								0.02	0.03	NO	0.01
2.A.3 - Glass Production	0.01								NA			0.00
2.A.4 - Other Process Uses of Carbonates	1.60								NA			
2.A.5 - Other (please specify)	NO								NO			
2.B - Chemical Industry	NA, NO			NA					NA,NO			

2.B.1 - Ammonia Production	NO	NA	NA									
2.B.2 - Nitric Acid Production	NA		NO									
2.B.3 - Adipic Acid Production												
2.B.4 - Caprolactam, Glyoxal and Glyoxylic Acid Production												
2.B.5 - Carbide Production	NO	NO	NA									
2.B.6 - Titanium Dioxide Production		NA										
2.B.7 - Soda Ash Production												
2.B.8 - Petrochemical and Carbon Black Production		NO	NA									
2.B.9 - Fluorochemical Production	NA											
2.B.10 - Other (Please specify)	NO											
2.C - Metal Industry												
2.C.1 - Iron and Steel Production	58.23	NO							0.08	1.10	0.03	0.04
2.C.2 - Ferroalloys Production	330.39	0.07	NA									
2.C.3 - Aluminium production	0.03	NA			0.33	NA						
2.C.4 - Magnesium production	NO	NA							NO			
2.C.5 - Lead Production												
2.C.6 - Zinc Production												
2.C.7 - Other (please specify)												
2.D - Non-Energy Products from Fuels and Solvent Use	NO	NA										
2.D.1 - Lubricant Use												
2.D.2 - Paraffin Wax Use												
2.D.3 - Solvent Use												
2.D.4 - Other (please specify)												
2.E - Electronics Industry	NA				NO, NA			NA				
2.E.1 - Integrated Circuit or Semiconductor												
2.E.2 - TFT Flat Panel Display												
2.E.3 - Photovoltaics												
2.E.4 - Heat Transfer Fluid												
2.E.5 - Other (please specify)												
2.F - Product Uses as Substitutes for Ozone Depleting Substances	NA			102.84	NO,NA	NA						
2.F.1 - Refrigeration and Air Conditioning	NA			102.84	NA	NA						
2.F.2 - Foam Blowing Agents	NA			NO	NO	NA						
2.F.3 - Fire Protection												

2.F.4 - Aerosols											
2.F.5 - Solvents											
2.F.6 - Other Applications (please specify)											
2.G - Other Product Manufacture and Use											
2.G.1 - Electrical Equipment											
2.G.2 - SF6 and PFCs from Other Product Uses	NA				NE, NA		NA				
2.G.3 - N2O from Product Uses											
2.G.4 - Other (Please specify)											
2.H - Other											
2.H.1 - Pulp and Paper Industry	NO		NA								
2.H.2 - Food and Beverages Industry											
2.H.3 - Other (please specify)											
3 - Agriculture, Forestry, and Other Land Use	-1521.33	33.92	1.19	NA				0.08	NA	5.30	NA
3.A - Livestock		33.44	0.14					0.08	NA	4.67	NA
3.A.1 - Enteric Fermentation	NA	28.23	NA	NA				NA			
3.A.2 - Manure Management		5.21	0.14					0.08	NA	4.67	NA
3.B - Land	-1521.57										
3.B.1 - Forest land	-2825.49										
3.B.2 - Cropland	669.12										
3.B.3 - Grassland	503.29	NA									
3.B.4 - Wetlands											
3.B.5 - Settlements	121.12										
3.B.6 - Other Land	10.39										
3.C - Aggregate sources and non-CO2 emissions sources on land	1.28	0.48	1.05	NA, NO						0.63	NA
3.C.1 - Emissions from biomass burning	NA	NO		NA						0.63	NA
3.C.2 - Liming	NO	NA									
3.C.3 - Urea application	1.28	NA									
3.C.4 - Direct N2O Emissions from managed soils	NA		0.71								
3.C.5 - Indirect N2O Emissions from managed soils	NA		0.26								
3.C.6 - Indirect N2O Emissions from manure management	NA		0.09	NA							
3.C.7 - Rice cultivations	NA	0.48	NA								
3.C.8 - Other (please specify)	NA	NO									
3.D - Other	-1.04	NA									

3.D.1 - Harvested Wood Products	-1.04							
3.D.2 - Other (please specify)	NO							
4 - Waste	4.82	15.80	0.12	NA, NO	0.18	3.20	0.87	0.01
4.A - Solid Waste Disposal	NA	12.64		NA			0.80	NA
4.B - Biological Treatment of Solid Waste				NO				
4.C - Incineration and Open Burning of Waste	4.82	0.37	0.00	NA	0.18	3.20	0.07	0.01
4.D - Wastewater Treatment and Discharge	NA	2.79	0.12	NA			0.00	NA
4.E - Other (please specify)				NA				
5 - Other				NE, NO				
5.A - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3				NE				
5.B - Other (please specify)				NO				
Memo Items (5)								
International Bunkers	20.16	0.00	0.00	NA	NE, NO			
1.A.3.a.i - International Aviation (International Bunkers)	20.16	0.00	0.00	NA	NE			
1.A.3.d.i - International water-borne navigation (International bunkers)	NO			NA	NO			
1.A.5.c - Multilateral Operations	NO			NA	NO			

NO - Not occurring, NA – Not Applicable, NE – Not Estimated

**CO_2 net emissions (emission minus removals)*

Table A-4: GHG Inventory table for 2014

Categories	Emissions (Gg)			Emissions CO2 Equivalents (Gg)					Emissions (Gg)			
Categories	Net CO2*	CH4	N2O	HFCs	PFCs	SF6	Other halogenated gases with CO2 equivalent conversion factors	Other halogenated gases without CO2 equivalent conversion factors	NOx	CO	NMVOCs	SO2
Total National Emissions and Removals	4824.71	62.53	1.51	206.60	NA, NE, NO				18.00	54.08	18.42	76.64
1 - Energy	7734.17	10.35	0.20	NA					17.01	48.74	12.73	76.43
1.A - Fuel Combustion Activities	7728.95	3.40	0.20						16.34	45.73	6.68	76.42
1.A.1 - Energy Industries	4727.49	0.05	0.06						10.63	0.51	0.07	69.51
1.A.2 - Manufacturing Industries and Construction	1127.36	0.07	0.01						3.88	7.04	0.81	6.54
1.A.3 - Transport	1624.18	0.33	0.08						0.01	0.00	0.00	NO
1.A.4 - Other Sectors	75.31	2.87	0.04						0.66	37.90	5.69	0.25
1.A.5 - Non-Specified	174.61	0.08	0.00						1.17	0.27	0.11	0.13
1.B - Fugitive emissions from fuels	5.22	6.95	NA						0.67	3.01	6.05	0.01
1.B.1 - Solid Fuels	5.22	6.95							NA	NA	5.19	NA
1.B.2 - Oil and Natural Gas	0.00	0.00							0.67	3.01	0.86	0.01
1.B.3 - Other emissions from Energy Production	NO			NA								
1.C - Carbon dioxide Transport and Storage	NO	NA										
1.C.1 - Transport of CO2												
1.C.2 - Injection and Storage												
1.C.3 - Other												
2 - Industrial Processes and Product Use	677.76	0.07		206.60	NA, NE, NO				0.67	1.08	0.02	0.20
2.A - Mineral Industry	283.16	NA							0.65	0.76	0.01	0.19
2.A.1 - Cement production	275.68	NA							0.63	0.74	0.01	0.19
2.A.2 - Lime production	6.39								0.02	0.02	NO	0.00
2.A.3 - Glass Production	0.01								NO	NO	NO	0.00
2.A.4 - Other Process Uses of Carbonates	1.08								NO	NO	NO	NO
2.A.5 - Other (please specify)	NO											
2.B - Chemical Industry	NO, NA			NA					NA			

2.B.1 - Ammonia Production	NO										
2.B.2 - Nitric Acid Production											
2.B.3 - Adipic Acid Production	NA		NO								
2.B.4 - Caprolactam, Glyoxal and Glyoxylic Acid Production											
2.B.5 - Carbide Production		NO	NA								
2.B.6 - Titanium Dioxide Production	NO	NA									
2.B.7 - Soda Ash Production											
2.B.8 - Petrochemical and Carbon Black Production		NO	NA								
2.B.9 - Fluorochemical Production	NA										
2.B.10 - Other (Please specify)	NO										
2.C - Metal Industry	394.60	0.07	NA, NO					0.03	0.32	0.01	0.01
2.C.1 - Iron and Steel Production	17.03	NA						0.03	0.32	0.01	0.01
2.C.2 - Ferroalloys Production	377.56	0.07	NA								
2.C.3 - Aluminium production											
2.C.4 - Magnesium production								NA,NO			
2.C.5 - Lead Production	NO	NA,NO									
2.C.6 - Zinc Production											
2.C.7 - Other (please specify)											
2.D - Non-Energy Products from Fuels and Solvent Use											
2.D.1 - Lubricant Use											
2.D.2 - Paraffin Wax Use	NO	NA						NA			
2.D.3 - Solvent Use											
2.D.4 - Other (please specify)											
2.E - Electronics Industry											
2.E.1 - Integrated Circuit or Semiconductor											
2.E.2 - TFT Flat Panel Display											
2.E.3 - Photovoltaics	NA					NO,NA		NA			
2.E.4 - Heat Transfer Fluid											
2.E.5 - Other (please specify)											
2.F - Product Uses as Substitutes for Ozone Depleting Substances	NA			206.60		NO, NA	NA				
2.F.1 - Refrigeration and Air Conditioning	NA			206.60		NA	NA				
2.F.2 - Foam Blowing Agents	NA			NO		NO, NA	NA				
2.F.3 - Fire Protection											

2.F.4 - Aerosols								
2.F.5 - Solvents								
2.F.6 - Other Applications (please specify)								
2.G - Other Product Manufacture and Use	NA			NE, NA	NA			
2.G.1 - Electrical Equipment								
2.G.2 - SF6 and PFCs from Other Product Uses								
2.G.3 - N2O from Product Uses								
2.G.4 - Other (Please specify)								
2.H - Other	NO	NA						
2.H.1 - Pulp and Paper Industry								
2.H.2 - Food and Beverages Industry								
2.H.3 - Other (please specify)								
3 - Agriculture, Forestry, and Other Land Use	-3593.70	31.11	1.17	NA	0.08	NA	4.51	NA
3.A - Livestock	NA	30.15	0.13	NA	0.08	NA	4.25	NA
3.A.1 - Enteric Fermentation		25.01	NA	NA	NA			
3.A.2 - Manure Management		5.14	0.13		0.08		4.25	
3.B - Land	-3595.88	NA						
3.B.1 - Forest land	-3632.75							
3.B.2 - Cropland	7.34							
3.B.3 - Grassland	17.39							
3.B.4 - Wetlands								
3.B.5 - Settlements	3.10							
3.B.6 - Other Land	9.04							
3.C - Aggregate sources and non-CO2 emissions sources on land	3.67	0.96	1.04	NA			0.26	NO
3.C.1 - Emissions from biomass burning	NA	NO		NA			0.26	NA
3.C.2 - Liming	NO	NA		NA				
3.C.3 - Urea application	3.67	NA	NA					
3.C.4 - Direct N2O Emissions from managed soils	NA		0.70					
3.C.5 - Indirect N2O Emissions from managed soils			0.25					
3.C.6 - Indirect N2O Emissions from manure management			0.09					
3.C.7 - Rice cultivations	NA	0.96	NA					
3.C.8 - Other (please specify)	NO							
3.D - Other	-1.48	NA						

3.D.1 - Harvested Wood Products	-1.48							
3.D.2 - Other (please specify)	NA							
4 - Waste	6.48	21.00	0.14	NA	0.24	4.26	1.17	0.01
4.A - Solid Waste Disposal	NA	17.65	NA		NA		1.08	NA
4.B - Biological Treatment of Solid Waste	NA	0.02	0.00		NA	0.00	NA	
4.C - Incineration and Open Burning of Waste	6.48	0.50	0.01		0.24	4.26	0.09	0.01
4.D - Wastewater Treatment and Discharge	NA	2.83	0.13		NA		0.00	NA
4.E - Other (please specify)	NO				NA			
5 - Other	NE, NO							
5.A - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3	NE							
5.B - Other (please specify)	NO							
Memo Items (5)								
International Bunkers	37.14	0.00	0.00	NA	NE, NO			
1.A.3.a.i - International Aviation (International Bunkers)	37.14	0.00	0.00	NA	NE			
1.A.3.d.i - International water-borne navigation (International bunkers)	NO			NA	NO			
1.A.5.c - Multilateral Operations	NO			NA	NO			

NO - Not occurring, NA – Not Applicable, NE – Not Estimated

**CO_2 net emissions (emission minus removals)*

Table A-5: GHG Inventory table for 2015

	Emissions (Gg)			Emissions CO2 Equivalents (Gg)					Emissions (Gg)			
Categories	Net CO2*	CH4	N2O	HFCs	PFCs	SF6	Other halogenated gases with CO2 equivalent conversion factors	Other halogenated gases without CO2 equivalent conversion factors	NOx	CO	NMVOCs	SO2
Total National Emissions and Removals	6632.71	63.81	1.52	219.06	NA, NE, NO				17.06	53.69	19.70	69.01
1 - Energy	7400.61	9.71	0.19						16.05	48.30	12.40	68.79
1.A - Fuel Combustion Activities	7395.83	3.34	0.19						15.16	44.30	6.51	68.78
1.A.1 - Energy Industries	4242.83	0.04	0.06						9.53	0.47	0.06	62.02
1.A.2 - Manufacturing Industries and Construction	1061.99	0.07	0.01	NA					3.59	6.81	0.81	6.35
1.A.3 - Transport	1802.65	0.36	0.09						0.00	0.00	NA	NA
1.A.4 - Other Sectors	81.65	2.78	0.04						0.66	36.70	5.51	0.26
1.A.5 - Non-Specified	206.70	0.09	0.00						1.38	0.31	0.13	0.15
1.B - Fugitive emissions from fuels	4.78	6.36							0.89	4.01	5.89	0.01
1.B.1 - Solid Fuels	4.78	6.36	NA						NA		4.75	NA
1.B.2 - Oil and Natural Gas	0.00	0.00							0.89	4.01	1.15	0.01
1.B.3 - Other emissions from Energy Production	NA								NA			
1.C - Carbon dioxide Transport and Storage												
1.C.1 - Transport of CO2	NO	NA										
1.C.2 - Injection and Storage												
1.C.3 - Other												
2 - Industrial Processes and Product Use	570.32	0.05	NA	219.06	NA				0.69	1.00	0.02	0.21
2.A - Mineral Industry	294.43								0.67	0.79	0.01	0.20
2.A.1 - Cement production	288.64								0.66	0.78	0.01	0.20
2.A.2 - Lime production	4.72								0.01	0.02	NA	0.00
2.A.3 - Glass Production	0.01	NA										0.00
2.A.4 - Other Process Uses of Carbonates	1.05								NA			NA
2.A.5 - Other (please specify)	NO											
2.B - Chemical Industry	NO, NA			NA					NA			

2.B.1 - Ammonia Production	NO	NA								
2.B.2 - Nitric Acid Production	NA		NO							
2.B.3 - Adipic Acid Production										
2.B.4 - Caprolactam, Glyoxal and Glyoxylic Acid Production										
2.B.5 - Carbide Production	NO	NO								
2.B.6 - Titanium Dioxide Production		NA								
2.B.7 - Soda Ash Production										
2.B.8 - Petrochemical and Carbon Black Production		NO								
2.B.9 - Fluorochemical Production										
2.B.10 - Other (Please specify)	NO									
2.C - Metal Industry	275.89	0.05	NA				0.02	0.21	0.01	0.01
2.C.1 - Iron and Steel Production	11.04	NA					0.02	0.21	0.01	0.01
2.C.2 - Ferroalloys Production	263.47	0.05	NA							
2.C.3 - Aluminium production	NO, NA									
2.C.4 - Magnesium production										
2.C.5 - Lead Production	1.38	NA								0.01
2.C.6 - Zinc Production	NO	NA,								
2.C.7 - Other (please specify)										
2.D - Non-Energy Products from Fuels and Solvent Use										
2.D.1 - Lubricant Use										
2.D.2 - Paraffin Wax Use	NO	NA								
2.D.3 - Solvent Use										
2.D.4 - Other (please specify)										
2.E - Electronics Industry										
2.E.1 - Integrated Circuit or Semiconductor										
2.E.2 - TFT Flat Panel Display										
2.E.3 - Photovoltaics	NA			NO, NA			NA			
2.E.4 - Heat Transfer Fluid										
2.E.5 - Other (please specify)										
2.F - Product Uses as Substitutes for Ozone Depleting Substances	NA			219.06	NO, NA	NA				
2.F.1 - Refrigeration and Air Conditioning	NA			219.06	NA	NA				
2.F.2 - Foam Blowing Agents	NA			NO	NO,NA	NA				
2.F.3 - Fire Protection										

2.F.4 - Aerosols											
2.F.5 - Solvents											
2.F.6 - Other Applications (please specify)											
2.G - Other Product Manufacture and Use											
2.G.1 - Electrical Equipment											
2.G.2 - SF6 and PFCs from Other Product Uses	NA				NE, NO		NA	NA			
2.G.3 - N2O from Product Uses											
2.G.4 - Other (Please specify)											
2.H - Other											
2.H.1 - Pulp and Paper Industry	NO	NA									
2.H.2 - Food and Beverages Industry											
2.H.3 - Other (please specify)											
3 - Agriculture, Forestry, and Other Land Use	-1345.06	32.19	1.18	NA				0.08	NA	6.08	NA
3.A - Livestock		31.26	0.14					0.08	NA	4.35	NA
3.A.1 - Enteric Fermentation	NA	25.78	NA	NA				NA			
3.A.2 - Manure Management		5.48	0.14					0.08		4.35	
3.B - Land	-1347.09										
3.B.1 - Forest land	-1697.39										
3.B.2 - Cropland	28.84										
3.B.3 - Grassland	27.94	NA									
3.B.4 - Wetlands											
3.B.5 - Settlements	9.36										
3.B.6 - Other Land	284.16										
3.C - Aggregate sources and non-CO2 emissions sources on land	3.51	0.93	1.04	NA						1.73	NA
3.C.1 - Emissions from biomass burning	NA	NO								1.73	NA
3.C.2 - Liming	NO	NA	NA								
3.C.3 - Urea application	3.51	NA	NA								
3.C.4 - Direct N2O Emissions from managed soils			0.70								
3.C.5 - Indirect N2O Emissions from managed soils	NA		0.25								
3.C.6 - Indirect N2O Emissions from manure management			0.09	NA							
3.C.7 - Rice cultivations	NA	0.93	NA								
3.C.8 - Other (please specify)	NA										
3.D - Other	-1.48										

3.D.1 - Harvested Wood Products	-1.48	NA	NA					
3.D.2 - Other (please specify)								
4 - Waste	6.85	21.87	0.14	NA	0.25	4.39	1.20	0.01
4.A - Solid Waste Disposal	NA	18.30	NA	NA	NA	NA	1.11	NA
4.B - Biological Treatment of Solid Waste	NA	0.03	0.00		NA	0.00	NA	NA
4.C - Incineration and Open Burning of Waste	6.85	0.51	0.01		0.25	4.39	0.10	0.01
4.D - Wastewater Treatment and Discharge	NA	3.03	0.13		NA	NA	0.00	NA
4.E - Other (please specify)	NA							
5 - Other	NE, NO							
5.A - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3	NE							
5.B - Other (please specify)	NO							
Memo Items (5)								
International Bunkers	41.64	0.00	0.00	NA	NE, NO			
1.A.3.a.i - International Aviation (International Bunkers)	41.64	0.00	0.00	NA	NE			
1.A.3.d.i - International water-borne navigation (International bunkers)	NO			NA	NO			
1.A.5.c - Multilateral Operations	NO			NA	NO			

NO - Not occurring, NA – Not Applicable, NE – Not Estimated

$^*CO_2$ net emissions (emission minus removals)

Table A-6: GHG Inventory table for 2016

Categories	Emissions (Gg)			Emissions CO2 Equivalents (Gg)					Emissions (Gg)			
	Net CO2*	CH4	N2O	HFCs	PFCs	SF6	Other halogenated gases with CO2 equivalent conversion factors	Other halogenated gases without CO2 equivalent conversion factors	NOx	CO	NMVOCs	SO2
Total National Emissions and Removals	5896.75	63.53	1.60	315.72	NA				15.93	47.54	17.38	59.98
1 - Energy	7179.56	8.47	0.19	NA					14.71	41.88	10.74	59.69
1.A - Fuel Combustion Activities	7175.41	2.95	0.19						13.94	38.44	5.64	59.68
1.A.1 - Energy Industries	3785.76	0.04	0.05						8.41	0.51	0.06	53.18
1.A.2 - Manufacturing Industries and Construction	1031.89	0.08	0.01						3.48	6.55	0.79	6.11
1.A.3 - Transport	2056.95	0.39	0.10						0.01	0.00	NA	
1.A.4 - Other Sectors	81.75	2.35	0.03						0.59	31.05	4.66	0.24
1.A.5 - Non-Specified	219.07	0.09	0.00						1.46	0.32	0.13	0.16
1.B - Fugitive emissions from fuels	4.15	5.52	NA						0.77	3.44	5.11	0.01
1.B.1 - Solid Fuels	4.15	5.52							NA		4.12	NA
1.B.2 - Oil and Natural Gas	0.00	0.00							0.77	3.44	0.98	0.01
1.B.3 - Other emissions from Energy Production	NA								NA			
1.C - Carbon dioxide Transport and Storage	NO	NA										
1.C.1 - Transport of CO2												
1.C.2 - Injection and Storage												
1.C.3 - Other												
2 - Industrial Processes and Product Use	541.70	0.02	NO	315.72	NA, NE, NO				0.89	1.31	0.02	0.28
2.A - Mineral Industry	379.39	NA							0.87	1.02	0.01	0.26
2.A.1 - Cement production	372.92								0.85	1.00	0.01	0.26
2.A.2 - Lime production	5.38								0.01	0.02	NA	0.00
2.A.3 - Glass Production	0.05								0.00	NA		0.00
2.A.4 - Other Process Uses of Carbonates	1.04								NA			
2.A.5 - Other (please specify)	NO											
2.B - Chemical Industry	NO, NA			NA					NA			

2.B.1 - Ammonia Production	NO	NA									
2.B.2 - Nitric Acid Production											
2.B.3 - Adipic Acid Production	NA		NO								
2.B.4 - Caprolactam, Glyoxal and Glyoxylic Acid Production											
2.B.5 - Carbide Production		NO	NA								
2.B.6 - Titanium Dioxide Production	NO	NA									
2.B.7 - Soda Ash Production											
2.B.8 - Petrochemical and Carbon Black Production		NO	NA								
2.B.9 - Fluorochemical Production	NA										
2.B.10 - Other (Please specify)	NO										
2.C - Metal Industry	162.31	0.02	NA					0.02	0.29	0.01	0.02
2.C.1 - Iron and Steel Production	15.31	NA						0.02	0.29	0.01	0.01
2.C.2 - Ferroalloys Production	144.67	0.02	NA								
2.C.3 - Aluminium production	NO, NA										
2.C.4 - Magnesium production											
2.C.5 - Lead Production	2.33	NA									0.01
2.C.6 - Zinc Production	NO, NA										
2.C.7 - Other (please specify)											
2.D - Non-Energy Products from Fuels and Solvent Use											
2.D.1 - Lubricant Use											
2.D.2 - Paraffin Wax Use	NO	NA									
2.D.3 - Solvent Use											
2.D.4 - Other (please specify)											
2.E - Electronics Industry											
2.E.1 - Integrated Circuit or Semiconductor											
2.E.2 - TFT Flat Panel Display											
2.E.3 - Photovoltaics	NA				NO, NA		NA				
2.E.4 - Heat Transfer Fluid											
2.E.5 - Other (please specify)											
2.F - Product Uses as Substitutes for Ozone Depleting Substances	NA			315.72	NA,NO	NA					
2.F.1 - Refrigeration and Air Conditioning	NA			315.72	NA	NA					
2.F.2 - Foam Blowing Agents	NA			NO	NO, NA	NA					
2.F.3 - Fire Protection											

2.F.4 - Aerosols										
2.F.5 - Solvents										
2.F.6 - Other Applications (please specify)										
2.G - Other Product Manufacture and Use										
2.G.1 - Electrical Equipment										
2.G.2 - SF6 and PFCs from Other Product Uses	NA				NE,NA		NA			
2.G.3 - N2O from Product Uses										
2.G.4 - Other (Please specify)										
2.H - Other										
2.H.1 - Pulp and Paper Industry	NO	NA								
2.H.2 - Food and Beverages Industry										
2.H.3 - Other (please specify)										
3 - Agriculture, Forestry, and Other Land Use	-1831.16	32.62	1.26	NA			0.08	NA	5.43	NA
3.A - Livestock		31.68	0.14				0.08	NA	4.44	NA
3.A.1 - Enteric Fermentation	NA	26.06	NA	NA			NA			
3.A.2 - Manure Management		5.62	0.14				0.08	NA	4.44	NA
3.B - Land	-1834.34									
3.B.1 - Forest land	-2156.85									
3.B.2 - Cropland	31.22									
3.B.3 - Grassland	25.80	NA								
3.B.4 - Wetlands										
3.B.5 - Settlements	2.92									
3.B.6 - Other Land	262.57									
3.C - Aggregate sources and non-CO2 emissions sources on land	3.19	0.94	1.12	NA					0.99	NA
3.C.1 - Emissions from biomass burning	NA	NO		NA					0.99	NA
3.C.2 - Liming	NO	NA								
3.C.3 - Urea application	3.19	NA	NA							
3.C.4 - Direct N2O Emissions from managed soils			0.75							
3.C.5 - Indirect N2O Emissions from managed soils	NA		0.27	NA						
3.C.6 - Indirect N2O Emissions from manure management			0.09							
3.C.7 - Rice cultivations	NA	0.94	NA							
3.C.8 - Other (please specify)	NO									
3.D - Other	NO	NA								

3.D.1 - Harvested Wood Products								
3.D.2 - Other (please specify)								
4 - Waste	6.65	22.42	0.14	NA	0.25	4.35	1.19	0.01
4.A - Solid Waste Disposal	NA	18.93	NA	NA	NA	NA	1.10	NA
4.B - Biological Treatment of Solid Waste	NA	0.02	0.00		NA	0.00	NA	NA
4.C - Incineration and Open Burning of Waste	6.65	0.51	0.01		0.25	4.35	0.10	0.01
4.D - Wastewater Treatment and Discharge	NA	2.96	0.13		NA	NA	0.00	NA
4.E - Other (please specify)	NA							
5 - Other	NE, NO							
5.A - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3	NE							
5.B - Other (please specify)	NO							
Memo Items (5)								
International Bunkers	47.48	0.00	0.00	NA	NE, NO			
1.A.3.a.i - International Aviation (International Bunkers)	47.48	0.00	0.00	NA	NE			
1.A.3.d.i - International water-borne navigation (International bunkers)	NO			NA	NO			
1.A.5.c - Multilateral Operations	NO			NA	NO			

NO - Not occurring, NA – Not Applicable, NE – Not Estimated

**CO_2 net emissions (emission minus removals)*

Annex 2. Activity Data

Activity Data for the Energy Sector

Table A-7: Activity data used in Energy sector, for 1990 (in TJ)

	Solid fuels						Liquid fuels					Gaseous fuels	Biomass
2006 IPCC Categories	Lignite	Coking coal	Sub-bituminous coal	Anthracite	Coke Oven Coke / Lignite Coke	Other bituminoous coal	Residual fuel oil	Motor gasoline	Gas/Diesel oil	LPG	Jet kerosene	Natural gas	Wood/Wood waste
1.A - Fuel Combustion Activities	53978.5	3079.1	0.0	0.0	0.0	318.5	20221.3	7132.3	11025.6	1886.0	0.0	0.0	7356.0
1.A.1 - Energy Industries	51118.7	0.0	0.0	0.0	0.0	0.0	6221.6	0.0	0.0	0.0	0.0	0.0	0.0
1.A.1.a - Main Activity Electricity and Heat Production	51118.7	0.0	0.0	0.0	0.0	0.0	6221.6	0.0	0.0	0.0	0.0	0.0	0.0
1.A.1.a.i - Electricity Generation	50329.3						40.4						
1.A.1.a.ii - Combined Heat and Power Generation (CHP)	789.4						3959.2						
1.A.1.a.iii - Heat Plants							2222.0						
1.A.1.c - Manufacture of Solid Fuels and Other Energy Industries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.A.1.c.ii - Other Energy Industries													
1.A.2 - Manufacturing Industries and Construction	2424.9	3079.1	0.0	0.0	0.0	318.5	11399.7	0.0	2641.2	1886.0	0.0	0.0	0.0
1.A.2.a - Iron and Steel	2202.9	212.4				318.5	3759.9			874.0			
1.A.2.b - Non-Ferrous Metals		2866.8					520.0		298.2	46.0			
1.A.2.c - Chemicals							920.0		85.2				
1.A.2.d - Pulp, Paper and Print													
1.A.2.e - Food Processing, Beverages and Tobacco	68.3						280.0		340.8				
1.A.2.f - Non-Metallic Minerals							880.0		170.4	828.0			

1.A.2.g - Transport Equipment													
1.A.2.h - Machinery	34.2									92.0			
1.A.2.i - Mining (excluding fuels) and Quarrying							280.0		298.2				
1.A.2.j - Wood and wood products													
1.A.2.k - Construction													
1.A.2.l - Textile and Leather	102.5						120.0						
1.A.2.m - Non-specified Industry	17.1						4639.9		1448.4	46.0			
1.A.3 - Transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7132.3	3741.0	0.0	0.0	0.0	0.0
1.A.3.a - Civil Aviation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.A.3.a.ii - Domestic Aviation													
1.A.3.b - Road Transportation								7132.3	3440.0				
1.A.3.c - Railways									301.0				
1.A.4 - Other Sectors	434.9	0.0	0.0	0.0	0.0	0.0	2599.9	0.0	4643.4	0.0	0.0	0.0	7356.0
1.A.4.a - Commercial/Institutional													
1.A.4.b - Residential	208.8						2079.9		3280.2				7356.0
1.A.4.c - Agriculture/Forestry/Fishing/Fish Farms	0.0	0.0	0.0	0.0	0.0	0.0	520.0	0.0	1363.2	0.0	0.0	0.0	0.0
1.A.4.c.i - Stationary							520.0		1363.2				
1.A.5 - Non-Specified	226.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.A.5.a - Stationary	226.1												
Memo Items													
International Bunkers													
1.A.3.a.i - International Aviation (International Bunkers)											220.5		

Table A-8: Activity data used in Energy sector, for 2000 (in TJ)

	Solid fuels			Liquid fuels						Gaseous fuels	Biomass
2006 IPCC Categories	Lignite	Coke Oven Coke / Lignite Coke	Other bituminoous coal	Residual fuel oil	Motor gasoline	Gas/Diesel oil	LPG	Petroleum Coke	Jet kerosene	Natural gas	Wood/Wood waste
1.A - Fuel Combustion Activities	54587.4	2363.5	1869.0	14041.9	6387.0	13294.4	1539.4	2759.5	10.2	2277.3	8897.8
1.A.1 - Energy Industries	54264.9	0.0	12.6	9681.6	0.0	719.9	116.4	0.0	0.0	1983.6	352.0
1.A.1.a - Main Activity Electricity and Heat Production	54262.7	0.0	12.6	9681.6	0.0	552.2	115.4	0.0	0.0	1983.6	348.9
1.A.1.a.i - Electricity Generation	53212.9			4238.8		3.2					
1.A.1.a.ii - Combined Heat and Power Generation (CHP)	387.5			786.2						332.9	
1.A.1.a.iii - Heat Plants	662.2		12.6	4656.5		549.0	115.4			1650.7	348.9
1.A.1.c - Manufacture of Solid Fuels and Other Energy Industries	2.3	0.0	0.0	0.0	0.0	167.7	0.9	0.0	0.0	0.0	3.1
1.A.1.c.ii - Other Energy Industries	2.3					167.7	0.9				3.1
1.A.2 - Manufacturing Industries and Construction	18.9	2363.5	1856.4	3188.1	0.2	2335.4	680.9	2759.5	10.2	293.7	80.3
1.A.2.a - Iron and Steel	14.2	289.3	1856.4	1140.8		1.8	556.5	1064.0		27.3	
1.A.2.b - Non-Ferrous Metals		2046.4		125.3		603.9	41.9				
1.A.2.c - Chemicals											
1.A.2.d - Pulp, Paper and Print						0.1	0.2				0.5
1.A.2.e - Food Processing, Beverages and Tobacco		27.8		15.4		1593.6	5.8				13.2
1.A.2.f - Non-Metallic Minerals	1.1			1891.8		28.4	60.2	1695.4	10.2	225.5	17.4
1.A.2.g - Transport Equipment											
1.A.2.h - Machinery					0.2	28.1	13.4				8.2
1.A.2.i - Mining (excluding fuels) and Quarrying				2.6		38.3				40.9	0.9
1.A.2.j - Wood and wood products											
1.A.2.k - Construction											
1.A.2.l - Textile and Leather	3.4					1.5	2.9				1.5
1.A.2.m - Non-specified Industry	0.3			12.3		39.6					38.6

1.A.3 - Transport	0.0	0.0	0.0	0.0	6340.3	7298.9	93.2	0.0	0.0	0.0	0.0
1.A.3.a - Civil Aviation	0.0	0.0	0.0	0.0	1.2	12.7	0.0	0.0	0.0	0.0	0.0
1.A.3.a.ii - Domestic Aviation					1.2	12.7					
1.A.3.b - Road Transportation					6339.1	7106.1	93.2				
1.A.3.c - Railways						180.1					
1.A.4 - Other Sectors	303.6	0.0	0.0	1172.2	46.6	2940.2	648.9	0.0	0.0	0.0	8465.5
1.A.4.a - Commercial/Institutional											
1.A.4.b - Residential	235.3					1093.3	300.9				7617.5
1.A.4.c - Agriculture/Forestry/Fishing/Fish Farms	10.4	0.0	0.0	1172.2	46.6	507.2	0.4	0.0	0.0	0.0	0.0
1.A.4.c.i - Stationary	10.4			1172.2	46.6	507.2	0.4				
1.A.5 - Non-Specified	57.9	0.0	0.0	0.0	0.0	1339.7	347.5	0.0	0.0	0.0	848.0
1.A.5.a - Stationary	57.9					1339.7	347.5				848.0
Memo Items											
International Bunkers											
1.A.3.a.i - International Aviation (International Bunkers)									1231.4		

Table A- 9: Activity data used in Energy sector, for 2005 (in TJ)

	Solid fuels				Liquid fuels							Gaseous fuels	Biomass
2006 IPCC Categories	Lignite	Coking coal	Sub-bituminous coal	Coke Oven Coke / Lignite Coke	Residual fuel oil	Motor gasoline	Gas/Diesel oil	LPG	Refinery gas	Petroleum Coke	Jet kerosene	Natural gas	Wood/Wood waste
1.A - Fuel Combustion Activities	58845.0	68.0	1714.4	460.5	9819.8	5135.1	14685.8	2100.2	92.5	3723.3	0.0	2637.9	8647.2
1.A.1 - Energy Industries	55385.7	0.0	0.0	0.0	3530.6	0.0	91.6	0.0	92.5	0.0	0.0	549.6	1.7
1.A.1.a - Main Activity Electricity and Heat Production	55385.4	0.0	0.0	0.0	3197.8	0.0	1.9	0.0	0.0	0.0	0.0	549.6	0.0
1.A.1.a.i - Electricity Generation	55002.6				145.9		1.9						
1.A.1.a.ii - Combined Heat and Power Generation (CHP)	382.8				10.2		0.0						
1.A.1.a.iii - Heat Plants					3041.7							549.6	
1.A.1.c - Manufacture of Solid Fuels and Other Energy Industries	0.3	0.0	0.0	0.0	332.8	0.0	89.7	0.0	92.5	0.0	0.0	0.0	1.7
1.A.1.c.ii - Other Energy Industries	0.3				332.8		89.7		92.5				1.7
1.A.2 - Manufacturing Industries and Construction	2907.4	68.0	1714.4	460.5	4345.4	0.0	1483.6	272.4	0.0	3723.3	0.0	1966.5	296.0
1.A.2.a - Iron and Steel	2628.0	68.0	1712.1	444.6	1741.9		302.3	20.7		1064.0		1430.7	82.8
1.A.2.b - Non-Ferrous Metals					0.7		21.6	0.5					
1.A.2.c - Chemicals					173.2		17.4					119.1	
1.A.2.d - Pulp, Paper and Print	0.6				39.9		14.3					75.5	1.9
1.A.2.e - Food Processing, Beverages and Tobacco			2.2	15.6	622.1		457.9	12.6				255.7	11.3
1.A.2.f - Non-Metallic Minerals	0.0				1260.6		79.4	195.5		2659.2		79.7	5.0
1.A.2.g - Transport Equipment													
1.A.2.h - Machinery	16.4			0.3	119.6		58.7	15.3					2.9
1.A.2.i - Mining (excluding fuels) and Quarrying							152.0						2.0
1.A.2.j - Wood and wood products													
1.A.2.k - Construction													
1.A.2.l - Textile and Leather	262.0				249.4		87.3	4.4					62.6
1.A.2.m - Non-specified Industry	0.3				138.0		292.7	23.6				5.8	127.5

1.A.3 - Transport	0.0	0.0	0.0	0.0	0.0	5118.7	7919.0	1267.8	0.0	0.0	0.0	0.0	0.0
1.A.3.a - Civil Aviation	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.A.3.a.ii - Domestic Aviation						1.3							
1.A.3.b - Road Transportation						5117.4	7807.2	1267.8					
1.A.3.c - Railways							111.8						
1.A.4 - Other Sectors	552.0	0.0	0.0	0.0	1943.8	16.4	5191.6	560.0	0.0	0.0	0.0	121.9	8349.5
1.A.4.a - Commercial/Institutional													
1.A.4.b - Residential	249.5						1318.9	381.1					8179.2
1.A.4.c - Agriculture/Forestry/Fishing/Fish Farms	4.4	0.0	0.0	0.0	933.9	16.4	80.1	6.3	0.0	0.0	0.0	0.0	41.4
1.A.4.c.i - Stationary	4.4				933.9	16.4	80.1	6.3					41.4
1.A.5 - Non-Specified	298.1	0.0	0.0	0.0	1010.0	0.0	3792.6	172.5	0.0	0.0	0.0	121.9	128.9
1.A.5.a - Stationary	298.1				1010.0		3792.6	172.5				121.9	128.9
Memo Items													
International Bunkers													
1.A.3.a.i - International Aviation (International Bunkers) (2)											281.9		

Table A- 10: Activity data used in Energy sector, for 2014 (in TJ)

	Solid fuels				Liquid fuels						Gaseous fuels	Biomass
2006 IPCC Categories	Lignite	Coking coal	Sub-bituminous coal	Coke Oven Coke / Lignite Coke	Residual fuel oil	Motor gasoline	Gas/ Diesel oil	LPG	Petroleum Coke	Jet kerosene	Natural gas	Wood/ Wood waste
1.A - Fuel Combustion Activities	41717.3	167.4	3186.3	39.7	4913.9	4472.8	20167.8	2898.1	2842.3	0.0	4622.1	9912.6
1.A.1 - Energy Industries	40856.2	0.0	0.0	0.0	1753.3	0.0	79.7	0.0	0.0	0.0	3218.3	3.3
1.A.1.a - Main Activity Electricity and Heat Production	40856.2	0.0	0.0	0.0	1651.0	0.0	0.0	0.0	0.0	0.0	3218.3	0.0
1.A.1.a.i - Electricity Generation	40774.1				1651.0							
1.A.1.a.ii - Combined Heat and Power Generation (CHP)	82.0										1537.0	
1.A.1.a.iii - Heat Plants											1681.4	
1.A.1.c - Manufacture of Solid Fuels and Other Energy Industries	0.0	0.0	0.0	0.0	102.3	0.0	79.7	0.0	0.0	0.0	0.0	3.3
1.A.1.c.ii - Other Energy Industries					102.3		79.7					3.3
1.A.2 - Manufacturing Industries and Construction	766.1	167.4	3186.3	39.7	2796.4	0.0	1820.2	353.4	2842.3	0.0	1195.2	281.6
1.A.2.a - Iron and Steel	702.9	148.9	3186.3	32.3	1975.0		112.8	21.0	630.5		763.6	3.4
1.A.2.b - Non-Ferrous Metals							0.8	2.4			38.4	0.1
1.A.2.c - Chemicals					46.9		19.6	0.0			36.3	
1.A.2.d - Pulp, Paper and Print	0.3	0.7			9.1		8.6	0.5			15.2	0.2
1.A.2.e - Food Processing, Beverages and Tobacco	0.4			3.4	273.3		298.3	101.9			203.4	188.9
1.A.2.f - Non-Metallic Minerals	0.1	17.8			369.0		115.3	192.8	2211.9		38.7	0.7
1.A.2.g - Transport Equipment												
1.A.2.h - Machinery	0.1			4.0	16.5		21.9	31.6			95.4	6.4
1.A.2.i - Mining (excluding fuels) and Quarrying							547.7	0.0				6.2
1.A.2.j - Wood and wood products												
1.A.2.k - Construction												
1.A.2.l - Textile and Leather	62.2				74.0		162.9	2.6			1.9	45.0
1.A.2.m - Non-specified Industry	0.2				32.5		532.3	0.5			2.2	30.7
1.A.3 - Transport	0.0	0.0	0.0	0.0	0.0	4456.3	16048.5	1994.1	0.0	0.0	6.2	0.0

1.A.3.a - Civil Aviation	0.0	0.0	0.0	0.0	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0
1.A.3.a.ii - Domestic Aviation						2.4						
1.A.3.b - Road Transportation						4453.9	15936.6	1994.1			6.2	
1.A.3.c - Railways							111.8					
1.A.4 - Other Sectors	95.1	0.0	0.0	0.0	364.3	16.4	2219.4	550.6	0.0	0.0	202.3	9627.6
1.A.4.a - Commercial/Institutional												
1.A.4.b - Residential	37.3						178.5	261.2			1.7	9398.2
1.A.4.c - Agriculture/Forestry/Fishing/Fish Farms	36.7	0.0	0.0	0.0	205.5	16.4	277.1	0.9	0.0	0.0	0.0	56.7
1.A.4.c.i - Stationary	36.7				205.5	16.4	277.1	0.9				56.7
1.A.5 - Non-Specified	21.1	0.0	0.0	0.0	158.8	0.0	1763.7	288.4	0.0	0.0	200.6	172.7
1.A.5.a - Stationary	21.1				158.8		1763.7	288.4			200.6	172.7
Memo Items												
International Bunkers												
1.A.3.a.i - International Aviation (International Bunkers) (2)										519.5		

Table A- 11: Activity data used in Energy sector, for 2015 (in TJ)

	Solid fuels				Liquid fuels						Gaseous fuels	Biomass
2006 IPCC Categories	Lignite	Coking coal	Sub-bituminous coal	Coke Oven Coke / Lignite Coke	Residual fuel oil	Motor gasoline	Gas/Diesel oil	LPG	Petroleum Coke	Jet kerosene	Natural gas	Wood/ Wood waste
1.A - Fuel Combustion Activities	37096.8	325.0	3241.0	15.0	4327.4	4574.3	22521.0	3285.4	2706.0	0.2	4630.6	9095.3
1.A.1 - Energy Industries	36447.5	0.0	0.0	0.0	1580.9	0.0	59.1	0.0	0.0	0.0	3325.9	1.9
1.A.1.a - Main Activity Electricity and Heat Production	36447.5	0.0	0.0	0.0	1571.8	0.0	0.0	0.0	0.0	0.0	3325.9	0.0
1.A.1.a.i - Electricity Generation	36447.5				1571.8							
1.A.1.a.ii - Combined Heat and Power Generation (CHP)											1471.4	
1.A.1.a.iii - Heat Plants											1854.6	
1.A.1.c - Manufacture of Solid Fuels and Other Energy Industries	0.0	0.0	0.0	0.0	9.1	0.0	59.1	0.0	0.0	0.0	0.0	1.9
1.A.1.c.ii - Other Energy Industries					9.1		59.1					1.9
1.A.2 - Manufacturing Industries and Construction	573.8	325.0	3198.7	15.0	2207.4	0.0	1859.5	432.9	2706.0	0.0	1076.5	238.8
1.A.2.a - Iron and Steel	501.5	147.6	2626.6	6.2	1373.6		112.8	17.5	1115.0		665.7	4.0
1.A.2.b - Non-Ferrous Metals							1.4	42.0				
1.A.2.c - Chemicals					67.8		19.7	0.1			36.9	
1.A.2.d - Pulp, Paper and Print	0.3				16.9		7.0	3.3			15.4	0.2
1.A.2.e - Food Processing, Beverages and Tobacco					316.7		304.4	91.2			214.1	182.2
1.A.2.f - Non-Metallic Minerals	0.3	177.5	572.1		300.1		119.3	242.3	1591.0		34.1	0.8
1.A.2.g - Transport Equipment												
1.A.2.h - Machinery	0.0			8.8	16.3		32.6	33.6			103.8	7.4
1.A.2.i - Mining (excluding fuels) and Quarrying							573.1	0.0				3.0
1.A.2.j - Wood and wood products												
1.A.2.k - Construction												
1.A.2.l - Textile and Leather	71.5				80.7		124.3	2.4			2.5	15.5

1.A.2.m - Non-specified Industry	0.3				35.2		565.0	0.4			4.0	25.7
1.A.3 - Transport	0.0	0.0	0.0	0.0	0.0	4557.0	18140.1	2260.4	0.0	0.0	0.6	0.0
1.A.3.a - Civil Aviation	0.0	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0
1.A.3.a.ii - Domestic Aviation						2.8						
1.A.3.b - Road Transportation						4554.2	18059.4	2260.4			0.6	
1.A.3.c - Railways							80.6					
1.A.4 - Other Sectors	75.5	0.0	42.3	0.0	539.1	17.3	2462.3	592.1	0.0	0.2	227.5	8854.6
1.A.4.a - Commercial/Institutional												
1.A.4.b - Residential			42.3				177.1	292.8			2.6	8616.8
1.A.4.c - Agriculture/Forestry/Fishing/Fish Farms	45.0	0.0	0.0	0.0	225.8	17.3	291.3	1.1	0.0	0.2	0.0	56.7
1.A.4.c.i - Stationary	45.0				225.8	17.3	291.3	1.1		0.2		56.7
1.A.5 - Non-Specified	30.5	0.0	0.0	0.0	313.3	0.0	1993.9	298.2	0.0	0.0	224.9	181.1
1.A.5.a - Stationary	30.5				313.3		1993.9	298.2			224.9	181.1
Memo Items												
International Bunkers												
1.A.3.a.i - International Aviation (International Bunkers) (2)										582.3		

Table A- 12: Activity data used in Energy sector, for 2016 (in TJ)

2006 IPCC Categories	Lignite	Coking coal	Sub-bituminous coal	Coke Oven Coke / Lignite Coke	Residual fuel oil	Motor gasoline	Gas/Diesel oil	LPG	Petroleum Coke	Jet kerosene	Natural gas	Wood/Wood waste
1.A - Fuel Combustion Activities	31713.5	762.3	4167.5	42.9	3645.5	4597.9	25902.8	3603.6	1293.7	1.1	7239.6	7606.5
1.A.1 - Energy Industries	31319.6	0.0	0.0	0.0	1132.4	0.0	63.0	0.0	0.0	0.0	5701.8	1.1
1.A.1.a - Main Activity Electricity and Heat Production	31319.6	0.0	0.0	0.0	1121.5	0.0	0.0	0.0	0.0	0.0	5701.8	0.0
1.A.1.a.i - Electricity Generation	31319.6				1121.5							
1.A.1.a.ii - Combined Heat and Power Generation (CHP)											4556.3	
1.A.1.a.iii - Heat Plants											1145.5	
1.A.1.c - Manufacture of Solid Fuels and Other Energy Industries	0.0	0.0	0.0	0.0	10.9	0.0	63.0	0.0	0.0	0.0	0.0	1.1
1.A.1.c.ii - Other Energy Industries					10.9		63.0					1.1
1.A.2 - Manufacturing Industries and Construction	289.6	762.3	4167.5	42.9	1979.7	0.0	1878.1	479.2	1293.7	0.0	1293.3	257.6
1.A.2.a - Iron and Steel	251.6	112.5	2537.9	40.3	1122.0		69.1	14.3	1064.0		875.0	2.4
1.A.2.b - Non-Ferrous Metals							1.5	52.7				
1.A.2.c - Chemicals					55.4		19.5	0.0				39.3
1.A.2.d - Pulp, Paper and Print	0.2	649.8	1629.6		8.9		5.0	5.6			14.2	2.0
1.A.2.e - Food Processing, Beverages and Tobacco					312.4		293.0	96.0			232.6	152.8
1.A.2.f - Non-Metallic Minerals	0.2				323.4		118.9	255.9	229.6		44.1	1.0
1.A.2.g - Transport Equipment												
1.A.2.h - Machinery	0.0			2.6	21.2		64.0	46.4			114.4	10.9
1.A.2.i - Mining (excluding fuels) and Quarrying							552.1	0.0				0.6
1.A.2.j - Wood and wood products												
1.A.2.k - Construction												
1.A.2.l - Textile and Leather	37.2				102.1		118.8	4.6			2.9	15.2
1.A.2.m - Non-specified Industry	0.4				34.3		636.3	3.7			10.1	33.5
1.A.3 - Transport	0.0	0.0	0.0	0.0	0.0	4580.3	21357.8	2481.1	0.0	0.0	6.6	0.0

1.A.3.a - Civil Aviation	0.0	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0
1.A.3.a.ii - Domestic Aviation						2.8						
1.A.3.b - Road Transportation						4577.5	21271.5	2481.1			6.6	
1.A.3.c - Railways							86.2					
1.A.4 - Other Sectors	104.3	0.0	0.0	0.0	533.5	17.6	2603.8	643.3	0.0	1.1	237.9	7347.8
1.A.4.a - Commercial/Institutional												
1.A.4.b - Residential	38.2						161.6	320.5			3.8	7122.9
1.A.4.c - Agriculture/Forestry/Fishing/Fish Farms	36.4	0.0	0.0	0.0	221.2	17.6	305.9	1.1	0.0	1.1	0.0	51.2
1.A.4.c.i - Stationary	36.4				221.2	17.6	305.9	1.1		1.1		51.2
1.A.5 - Non-Specified	29.8	0.0	0.0	0.0	312.2	0.0	2136.4	321.6	0.0	0.0	234.1	173.7
1.A.5.a - Stationary	29.8				312.2		2136.4	321.6			234.1	173.7
Memo Items												
International Bunkers												
1.A.3.a.i - International Aviation (International Bunkers) (2)										664.0		

Activity Data for the IPPU Sector

Table A- 13: Activity data used in IPPU sector (in t)

Categories	1990	2000	2005	2014	2015	2016
2.A - Mineral Industry						
2.A.1 - Cement production (t)	732,926	870,188	886,529	686,497	695,923	882,222
2.A.2 - Lime production (t)	47,000	15,397	15,009	10,836	8,003	9,125
2.A.3 - Glass Production	1,648	230	68	56	45	241
2.A.4 - Other Process Uses of Carbonates						
2.A.4.a - Ceramics* (t)	59,290	9,199	6,767	278	216	357
2.A.4.b - Other Uses of Soda Ash (t)	6,457	3,488	3,128	2,572	2,516	2,462
2.C - Metal Industry						
2.C.1 - Iron and Steel Production (t)	274,993	168,386	647,036	189,248	122,632	170,091
2.C.2 - Ferroalloys Production (t)	85,193	57,842	79,390	91,067	63,747	35,038
2.C.3 - Aluminium production (t)	5,487	3,763	20	NO		
2.C.5 - Lead Production (t)	53,826	56,077	NO		2,648	4,472
2.C.6 - Zinc Production (t)	108,275	126,992	NO			

Table A- 14: Activity data used for Product uses as substitutes for ODS)

Substance/Blend	Import (tones)	
	2015	2016
HFC-134a	24.9	55.4
R-404A	21.6	43.2
R-407C	1.65	8.1
R-410A	4.3	14.7
R-507	0.214	1.3
HFC-227	/	2.1
R-152A / HFC-152a	/	74.2

Activity Data in the AFOLU Sector

Table A- 15: Activity data used for GHG emissions inventory in Livestock (number of heads)

Species and categories	1990	2000	2005	2014	2015	2016
Dairy Cows	166237	171745	156950	155432	156699	160603
Other Cattle	120937	93223	91235	86175	96743	94165
Sheep	2297115	1250686	1244000	619839	599869	607622
Sheep <1 Y				113671	123426	116933
Goats			62190	81346	88064	101669
Horses	66282	56486	39651	19371	18784	19263
Swine	178537	204135	155753	23511	20857	28671
Finishers				141542	174586	202758
Poultry	5728981	3713369	2617012	1939879	1761145	1865769
Layers				1884289	1423841	1705948

Broilers (year equivalent)				4355	51256	15998
Turkey (year equivalent)				3690	2910	10070
Other poultry				19477	17908	36245

Table A- 16: Activity data used for GHG emissions inventory in Forest land (ha)

	1990	2000	2005	2014	2015	2016
Forest land (total)	992532.3	973519.0	969258.0	1084281.5	1101467.4	1102539.0
Forest land Remaining Forest land	970978.0	957550.0	955228.0	1084048.0	1101265.0	1102352.0
Land Converted to Forest land	21554.3	15969.0	14030.0	233.5	202.4	187.0
Cropland converted to Forest Land	*4962.0*	*3128.0*	*2841.1*	*90.9*	*78.8*	*72.8*
Grassland converted to Forest Land	*15892.0*	*12428.0*	*10929.4*	*115.9*	*100.4*	*92.8*
Wetlands converted to Forest Land	*185.6*	*228.0*	*62.7*	*0.0*	*0.0*	*0.0*
Settlements converted to Forest Land	*149.7*	*69.0*	*50.9*	*0.0*	*0.0*	*0.0*
Other Land converted to Forest Land	*365.0*	*116.0*	*145.9*	*26.8*	*23.2*	*21.4*

Table A- 17: Activity data used for GHG emissions inventory in Cropland (ha)

	1990	2000	2005	2014	2015	2016
Cropland (total)	542667.9	508399.1	516312.4	513271.9	512881.8	512303.1
Cropland Remaining Cropland	525559.0	496170.0	505176.0	513078.2	512713.9	512148.0
Land Converted to Cropland	17108.9	12229.1	11136.4	193.7	167.9	155.1
Forest Land converted to Cropland	*9985.3*	*6476.0*	*6302.9*	*86.0*	*74.5*	*68.8*
Grassland converted to Cropland	*6584.3*	*4138.4*	*4519.0*	*105.2*	*91.2*	*84.3*
Wetlands converted to Cropland	*96.1*	*1283.7*	*39.4*	*0.0*	*0.0*	*0.0*
Settlements converted to Cropland	*289.0*	*183.5*	*165.0*	*0.3*	*0.2*	*0.2*
Other Land converted to Cropland	*154.2*	*147.5*	*110.3*	*2.2*	*1.9*	*1.8*

Table A- 18: Activity data used for GHG emissions inventory in Grassland (ha)

	1990	2000	2005	2014	2015	2016
Grassland (total)	637103.1	667146.1	645420.6	616296.7	615980.4	615700.5
Grassland Remaining Grassland	616821.1	653847.10	632218.75	616082.14	615794.49	615528.71
Land Converted to Grassland	20282.0	13298.98	13201.89	214.52	185.93	171.80
Forest Land converted to Grassland	*13056.13*	*8682.00*	*8412.62*	*49.88*	*43.23*	*39.95*
Cropland converted to Grassland	*6346.54*	*3655.45*	*4065.30*	*145.06*	*125.73*	*116.17*
Wetlands converted to Grassland	*169.00*	*183.26*	*102.27*	*19.58*	*16.97*	*15.68*
Settlements converted to Grassland	*499.63*	*476.79*	*384.78*	*0.00*	*0.00*	*0.00*
Other Land converted to Grassland	*210.74*	*301.48*	*236.92*	*0.00*	*0.00*	*0.00*

Table A- 19: Activity data used for GHG emissions inventory in Wetlands (ha)

	1990	2000	2005	2014	2015	2016
Wetlands (total)	**29975.55**	**31785.07**	**34275.73**	**34597.09**	**34617.67**	**34638.3**
Wetlands Remaining Wetlands	28259.40	30609.68	33158.31	34568.73	34593.08	34615.58
Land Converted to Wetlands	1716.15	1175.39	1117.42	28.36	24.59	22.72
Forest Land converted to Wetlands	*114.03*	*79.00*	*70.07*	*2.48*	*2.15*	*1.99*
Cropland converted to Wetlands	*591.96*	*262.44*	*282.56*	*20.31*	*17.61*	*16.27*

Grassland converted to Wetlands	*894.56*	*764.23*	*705.80*	*5.57*	*4.83*	*4.46*
Settlements converted to Wetlands	*45.70*	*21.01*	*22.84*	*0.00*	*0.00*	*0.00*
Other Land converted to Wetlands	*69.90*	*48.71*	*36.15*	*0.00*	*0.00*	*0.00*

Table A- 20: Activity data used for GHG emissions inventory in Settlements (ha)

	1990	2000	2005	2014	2015	2016
Settlements (total)	**29975.55**	**31785.07**	**34275.73**	**34597.09**	**34617.67**	**34638.3**
Settlements Remaining Settlements	28259.40	30609.68	33158.31	34568.73	34593.08	34615.58
Land Converted to Settlements	1716.15	1175.39	1117.42	28.36	24.59	22.72
Forest Land converted to Settlements	*114.03*	*79.00*	*70.07*	*2.48*	*2.15*	*1.99*
Cropland converted to Settlements	*591.96*	*262.44*	*282.56*	*20.31*	*17.61*	*16.27*
Grassland converted to Settlements	*894.56*	*764.23*	*705.80*	*5.57*	*4.83*	*4.46*
Wetlands converted to Settlements	*45.70*	*21.01*	*22.84*	*0.00*	*0.00*	*0.00*
Other Land converted to Settlements	*69.90*	*48.71*	*36.15*	*0.00*	*0.00*	*0.00*

Table A- 21: Activity data used for GHG emissions inventory in Other Land (ha)

	1990	2000	2005	2014	2015	2016
Other Land (total)	**323056.26**	**335061.5**	**349939.9**	**222338**	**205774.2**	**217210.6**
Other land Remaining Other land	321306.00	333342.95	348800.69	220253.76	203967.84	215541.50
Land Converted to Other land	1750.26	1718.50	1139.20	2084.20	1806.40	1669.10
Forest Land converted to Other Land	*513.30*	*397.00*	*287.80*	*1449.20*	*1256.00*	*1160.60*
Cropland converted to Other Land	*601.30*	*550.23*	*330.90*	*319.60*	*277.00*	*255.90*
Grassland converted to Other Land	*468.20*	*650.23*	*414.80*	*315.40*	*273.40*	*252.60*
Wetlands converted to Other Land	*18.96*	*39.26*	*16.90*	*0.00*	*0.00*	*0.00*
Settlements converted to Other Land	*148.50*	*81.78*	*88.80*	*0.00*	*0.00*	*0.00*

Activity Data in the Waste Sector

Table A- 22: Population used for estimation of GHG emission from Municipal Solid Waste and Domestic Wastewater Treatment and Discharge

Population (in millions)															
Year	**1950**	**1951**	**1952**	**1953**	**1954**	**1955**	**1956**	**1957**	**1958**	**1959**	**1960**	**1961**	**1962**	**1963**	**1964**
	1.225	1.25151	1.27801	1.30451	1.3133	1.32208	1.33087	1.33965	1.34843	1.35722	1.366	1.406	1.43013	1.45426	1.4784
Year	**1965**	**1966**	**1967**	**1968**	**1969**	**1970**	**1971**	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**
	1.50253	1.52666	1.55079	1.57492	1.59905	1.69151	1.70866	1.72345	1.73755	1.75334	1.77241	1.79556	1.82192	1.84932	1.87465
Year	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**
	1.89573	1.9115	1.92273	1.93128	1.93991	1.95049	1.96419	1.98006	1.99847	1.99934	1.99623	1.98846	1.97703	1.96492	1.94593
Year	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
	1.94382	1.94909	1.96064	1.97605	1.99168	**2.00487**	2.01492	2.02255	2.02677	2.03254	2.03686	2.04194	2.04518	2.04862	2.05272
Year	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**								
	2.05728	2.05979	2.06229	2.06577	2.06917	2.071278	2.07371								

Table A- 23: Other activity data used for estimation of GHG emission from Municipal Solid Waste

	IPCC Regional Default	**National**					
		1990	**2000**	**2005**	**2014**	**2015**	**2016**
Waste per capita (kg/cap/yr)	520	197	197	281	370	380	376
% to SWDS	90	90	90	90	90	90	90

Table A- 24: Composition of waste going to the Municipal solid waste disposal sites

food	garden	paper	wood	textile	nappies	other
(%)	**(%)**	**(%)**	**(%)**	**(%)**	**(%)**	**(%)**
36.73	10.72	10.84	0.39	3.68	5.03	32.61

Table A- 25: GDP (in $ million) used for estimation of GHG emission from Industrial Waste

	GDP ($ million)														
Year	**1970**	**1971**	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**
	1,219	1,326	1,384	1,802	2,494	2,800	3,174	3,882	4,648	5,863	6,031	5,941	5,402	5,517	5,934
Year	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
	6,338	6,910	7,425	7,776	8,390	7,871	2,916	2,739	2,963	3,560	4,707	4,413	3,720	3,580	3,673
Year	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
	3,587	3,437	3,791	4,756	5,514	5,987	6,558	8,160	9,834	9,314	9,339	10,395	9,745	10,818	11,362
Year	**2015**	**2016**													
	10,065	10,672													

Table A- 26: Other activity data used for estimation of GHG emission from Industrial Waste

	National					
	1990	**2000**	**2005**	**2014**	**2015**	**2016**
Waste Generation Rate (Gg/$mGDP/yr)	0.139	0.139	0.139	0.144	0.139	0.139
% to SWDS	90	90	90	90	90	90

Table A- 27: Total annual amount of solid waste treated by biological treatment facilities (in Gg)

Biological Treatment System	Waste Category	Type of Waste	Waste basis	1990	2000	2005	2014	2015	2016
Composting	Municipal Solid Waste	Total MSW	Dry	NO			1.945	2.807	2.239

Table A- 28: Activity data for waste incineration

	2000	2005	2014	2015	2016
Clinical waste (t)	114.90	375.65	572.88	774.87	869.44

Table A- 29: Activity data used for estimation of the GHG emissions from Open burning of waste

Parametar	Unit	1990	2000	2005	2014	2015	2016
Population - P	(Capita)	1996227	2004873	2036855	2069172	2071278	2073710
Fraction of Population Burning Waste - P frac	(Fraction)	0.1	0.1	0.1	0.1	0.1	0.1
Per Capita Waste Generation - MSWp	(kg waste/capita/day)	0.5	0.54	0.77	1.01	1.04	1.03
Fraction of the waste amount burned relative to the total amount of waste treated - Bfrac	(Fraction)	1	1	1	1	1	1
Number of days by year	(Day)	365	365	365	365	365	365

Annex 3. Methods Applied

Table A- 30: Methods and tiers applied in the preparation of the GHG Inventory (for 2016)

Categories	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Method used	Emiss. factor	Method used	Emiss. factor	Method used	Emiss. factor	Method used	Emiss. factor	Method used	Emiss. factor	Method used	Emiss. factor
1 - Energy	**T1, T2**	**CS, DF**	**T1**	**DF**	**T1**	**DF**						
1.A - Fuel Combustion Activities	T1, T2	CS, DF	T1	DF	T1	DF						
1.A.1 - Energy Industries	T2	CS	T1	DF	T1	DF						
1.A.2 - Manufacturing Industries and Construction	T1, T2	CS, DF	T1	DF	T1	DF						
1.A.3 - Transport	T1, T2	CS, DF	T1	DF	T1	DF						
1.A.4 - Other Sectors	T1, T2	CS, DF	T1	DF	T1	DF						
1.A.5 - Non-Specified	T1, T2	CS, DF	T1	DF	T1	DF						
1.B - Fugitive emissions from fuels	T1	DF	T1	DF								
1.B.1 - Solid Fuels			T1	DF								
1.B.2 - Oil and Natural Gas	T1	DF	T1	DF								
2 - Industrial Processes and Product Use	**T1, T2**	**CS, DF**					**T1**	**DF**	**T1**	**DF**	**NE**	**NE**
2.A - Mineral Industry	T1, T2	CS, DF										
2.A.1 - Cement production	T2	CS										
2.A.2 - Lime production	T1	DF										
2.A.3 - Glass Production	T1	DF										
2.A.4 - Other Process Uses of Carbonates	T1	DF										

Categories	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Method used	Emiss. factor	Method used	Emiss. factor	Method used	Emiss. factor	Method used	Emiss. factor	Method used	Emiss. factor	Method used	Emiss. factor
2.A.5 - Other (please specify)	NO	NO	NO	NO								
2.B - Chemical Industry	T1	DF										
2.B.1 - Ammonia Production	NO	NO										
2.B.2 - Nitric Acid Production					NO	NO						
2.B.3 - Adipic Acid Production					NO	NO						
2.B.4 - Caprolactam, Glyoxal and Glyoxylic Acid Production					NO	NO						
2.B.5 - Carbide Production	NO	NO	NO	NO								
2.B.6 - Titanium Dioxide Production	NO	NO										
2.B.7 - Soda Ash Production	NO	NO										
2.B.8 - Petrochemical and Carbon Black Production	NO	NO										
2.B.9 - Fluorochemical Production												
2.B.10 - Other (Please specify)												
2.C - Metal Industry	T2	CS	T1	DF					NO	NO		
2.C.1 - Iron and Steel Production	T2	CS	NO	NO								
2.C.2 - Ferroalloys Production	T2	CS	T1	DF								
2.C.3 - Aluminium production	NO	NO							NO	NO		
2.C.4 - Magnesium production	NO	NO										
2.C.5 - Lead Production	NO	NO										
2.C.6 - Zinc Production	NO	NO										
2.C.7 - Other (please specify)												

Categories	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Method used	Emiss. factor	Method used	Emiss. factor	Method used	Emiss. factor	Method used	Emiss. factor	Method used	Emiss. factor	Method used	Emiss. factor
2.D - Non-Energy Products from Fuels and Solvent Use												
2.D.1 - Lubricant Use	NO	NO										
2.D.2 - Paraffin Wax Use	NO	NO										
2.D.3 - Solvent Use												
2.D.4 - Other (please specify)	NO	NO										
2.E - Electronics Industry							NO	NO	NO	NO	NO	NO
2.E.1 - Integrated Circuit or Semiconductor							NO	NO	NO	NO	NO	NO
2.E.2 - TFT Flat Panel Display									NO	NO	NO	NO
2.E.3 - Photovoltaics									NO			
2.E.4 - Heat Transfer Fluid									NO			
2.E.5 - Other (please specify)							NO	NO	NO	NO	NO	NO
2.F - Product Uses as Substitutes for Ozone Depleting Substances							**T1**	**DF**				
2.F.1 - Refrigeration and Air Conditioning							T1	DF				
2.F.2 - Foam Blowing Agents							NO	NO				
2.F.3 - Fire Protection							NO	NO	NO	NO		
2.F.4 - Aerosols							NO	NO				
2.F.5 - Solvents							NO	NO	NO	NO		
2.F.6 - Other Applications (please specify)												
2.G - Other Product Manufacture and Use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		
2.G.1 - Electrical Equipment									NE	NE		
2.G.2 - SF6 and PFCs from Other Product Uses									NO	NO	NE	NE

Categories	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Method used	Emiss. factor	Method used	Emiss. factor	Method used	Emiss. factor	Method used	Emiss. factor	Method used	Emiss. factor	Method used	Emiss. factor
2.G.3 - N_2O from Product Uses					*NO*	*NO*						
2.G.4 - Other (Please specify)	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*		
2.H - Other												
2.H.1 - Pulp and Paper Industry												
2.H.2 - Food and Beverages Industry												
2.H.3 - Other (please specify)												
3 - Agriculture, Forestry, and Other Land Use	***T1***	***DF***	***T1***	***DF***	***T1***	***DF***						
3.A - Livestock	*NO*	*NO*	*T1*	*DF*	*T1*	*DF*						
3.A.1 - Enteric Fermentation			*T1*	*DF*	*NO*	*NO*						
3.A.2 - Manure Management			*T1*	*DF*	*T1*	*DF*						
3.B - Land	*T1*	*DF*										
3.B.1 - Forest land	*T1*	*DF*										
3.B.2 - Cropland	*T1*	*DF*										
3.B.3 - Grassland	*T1*	*DF*										
3.B.4 - Wetlands	*NO*	*NO*										
3.B.5 - Settlements	*T1*	*DF*										
3.B.6 - Other Land	*T1*	*DF*										
3.C - Aggregate sources and non-CO_2 emissions sources on land	*T1*	*DF*	*T1*	*DF*	*T1*	*DF*						
3.C.1 - Emissions from biomass burning												
3.C.2 - Liming												
3.C.3 - Urea application					*T1*	*DF*						

Categories	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Method used	Emiss. factor	Method used	Emiss. factor	Method used	Emiss. factor	Method used	Emiss. factor	Method used	Emiss. factor	Method used	Emiss. factor
3.C.4 - Direct N_2O emissions from managed soils					T1	DF						
3.C.5 - Indirect N_2O emissions from managed soils					T1	DF						
3.C.6 - Indirect N_2O emissions from manure management					T1	DF						
3.C.7 - Rice cultivations			T1	DF								
3.C.8 - Other (please specify)												
3.D - Other	T1	DF										
3.D.1 - Harvested Wood Products	T1	DF										
3.D.2 - Other (please specify)												
4 - Waste	**T1**	**DF**	**T1, T2**	**DF**	**T1**	**DF**						
4.A - Solid Waste Disposal			T2	DF								
4.B - Biological Treatment of Solid Waste			T1	DF								
4.C - Incineration and Open Burning of Waste	T1	DF	T1	DF	T1	DF						
4.D - Wastewater Treatment and Discharge			T1	DF	T1	DF						
4.E - Other (please specify)												
5 - Other												
5.A - Indirect N_2O emissions from the atmospheric deposition of nitrogen in NOx and NH3				NE	NE							
5.B - Other (please specify)												
Memo Items												
International Bunkers												

Categories	*CO_2*		*CH_4*		*N_2O*		*HFCs*		*PFCs*		*SF_6*	
	Method used	***Emiss. factor***	***Method used***	***Emiss. factor***	***Method used***	***Emiss. factor***	***Method used***	***Emiss. factor***	***Method used***	***Emiss. factor***	***Method used***	***Emiss. factor***
1.A.3.a.i - International Aviation (International Bunkers)	*T1*	*DF*	*T1*	*DF*	*T1*	*DF*						
1.A.3.d.i - International water-borne navigation (International bunkers)	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*						

T1 - Tier1 approach, T2 - Tier2 approach, CS - Country specific, DF – Default factor, NO - Not occurring, NE - Not estimated

Annex 4. Emission Factors

Energy

Table A- 31: Emission factors used in Energy sector (in kg/TJ)

Fuel	CO_2	CH_4	N_2O
Coking coal	94,600	10	1.5
Other Bituminous Coal	94,600	10	1.5
Sub-bituminous Coal	96,100	10	1.5
Lignite	107,879*	1(10)**	1.5
Crude oil	73,333		
Residual fuel oil	78,049*	3	0.6
Gas / Diesel oil	74,100	3	0.6
Motor gasoline	69,300	0.5	2
Jet kerosene	71,500	0.5	2
LPG	63,100	1	0.1
Petroleum coke	97,500	3	0.6
Natural gas	55,066*	1	0.1
Biomass	112,000	30	4

* Country Specific Emission Factor (CS EF)

**Default CH_4 EF for lignite in Energy industries is 1 kg/TJ and in Manufacturing Industries and Construction is 10 kg/TJ

Note: The default IPCC EF for CH_4 and N_2O are used. For some of the fuels, the values differ between the IPCC categories in the Energy sector (not all are included in table above).

IPPU

Table A- 32: Emission factors used for IPPU sector

Categories	CO_2 (t gas/ t product)	CH_4 (kg gas/ t product)	CF_4 (kg gas/ t product)	C_2F_6 (kg gas/ t product)
Mineral Industry				
Cement production	0.54			
Lime production	0.75			
Glass Production	0.20			
Other Process Uses of Carbonates				
Ceramics	0.44			
Other Uses of Soda Ash	0.41			
Metal Industry				
Iron and Steel Production	0.09			
Ferroalloys Production	4.16	1.00		
Aluminium production	1.60		1.60	0.40
Lead Production	0.52; 0.25			
Zinc Production	1.72			

AFOLU

Table A- 33: Emission factors used for GHG emissions inventory in livestock activities

Emission factor	3rd BUR	Comment
Livestock		
Dairy cows (enteric - CH_4)	99 kg/head/year	
Other cattle (enteric- CH_4)	58 kg/head/year	
Sheep (enteric- CH_4)	5 kg/head/year	40kg live weight
Sheep < 1 Y (enteric- CH_4)	5 kg/head/year	Sheep < 1 Y with 28kg live weight
Goat (enteric- CH_4)	5 kg/head/year	
Horses (enteric- CH_4)	18 kg/head/year	
Swine (enteric- CH_4)	1 kg/head/year	180 kg live weight
Finishers (enteric- CH_4)	1 kg/head/year	Finishers 50 kg live weight
Dairy cows (manure - CH_4)	20 kg/head/year	
Dairy cows (manure - N_2O)	0.35 kg/1000 kg/day 18% liquid slurry (40% N loss); 67% solid storage slurry (40% N loss); 1% daily spread slurry (22% N loss) 13% pasture 0.005 Direct N_2O - N	
Other cattle (manure- CH_4)	9 kg/head/year	
Other cattle (manure- N_2O)	0.35 kg/1000 kg/day 18% liquid slurry (40% N loss); 67% solid storage slurry (40% N loss); 1% daily spread slurry (22% N loss) 13% pasture 0.005 Direct N_2O - N	
Sheep (manure- CH_4)	0.15 kg/head/year	t
Sheep (manure- N_2O)	0.9 kg/1000 kg/day 20% solid storage 80% pasture 0.005 Direct N_2O - N	40 kg live weigh
Sheep < 1 Y (manure- CH_4)	0.15 kg/head/year	Sheep < 1 Y with 28kg live weight
Sheep < 1 Y (manure- N_2O)	0.9 kg/1000 kg/day 20% solid storage 80% pasture 0.005 Direct N_2O - N	Sheep < 1 Y with 28kg live weight
Goat (manure- CH_4)	0.17 kg/head/year	
Goat (manure- N_2O)	1.28 kg/1000 kg/day 20% solid storage 80% pasture 0.005 Direct N_2O - N	
Horses (manure- CH_4)	1.64 kg/head/year	
Horses (manure- N_2O)	100% pasture	
Swine (manure- CH_4)	6 kg/head/year	180 kg live weight
Swine (manure- N_2O)	0.46 kg/1000 kg/day 60% Pit storage (25% N loss); 0.002 Direct N_2O – N 40% solid storage (50% N loss); 0.005 Direct N_2O - N	180 kg live weight
Finishers (manure- CH_4)	6 kg/head/year	Finishers 50 kg live weight
Finishers (manure-N_2O)	0.55 kg/1000 kg/day	Finishers 50 kg live weight

	60% Pit storage (25% N loss); 0.002 Direct N_2O – N 40% solid storage (50% N loss); 0.005 Direct N_2O - N	
Poultry (manure- CH_4)	-	1.8 kg live weight
Poultry (manure- N_2O)	-	1.8 kg live weight
Layers (manure- CH_4)	0.2 kg/head/year	1.8 kg live weight
Layers (manure- N_2O)	0.82 kg/1000 kg/day 100% Poultry litter (50% N loss); 0.001 Direct N_2O - N	1.8 kg live weight
Broilers (manure- CH_4)	0.2 kg/head/year	0.9 kg live weight
Broilers (manure- N_2O)	1.1 kg/1000 kg/day 100% Poultry litter (50% N loss); 0.001 Direct N_2O - N	0.9 kg live weight, specific factors for broilers were used
Turkey (manure- CH_4)	0.9 kg/head/year	6.8 kg live weight, specific factors for Turkey were used
Turkey (manure- N_2O)	0.74 kg/1000 kg/day 100% Poultry litter (50% N loss); 0.001 Direct N_2O - N	6.8 kg live weight, specific factors for Turkey were used
Other (manure- CH_4)	0.2 kg/head/year	1.8 kg live weight
Other (manure- N_2O)	0.82 kg/1000 kg/day 100% Poultry litter (50% N loss); 0.001 Direct N_2O - N	1.8 kg live weight

Waste

Table A- 34: Parameters used for methane calculations from Solid Waste Disposal

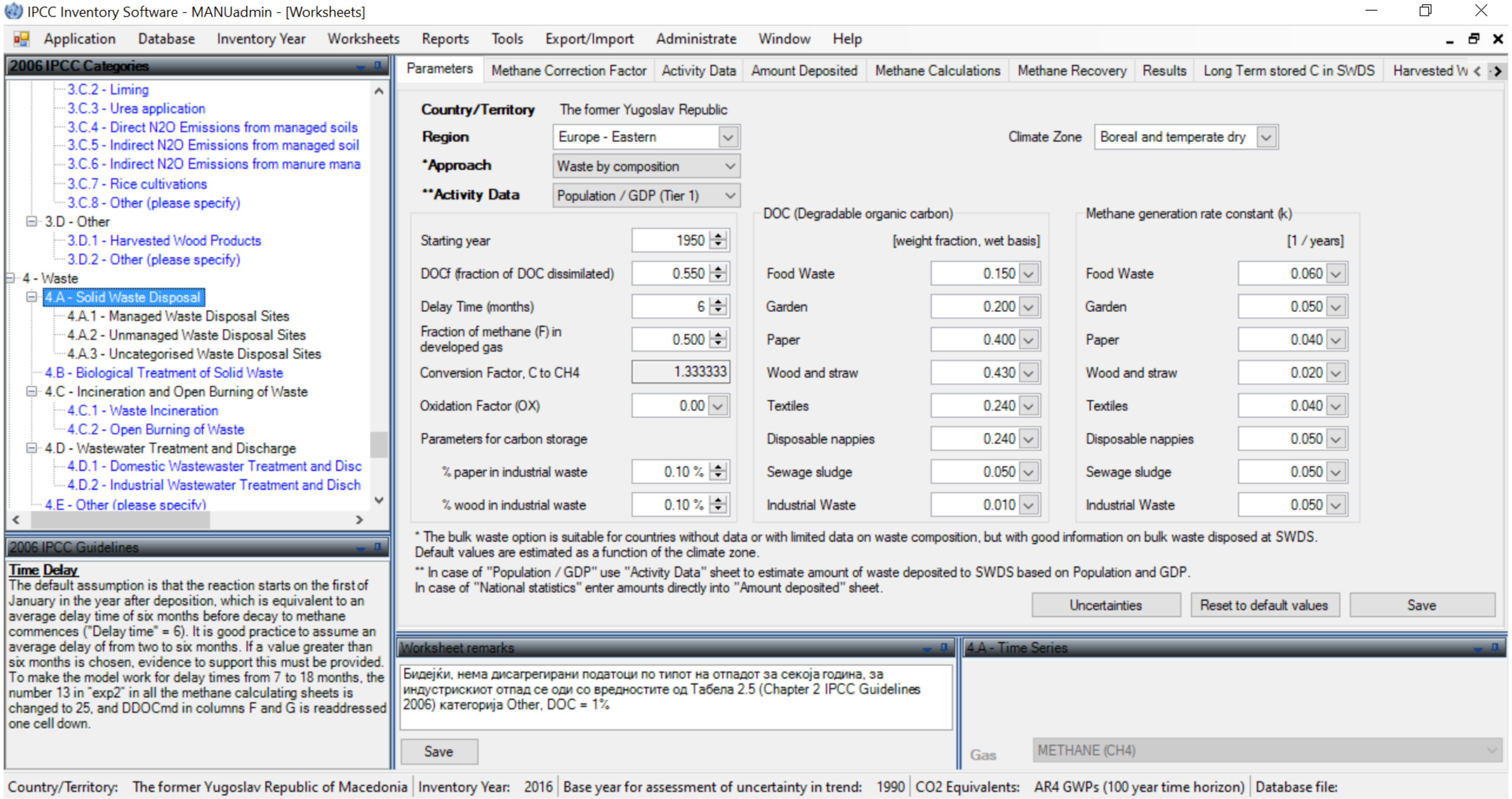


Table A- 35: Methane correction factor and distribution of waste by type of SWDS

	Unmanaged – shallow	Unmanaged – deep	Managed – anaerobic	Managed – semi-aerobic	Uncategorised SWDS
Methane correction factor (MCF)	0.4	0.8	1	0.5	0.6
Fixed distribution (%)	12	46	16	0	26

Table A- 36: Emission factors used for biological treatment of solid waste

	Emission Factor (g/ kg waste treated)	
	CH_4	N_2O
Composting/Total MSW	10	0.6

Table A- 37: Parameters used for estimation of GHG emissions from Open burning of waste

Parameter	Unit	
Dry Matter Content - dm	(Fraction)	0.97
Fraction of Carbon in Dry Matter - CF	(Fraction)	0.38
Fraction of Fossil Carbon in Total Carbon - FCF	(Fraction)	0.1
Oxidation Factor - OF	(Fraction)	0.58
Methane Emission Factor	(kg CH_4/Gg Wet Waste)	6500
Nitrous Oxide Emission Factor	(kg N_2O/Gg Dry Waste)	150

Table A- 38: Parameters used for estimation of emissions from Domestic and Industrial Wastewater Treatment and Discharge

Estimation of CH_4 emission factor for Domestic Wastewater	
Type of treatment or discharge	Sea, river and lake discharge
Maximum methane producing capacity - B0 (kg CH_4/kg BOD)	0.6
Methane correction factor for each treatment system - MCFj	0.1
Fraction of Population Income Group - Ui (Fraction)	Rural 0.4; Urban 0.6
Degree of utilization - Tij (Fraction)	0.3
Estimation of emissions of indirect N_2O from Domestic Wastewater	
Estimation of nitrogen in effluent	
Per capita protein consumption (Protein) (kg/person/Year)	28.91
Fraction of nitrogen in protein (Fnpr) (kg N/kg Protein)	0.16
Fraction of non-consumption protein (Fnon-con) (-)	1.4
Fraction of industrial and commercial co-discharged protein (Find-com) (-)	1.25
Emission Factor (kg N_2O-N/kg N)	0.005
Estimation of CH_4 emission factor for Industrial Wastewater	
Type of treatment or discharge	Sea, river and lake discharge
Maximum Methane Producing Capacity (B0) (kg CH_4/kg COD)	0.25

Annex 5. Mitigation Action Plan

Table A- 39: Action plan for realization of the Scenario with existing measures – WAM

Policy/ measure	*Competent entity for realization*	*Type*	*Status*	*Source of finance*	*Indicative emissions reduction (Gg CO_2-eq)*	*Specific costs: (€/t CO2-eq)*	*Budget (mil. €)*	*Green jobs*		
					2030	2030		2030	2035	2040
Reduction of network losses	► Electricity distribution companies ► Heat distribution companies ► Ministry of Economy, Energy Agency	Technical	Ongoing	Distribution and transmission companies	323.4	-31.0	170.0			
Large hydropower plants	► JSC ESM ► Ministry of Environment and Physical Planning ► Ministry of Economy, Energy Agency	Technical	Planned	JSC ESM, Public Private Partnership, Independent power producers	740.7	9.5	1716.2			
Incentives feed-in tariff	► Government of the Republic of North Macedonia ► Energy Regulatory Commission ► Ministry of Environment and Physical Planning ► Ministry of Economy, Energy Agency ► Private investors	Technical, Regulatory	Ongoing	Independent power producers, consumers of electricity through their bills	149.5	-6.1	356.9	152.0	163.0	181.0
Incentives feed-in premium	► Government of the Republic of North Macedonia ► Energy Regulatory Commission ► Ministry of Economy ► Private investors	Technical, Regulatory	Ongoing	Independent power producers, incentives from the central government budget	162.6	-3.7	240.6	220.0	220.0	220.0

Policy/ measure	*Competent entity for realization*	*Type*	*Status*	*Source of finance*	*Indicative emissions reduction (Gg CO_2-eq)*	*Specific costs: (€/t CO2-eq)*	*Budget (mil. €)*	*Green jobs*		
					2030	2030		2030	2035	2040
Biomass power plants (CHP optional)	▶ Government of the Republic of North Macedonia ▶ Energy Regulatory Commission ▶ Ministry of Environment and Physical Planning ▶ Ministry of Economy, Energy Agency ▶ Private investors	Technical, Regulatory	Ongoing	Independent power producers, incentives through consumers bills	21.0	5.0	24.3	21.0	28.0	23.0
Solar rooftop power plants	▶ Government of the Republic of North Macedonia ▶ Energy Regulatory Commission ▶ Ministry of Economy, Energy Agency ▶ Elektrodustribucija Skopje ▶ Suppliers of electricity ▶ Electricity end-users	Technical, Regulatory	Planned	Independent power producers, subsidies from national and local budget, EE fund	142.9	-33.0	318.0	443.0	209.0	167.0
RES without incentives	▶ Government of the Republic of North Macedonia ▶ Energy Regulatory Commission ▶ Ministry of Economy, Energy Agency ▶ JSC ESM ▶ Private investors	Technical, Regulatory	Ongoing	JSC ESM, Independent power producers, Public Private Partnership	189.2	-6.0	1046.0	1377.0	693.0	669.0
Introduction of CO_2 tax	▶ Government of the Republic of North Macedonia ▶ Energy Regulatory Commission ▶ Ministry of Environment and Physical Planning ▶ Ministry of Economy, Energy Agency ▶ Ministry of Finance	Regulatory	Planned	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Energy efficiency obligation schemes	▶ Ministry of Economy ▶ Distribution system operators ▶ Suppliers and traders of electricity and gas	Technical, Regulatory	Planned	Consumers through their bills	162.8	-88.7	182.0			

Policy/ measure	Competent entity for realization	Type	Status	Source of finance	Indicative emissions reduction (Gg CO_2-eq)	Specific costs: (€/t CO2-eq)	Budget (mil. €)	Green jobs		
					2030	2030		2030	2035	2040
Solar thermal collectors	► Ministry of Economy, Energy Agency ► End-users	Technical	Ongoing	Private, EE fund, incentives from the central government budget, donors	7.2	-60.0	34.8	401.0	495.0	633.0
Labeling of electric appliances and equipment	► Ministry of Economy, Energy Agency ► Producers and suppliers of electrical equipment and household appliances ► End-users	Regulatory	Ongoing	Private, EE fund	56.3	-85.9	71.0			
Increased use of heat pumps	► Ministry of Economy, Energy Agency ► End-users	Regulatory , Policy	Ongoing	Private, EE fund, incentives from the central and local government budget, donors	392.3	-79.9	330.6	38.0	73.0	88.0
Public awareness campaigns and network of EE info centers	► Ministry of Economy, Energy Agency ► Energy suppliers ► End-users	Informatio n	Ongoing	Private sector, donors, central and local governments	177.0	-107.6	658.0			
Retrofitting of existing residential buildings	► Ministry of Economy, Energy Agency ► Donors and financial institutions ► Households	Technical, Regulatory	Ongoing	Private, donors through commercial EE loans, EE fund	49.0	88.6	941.8	1576.0	735.0	8530

Policy/ measure	Competent entity for realization	Type	Status	Source of finance	Indicative emissions reduction (Gg CO_2-eq)	Specific costs: (€/t CO2-eq)	Budget (mil. €)	Green jobs		
					2030	2030		2030	2035	2040
Retrofitting of existing central government buildings	▶ Ministry of Economy, Energy Agency ▶ Ministry of Finance ▶ Local self-government ▶ Municipal public enterprises ▶ Donors and financial institutions	Technical, Regulatory	Ongoing	Central government budget, donors	12.6	17.5	155.0	87.0	87.0	910
Retrofitting of existing local self-government buildings	▶ Ministry of Economy, Energy Agency ▶ Ministry of Finance ▶ Local self-government ▶ Municipal public enterprises ▶ Donors and financial institutions	Technical, Regulatory	Ongoing	Local self-government budget, donors	13.2	4.9	100.0	77.0	75.0	770
Retrofitting of existing commercial buildings	▶ Ministry of Economy, Energy Agency ▶ Ministry of Finance ▶ Commercial buildings owners	Technical, Regulatory	Ongoing	Private, donors through commercial EE loans, EE fund	98.2	6.3	530.0	482.0	4470	502.0
Construction of new buildings	▶ Ministry of Economy, Energy Agency ▶ Donors and financial institutions ▶ Investors (households)	Technical, Regulatory	Ongoing	Private, donors through commercial EE loans, EE fund	19.8	64.6	282.7	553.0	167.0	117.0
Construction of passive buildings	▶ Ministry of Economy, Energy Agency ▶ Donors and financial institutions ▶ Investors (households)	Technical, Regulatory	Ongoing	Private, donors through commercial EE loans, EE fund	17.0	231.2	1068.0	1324.0	2084	1468.0
Phasing out of incandescent lights	▶ Government of the Republic of North Macedonia ▶ Ministry of Economy, Energy Agency ▶ End-users	Technical	Ongoing	Central government budget, private	401.8	61.5	558.0	274.0	425.0	657.0

Policy/ measure	Competent entity for realization	Type	Status	Source of finance	Indicative emissions reduction (Gg CO_2-eq)	Specific costs: (€/t CO2-eq)	Budget (mil. €)	Green jobs		
					2030	2030		2030	2035	2040
Improvement of the street lighting in the municipalities	▶ Government of the Republic of North Macedonia ▶ Ministry of Environment and Physical Planning ▶ Ministry of Economy, Energy Agency ▶ Local self-government	Technical	Ongoing	Central and local government budget, ESCO	32.5	-73.2	19.5	9.0	12.0	15.0
Green procurements	▶ Ministry of Economy, Energy Agency ▶ Public Procurement Bureau ▶ Local self-government	Regulatory	Ongoing	Central and local government budget	6.6	-61.2	16.0			
Increased use of central heating systems	▶ Ministry of Economy, Energy Agency ▶ Balkan energy Dooel Skopje ▶ JSC Skopje Sever ▶ "Energetika" - Skopje, subsidiary to JSC Macedonian Power Plants ▶ Private investors	Technical, Information	Ongoing	Private, EE fund, incentives from the central and local government budget	9.3	-105.6	3.2			
Energy management in manufacturing industries	▶ Ministry of Economy, Energy Agency ▶ Private companies	Regulatory, Technical	Ongoing	Private, donors through commercial EE loans	67.8	-45.7	/			
Introduction of efficient electric motors	▶ Ministry of Economy, Energy Agency ▶ Private companies	Technical	Ongoing	Private, donors through commercial EE funds	14.9	-21.7	99.7			
Introduction of more advanced technologies	▶ Government of the Republic of North Macedonia ▶ Ministry of Environment and Physical Planning ▶ Ministry of Economy, Energy Agency ▶ Private investors	Technical	Ongoing	Private, donors through commercial EE loans, EE funds	128.3	-42.1	344.8			

Policy/ measure	*Competent entity for realization*	*Type*	*Status*	*Source of finance*	*Indicative emissions reduction (Gg CO_2-eq)*	*Specific costs: (€/t CO2-eq)*	*Budget (mil. €)*	*Green jobs*		
					2030	2030		2030	2035	2040
Increased use of the railway	▶ Government of the Republic of North Macedonia ▶ Ministry of Transport and Communication ▶ Ministry of Economy, Energy Agency ▶ JSC Makedonski zeleznici ▶ End-users ▶ Private companies	Technical, Informatio n	Planned	Central government budget	37.2	-286.2	180.6			
Renewing of the national car fleet	▶ Government of the Republic of North Macedonia ▶ Ministry of Transport and Communication ▶ Ministry of Economy, Energy Agency ▶ End-users	Regulatory , Policy, Informatio n	Ongoing	Private, EE fund, incentives from the central government budget	24.0	-78.1	1659.5			
Renewing of other national road fleet	▶ Government of the Republic of North Macedonia ▶ Ministry of Transport and Communication ▶ Ministry of Interior Affairs ▶ Ministry of Economy, Energy Agency ▶ Private companies	Regulatory , Policy	Ongoing	Private sector	64.6	-80.7	2300.0			
Advanced mobility	▶ Ministry of Economy, Energy Agency ▶ Local self-government ▶ End-users	Regulatory , Technical, Informatio n	Ongoing	Private, EE fund, incentives from the central and local government budget, donors	3.6	-983.0	/			
Construction of the railway to the Republic of Bulgaria	▶ Government of the Republic of North Macedonia ▶ Ministry of Transport and Communication ▶ Ministry of Economy, Energy Agency	Technical, Policy	Ongoing	Central government budget	24.6	270.0	720.0			

Policy/ measure	Competent entity for realization	Type	Status	Source of finance	Indicative emissions reduction (Gg CO_2-eq)	Specific costs: (€/t CO2-eq)	Budget (mil. €)	Green jobs		
					2030	2030		2030	2035	2040
Electrification of the transport	► Government of the RM ► Ministry of Transport and Communication ► Ministry of Economy	Regulatory, Policy, Information	Ongoing	Private, EE fund, incentives from the central government budget	41.9	91.8	4132.0			
Reduction of CH4 emissions from enteric fermentation in dairy cows by 3%	► Ministry of Agriculture, Forestry and Water Economy	Livestock, enteric fermentation in dairy cow	Ongoing	Private sector	35.0	0.2	0.2			
Reduction of N2O emissions from manure management in dairy cows by 20%	► Ministry of Agriculture, Forestry and Water Economy	Livestock, manure management in dairy cow	Planned	Private sector	2.1	13.0	1.0			
Reduction of NO2 emissions from manure management in swine farms by 13%	► Ministry of Agriculture, Forestry and Water Economy	Livestock, manure management in swine cow	Ongoing	Private sector	0.4	77.4	1.0			
Reduction of N2O emissions from manure in dairy cows by 20% for farms below 50 Livestock Units	► Ministry of Agriculture, Forestry and Water Economy	Livestock, manure management in dairy cow	Planned	Private sector	0.7	44.2	1.0			

Policy/ measure	Competent entity for realization	Type	Status	Source of finance	Indicative emissions reduction (Gg CO_2-eq)	Specific costs: (€/t CO2-eq)	Budget (mil. €)	Green jobs		
					2030	2030		2030	2035	2040
Establishing integrated management of forest fires	► PE "National forests" ► Ministry of Agriculture, Forestry and Water Economy	Forest fires reduction	Ongoing	PE "National forests", other forest enterprises	345.0	-9.3	1.5			
Afforestation	► PE "National forests" ► Ministry of Agriculture, Forestry and Water Economy	Afforestation of Barren Land	Ongoing	PE "National forests", other forest enterprises	312.5	1.3	7.8			
Conversion of land use of field crops above 15% inclination	► Ministry of Agriculture, Forestry and Water Economy	Land management and land use change in the category of cropland	Ongoing	Private sector	3.7	21.0	1.5			
Contour cultivation on areas under field crops on inclined terrains (5-15%)	► Ministry of Agriculture, Forestry and Water Economy	Land management and land use change in the category of cropland	Ongoing	Private sector	28.0	2.0	1.0			
Perennial grass in orchard and vineyards on inclined terrains (>5%)	► Ministry of Agriculture, Forestry and Water Economy	Land management and land use change in the category of cropland	Ongoing	Private sector	8.9	5.9	1.0			

Policy/ measure	Competent entity for realization	Type	Status	Source of finance	Indicative emissions reduction (Gg CO_2-eq)	Specific costs: (€/t CO2-eq)	Budget (mil. €)	Green jobs		
					2030	2030		2030	2035	2040
Use of biochar for carbon sink on agricultural land	► Ministry of Agriculture, Forestry and Water Economy	Land management of the category of cropland	Planned	Private sector	110.0	30.5	47.0			
Photovoltaic irrigation	► Ministry of Agriculture, Forestry and Water Economy	Agriculture – irrigation replacing fossil energy with renewables	Ongoing	Private sector	93.3	36.0	47.0			
Landfill gas flaring	► Ministry of Environment and Physical Planning ► Public municipal enterprises for waste management ► State Environmental Inspectorate ► Inter-Municipal Waste Management Board ► Authorized Inspectors of Environment (Municipalities)	Technical	Ongoing	Local self-government through Public Utilities, Public Private Partnership, Grants from the EU	489.7	1.4	20.5			
Mechanical and biological treatment (MBT) in new landfills with composting	► Ministry of environment and physical planning ► Public utilities for waste management ► State Environmental Inspectorate ► Inter-municipal board for waste management ►Authorized Inspectors of Environment (Municipalities)	Technical	Ongoing	Local self-government through Public Utilities, Public Private Partnership, Grants from the EU	108.0	12.8	36.1			

Policy/ measure	Competent entity for realization	Type	Status	Source of finance	Indicative emissions reduction (Gg CO_2-eq)	Specific costs: (€/t CO2-eq)	Budget (mil. €)	Green jobs		
					2030	2030		2030	2035	2040
Selection of waste - paper	► Ministry of environment and physical planning ► Public utilities for waste management ► State Environmental Inspectorate ► Inter-municipal board for waste management ► Authorized Inspectors of Environment (Municipalities)	Technical	Ongoing	Local self-government through Public Utilities, Public Private Partnership, Grants from the EU	62.5	2.1	2.0			
Improved waste and materials management at industrial facilities	► Ministry of Environment and Physical Planning ► Public utilities for waste management ► State Environmental Inspectorate ► Inter-Municipal Waste Management Board ► Authorized Inspectors of Environment (Municipalities)	Regulation, Technical	Planned	Ministry of Environment and Physical Planning Municipalities and city of Skopje Industrial facilities	3.3	0	0			

Annex 6. Detailed Description of Policies and Measures Used in the WEM and/or WAM Scenarios

All measures/policies (47) used in the climate change mitigation scenarios (WEM, WAM and e-WAM) are presented in this Annex in tabular form and are providing information on:

a. Mitigation action;
b. Main objective;
c. Description;
d. Information: Type; Sector; Relevant Planning documents, legal and regulatory acts; Gases; Methodology; Assumption;
e. Progress of implementation: Steps taken or envisaged to achieve the action; Energy savings (Final Energy and Primary Energy); Estimated emission reductions; Timeframe; Finance (Budget, Costs[23] and Specific Costs[24]); Implementing entity;
f. Progress indicators;
g. Contribution to the achievement of the SDGs.

The effect of the mitigation measures regarding energy savings, emissions reduction and costs are presented in relation to the WOM scenario.

All the measures proposed in this report can be applied throughout the whole country, except the measure Increased use of central heating systems (which only applies to Skopje) and Contraction of the railway to Republic of Bulgaria (which applies to the north-eastern part of the country) . However, some of them have local/municipality context: Retrofitting of existing self-government buildings, Improvement of street lighting and Green procurements. The national circumstances of decreasing tendency of emissions from the AFOLU sector, makes a difficult choice of mitigation scenarios. However, the mitigation measures can have additional effects, co-benefits and in some cases can have significant potential to be used as adaptation options as well. For example, the contour cultivation of cropland on inclined terrains, will reduce GHG emission, but also will increase the amount of water absorbed by soil and increase the yield in water limited agriculture. Also, biochar application can sink the significant amount of carbon into the soil, but also boasts a porous surface structure and chemical properties that allow it to capture and hold nutrients, moisture, and agrochemicals, as well as providing a place for micro-organisms and fungi to reside, thus increase soil fertility and result with healthier soil that will be able to provide a higher amount of water and nutrients to the crop in changing climate. Therefore, mitigation measures with such potential are favorable for Macedonian agriculture, when AFOLU GHG emissions reduces with almost no measures applied, and the interest of the significant portion of the stakeholders for environmental measures in AFOLU sector is not high enough. These measures with a high level of co-benefits and adaptation potential can be much easier adopted by farmers due to the positive effect on crop growth and yield.

The IPCC reports that the mitigation measures can have additive positive effects, but they can also work in opposition, e.g., zero tillage can reduce the effectiveness of residue incorporation. Therefore, the choice of mitigation measures for the AFOLU sector in the country should be conducted carefully and providing the proper advisory package for the farmers. Moreover, it will be an advantage if such measures have potential to be included in the scheme of the national

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

[24] Specific cost (Economic effectiveness) - shows the number of investments required in order to reduce 1 t CO_2-eq by applying the specific policy/measure and it is expressed in €/t CO_2-eq

support for agriculture (direct payments and/or rural development programs) or to be included in IPARD program (particularly as agri-environmental measures, but not excluding all other types of measures). However, the measures that already fit in any of these programs should be considered as high priority measures, because the process of implementation will be easier, and farmers will be financially supported for implementation of such measures.

Energy – Energy Industries

Table A- 40: Reduction of Network Losses

Mitigation action: Reduction of network losses

Main objective: Reduction of losses in electricity and heat networks

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

Information	**Type**		Technical
	Sector		Electricity transmission and distribution operators
	Relevant planning documents, legal and regulatory acts		► Strategy for Energy Development of North Macedonia up to 2040 ► Development plan of EVN Macedonia, AD ► Development plan of Balkan Energy Group (BEG)
	Gases		CO_2, CH_4, N_2O
	Methodology		Technical interventions on the distribution network. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
	Assumptions		Technical interventions will reduce the electricity transmission and distribution losses from 12% to 8%, while the district heating system losses will be reduced from 12% to at least 7%.
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► A General investment plan in the electricity distribution network is developed for the next 20 years. ► Implementing measures for operation improvement and losses reduction in the heat distribution system.
		Steps envisaged	► Replacement old electric transformer with new transformers at 20 kV voltage level ► Reduction of the reactive power in the power network ► Rehabilitation of the hot water distribution network, replacement of the existing pumps in the heating substations with new energy efficient pumps and other measures for energy efficiency improvement (modernization of the SCADA system, integration of the distribution networks). ► Installation of modern equipment for regulation and monitoring in the heating substations for control and reduction of the consumed heat
	Energy savings – **Final energy**	**Per year**	n/a
		Cumulative	n/a
	Energy savings – **Primary energy**	**Per year**	► 11.0 ktoe in 2020 ► 28.9 ktoe in 2030 ► 263.7 ktoe in 2040 Additional benefit - decrease of net import: ► 41.8 ktoe in 2020 ► 86.6 ktoe in 2030 ► 332.3 ktoe in 2040
		Cumulative	► 32.8 ktoe in 2017-2020 ► 209.3 ktoe in 2021-2030 ► 941.0 ktoe in 2031-2040 Additional benefit decrease of net import: ► 112.6 ktoe in 2017-2020 ► 805.9 ktoe in 2021-2030 ► 1595.4 ktoe in 2031-2040
	Estimated emission reductions		► 201.8 Gg CO2-eq in 2020 ► 323.4 Gg CO2-eq in 2030 ► 701.8 Gg CO2-eq in 2040
	Timeframe		2020– 2040
	Finance		Budget: 170 M€ Source of finance: ► Distribution and transmission companies Costs (2030): ► WOM: 1,122 M€ ► WEM: 1,112 M€ Specific costs (2030): ► -31 €/t CO_2-eq

Implementing entity	► Electricity distribution companies ► Heat distribution companies ► Energy Agency, Ministry of Economy
Progress indicators:	► Percentage of network losses (%) ► Energy savings (ktoe/GWh) ► Emissions reductions (Gg CO2-eq)
Contribution for the achievement of the SDGs:	***direct***: 7 AFFORDABLE AND CLEAN ENERGY ***indirect***: 12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION

Table A- 41: Large Hydropower Plants

Mitigation action: Large hydropower plants				
Main objective: Increase of the domestic generation capacity from renewable energy sources *Description: Construction of new large hydropower plants*				
Information	**Type**			Technical
	Sector			Electricity producers
	Relevant planning documents, legal and regulatory acts			▶ Strategy for Energy Development of North Macedonia up to 2040 ▶ Strategy for utilization of renewable energy sources in the Republic of Macedonia ▶ The development plan of ESM AD (JSC Macedonian Power Plants).
	Gases			CO_2, CH_4, N_2O
	Methodology			Large hydropower plants construction. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions			It is envisaged construction of large hydropower plants according to the following dynamics: ▶ Vardar valley – 2025-2030 ▶ Chebren – 2029 ▶ Tunnel Vardar – Kozjak, Veles and Gradec ▶ Globochica II – 2035
Progress of implementation	**Steps taken or envisaged to achieve the action**		**Steps taken**	▶ Feasibility/pre-feasibility studies developed ▶ Chebren feasibility study developed
			Steps envisaged	▶ Call for investors for Chebren ▶ Invitation for tenders for the construction of the other hydropower plants, selection of the best bidder and commencement of the construction.
	Energy savings	**Final energy**	**Per year**	▶ n/a
			Cumulative	▶ n/a
		Primary energy	**Per year**	▶ 0 ktoe in 2020 ▶ 28.8 ktoe in 2030 ▶ 932.6 ktoe in 2040 Additional benefit - decrease of net import: ▶ 0 ktoe in 2020 ▶ 220.5 ktoe in 2030 ▶ 1156.0 ktoe in 2040
			Cumulative	▶ 0 ktoe in 2017-2020 ▶ 27.4 ktoe in 2021-2030 ▶ 3748.6 ktoe in 2031-2040 Additional benefit decrease of net import: ▶ 0 ktoe in 2017-2020 ▶ 340.5 ktoe in 2021-2030 ▶ 5926.0 ktoe in 2031-2040
	Estimated emission reductions			▶ 0 Gg CO2-eq in 2020 ▶ 740.7 Gg CO2-eq in 2030 ▶ 1868.2 Gg CO2-eq in 2040
	Timeframe			2020– 2040
	Finance			Budget: 1716.2 M€ Source of finance: ▶ Public private partnership, ESM, Independent Power Producers Costs (2030): ▶ WOM: 1,122 M€ ▶ WEM: 1,115 M€ Specific costs (2030): ▶ 9.5 €/t CO_2-eq
	Implementing entity			▶ ESM AD (JSC Macedonian Power Plants). ▶ Ministry of Environment and Physical Planning ▶ Energy Agency, Ministry of Economy
Progress indicators:				▶ Installed capacity (MW) ▶ Electricity generation (GWh) ▶ Emissions reductions (Gg CO2-eq)
Contribution for the achievement of the SDGs:				***direct***: 7 AFFORDABLE AND CLEAN ENERGY ***indirect***: 12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION

Table A- 42: Incentives Feed-In Tariff

Mitigation action: Incentives feed-in tariff				
Main objective: Increase of the domestic generation capacity from renewable energy sources				
Description: Construction of new small hydropower plants, wind and biogas with feed-in tariffs that will stimulate the construction				
Information	**Type**			Technical, regulatory
	Sector			Electricity producers
	Relevant planning documents, legal and regulatory acts			► Strategy for Energy Development of North Macedonia up to 2040 ► Strategy for Utilization of Renewable Energy Sources in the Republic of Macedonia ► Renewable Energy Action Plan ► Law on Energy ► Bylaws on renewable energy
	Gases			CO_2, CH_4, N_2O
	Methodology			Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions			Through stimulation with feed-in tariffs, it is envisaged that by 2040 additional capacity of: ► 86 MW wind power plants ► 13 MW biogas power plants ► 92.5 MW small hydropower plants will be constructed.
Progress of implementation	**Steps taken or envisaged to achieve the action**		**Steps taken**	Regulation on feed-in tariffs adopted (17.04.2013)
			Steps envisaged	► Decree on the measures for support of electricity generation from renewable energy sources adopted (5.04.2019). ► Decision on the total installed capacity for preferential producers of electricity adopted (5.04.2019).
	Energy savings	**Final energy**	**Per year**	► n/a
			Cumulative	► n/a
		Primary energy	**Per year**	► 1.8 ktoe in 2020 ► 24.5 ktoe in 2030 ► 169.6 ktoe in 2040 Additional benefit - decrease of net import: ► 5.7 ktoe in 2020 ► 56.4 ktoe in 2030 ► 211.4 ktoe in 2040
			Cumulative	► 3.2 ktoe in 2017-2020 ► 184.6 ktoe in 2021-2030 ► 691.6 ktoe in 2031-2040 Additional benefit decrease of net import: ► 1.8 ktoe in 2017-2020 ► 437.5 ktoe in 2021-2030 ► 1096.7 ktoe in 2031-2040
	Estimated emission reductions			► 11.75 Gg CO_2-eq in 2020 ► 149.5 Gg CO_2-eq in 2030 ► 431.6 Gg CO_2-eq in 2040
	Timeframe			2020– 2040
	Finance			Budget: 356.9 M€ Source of finance: ► IPP, incentives through consumer bills Costs (2030): ► WOM: 1,122 M€ ► WEM: 1,121 M€ Specific costs (2030): ► -6.1 €/t CO_2-eq
	Implementing entity			► Government of the Republic of North Macedonia ► Energy Regulatory Commission ► Ministry of Environment and Physical Planning ► Ministry of Economy, Energy Agency ► Private investors
Progress indicators:				► Installed capacity (MW) ► Electricity generation (GWh) ► Emissions reductions (Gg CO2-eq)
Contribution for the achievement of the SDGs:				***direct***: 7 AFFORDABLE AND CLEAN ENERGY ***indirect***: 12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION

Table A- 43: Incentives Feed-In Premium

Mitigation action: Incentives feed-in premium

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

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

Information	**Type**			Technical, regulatory
	Sector			Electricity producers
	Relevant planning documents, legal and regulatory acts			► Strategy for Energy Development of North Macedonia up to 2040 ► Law on Energy ► Bylaws for renewable energy
	Gases			CO_2, CH_4, N_2O
	Methodology			Bottom-up modelling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions			Through stimulation with feed-in premium, it is envisaged that by 2040 additional capacity will be constructed: ► 200 MW solar power plants ► 64 MW wind power plants
Progress of implementation	**Steps taken or envisaged to achieve the action**		**Steps taken**	► Decree on the measures for support of electricity generation from renewable energy sources adopted (5.04.2019). ► Decision on the total installed capacity for preferential producers of electricity adopted (5.04.2019). ► Public call on awarding an agreement for right to use premium for electric power produced from photovoltaic power plant constructed on land owned by the Republic of North Macedonia (21.07.2019) ► Public call on awarding the right to use a premium for electricity generated and sold from photovoltaic power plants built on land not owned by the Republic of North Macedonia or on land owned by the Republic of North Macedonia on which right to use has been established (2.10.2019) ► Electronic auction for both tenders
			Steps envisaged	► Construction of solar power plants ► New public call on awarding an agreement for right to use premium for electric power produced from photovoltaic power plant constructed on land owned by the Republic of North Macedonia ► New public call on awarding the right to use a premium for electricity generated and sold from photovoltaic power plants built on land not owned by the Republic of North Macedonia or on land owned by the Republic of North Macedonia on which right to use
	Energy savings	**Final energy**	**Per year**	n/a
			Cumulative	n/a
		Primary energy	**Per year**	► 0.0 ktoe in 2020 ► 21.5 ktoe in 2030 ► 175.7 ktoe in 2040 Additional benefit - decrease of net import: ► 0.0 ktoe in 2020 ► 53.3 ktoe in 2030 ► 209.5 ktoe in 2040
			Cumulative	► 0 ktoe in 2017-2020 ► 202.1 ktoe in 2021-2030 ► 577.8 ktoe in 2031-2040 Additional benefit decrease of net import: ► 0 ktoe in 2017-2020 ► 488.3 ktoe in 2021-2030 ► 932.4 ktoe in 2031-2040
	Estimated emission reductions			► 0 Gg CO2-eq in 2020 ► 162.6 Gg CO2-eq in 2030 ► 377.4 Gg CO2-eq in 2040
	Timeframe			2020 – 2040
	Finance			Budget: 240.6 M€ Source of finance: ► IPP, incentives from the central government budget Costs (2030): ► WOM: 1,122 M€ ► WEM: 1,121 M€ Specific costs (2030): ► -3.7 €/t CO_2-eq
	Implementing entity			► Government of the Republic of North Macedonia ► Energy Regulatory Commission ► Ministry of Economy ► Private investors
Progress indicators:				► Installed capacity (MW) ► Electricity generation (GWh) ► Emissions reductions (Gg CO2-eq)
				direct ***indirect***

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

Table A- 44: Biomass Power Plants (CHP Optional)

Mitigation action: Biomass power plants (CHP optional)				
Main objective: Increase of the domestic generation capacity from renewable energy sources *Description: Construction of biomass power plants (CHP optional) and with feed-in tariffs to stimulate the construction*				
Information	**Type**			Technical, regulatory
	Sector			Electricity producers
	Relevant planning documents, legal and regulatory acts			▶ Strategy for Energy Development of North Macedonia up to 2040 ▶ Strategy for Utilization of Renewable Energy Sources in the Republic of Macedonia ▶ Renewable Energy Action Plan ▶ Law on Energy ▶ Bylaws for renewable energy
	Gases			CO_2, CH_4, N_2O
	Methodology			Biomass power plants construction and preparation of regulation on feed-in premium tariffs. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
	Assumptions			Through stimulation with feed-in tariffs, it is envisaged that by 2040 biomass power plants with a capacity of 15 MW will be constructed.
Progress of implementation	**Steps taken or envisaged to achieve the action**		**Steps taken**	▶ Decree on the measures for support of electricity generation from renewable energy sources adopted (5.04.2019). ▶ Decision on the total installed capacity for preferential producers of electricity adopted (5.04.2019).
			Steps envisaged	Attract the investors
	Energy savings	**Final energy**	**Per year**	▶ n/a
			Cumulative	▶ n/a
		Primary energy	**Per year**	▶ 0.0 ktoe in 2020 ▶ 3.0 ktoe in 2030 ▶ 18.4 ktoe in 2040
			Cumulative	▶ 0.0 ktoe in 2020 ▶ 10.5 ktoe in 2030 ▶ 98.1 ktoe in 2040
	Estimated emission reductions			▶ 0 Gg CO2-eq in 2020 ▶ 21 Gg CO2-eq in 2030 ▶ 91.1 Gg CO2-eq in 2040
	Timeframe			2020– 2040
	Finance			Budget: 24.3 M€ Source of finance: ▶ IPP, incentives through consumer bills Costs (2030): ▶ WOM: 1,122 M€ ▶ WEM: 1,122 M€ Specific costs (2030): ▶ 5 €/t CO_2-eq
	Implementing entity			▶ Government of the Republic of North Macedonia ▶ Energy Regulatory Commission ▶ Ministry of Environment and Physical Planning ▶ Ministry of Economy, Energy Agency ▶ Private investors
Progress indicators:				▶ Installed capacity (MW) ▶ Electricity generation (GWh) ▶ Emissions reductions (Gg CO2-eq)
Contribution for the achievement of the SDGs:				***direct***: 7 AFFORDABLE AND CLEAN ENERGY ***indirect***: 12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION

Table A- 45: Solar Rooftop Power Plants

Mitigation action: Solar rooftop power plants

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

Description: Construction of solar rooftop power plants and the introduction of "prosumer" concept

Information	**Type**			Technical, regulatory			
	Sector			Household, industry and commercial sector			
	Relevant planning documents, legal and regulatory acts			► Strategy for Energy Development of North Macedonia up to 2040 ► Law on Energy ► Bylaws on renewable energy			
	Gases			CO_2, CH_4, N_2O			
	Methodology			Solar rooftop power plants construction. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.			
	Assumptions			The following capacities are envisioned to be constructed by 2040:			
					Reference	Moderate Transition	Green
				Solar (MW)	250	350	400
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**		► Rulebook on renewable energy sources adopted. ► Distribution grid code adopted			
		Steps envisaged		► Information campaigns			
	Energy savings	**Final energy**	**Per year**	n/a			
			Cumulative	n/a			
		Primary energy	**Per year**	ktoe	WEM	WAM	e-WAM
				2020	0.0	0.0	0.0
				2030	18.9	26.3	29.9
				2040	195.0	276.2	311.1
				Additional benefit - decrease of net import:			
				2020	0.0	0.0	0.0
				2030	35.1	50.2	57.7
				2040	223.7	316.6	356.8
			Cumulative	ktoe	WEM	WAM	e-WAM
				2017-2020	0.0	0.0	0.0
				2021-2030	90.2	126.0	144.2
				2031-2040	648.8	925.6	1058.0
				Additional benefit - decrease of net import			
				2017-2020	0.0	0.0	0.0
				2021-2030	169.9	240.7	276.1
				2031-2040	924.3	1309.2	1494.9
	Estimated emission reductions			Gg CO2-eq	WEM	WAM	e-WAM
				2020	1.95	2.8	3.2
				2030	100.4	142.9	164.3
				2040	392.44	552.7	627.2
	Timeframe			2020 – 2040			
	Finance			Budget	WEM	WAM	e-WAM
				M€	227.1	318.0	363.4
				Source of finance ► IPP, donors, subsidies from national and local budget, EE fund Costs (2030): ► WOM: 1,122 M€ ► e-WAM: 1,116 M€ Specific costs (2030): ► -33 €/t CO_2-eq			
	Implementing entity			► Government of the Republic of North Macedonia ► Energy Regulatory Commission ► Ministry of Economy, Energy Agency ► Elektrodustribucija Skopje ► Suppliers of electricity ► End-users of electricity			
Progress indicators:				► Installed capacity (MW) ► Electricity generation (GWh) ► Emissions reductions (Gg CO2-eq)			
					direct		***indirect***

Contribution for the achievement of the SDGs:	

Table A- 46: RES Without Incentives

Mitigation action: RES without incentives

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

Description: Construction of wind, solar and biogas power plants

Information

Type	Technical, regulatory
Sector	Electricity producers
Relevant planning documents, legal and regulatory acts	► Strategy for Energy Development of North Macedonia up to 2040 ► Law on Energy ► Bylaws for renewable energy
Gases	CO_2, CH_4, N_2O
Methodology	Wind, solar and biogas power plants construction. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
Assumptions	The following capacities by scenario without incentives are envisioned to be constructed by 2040:

Assumptions

	WEM	WAM	e-WAM
Wind (MW)	350	450	600
Solar (MW)	400	600	750
Biogas (MW)	10	10	10

Progress of implementation

Steps taken or envisaged to achieve the action	**Steps taken**	► Decree on the measures for support of electricity generation from renewable energy sources adopted (5.04.2019). ► Decision on the total installed capacity for preferential producers of electricity adopted (5.04.2019). ► Electricity grid code adopted ► Construction of 10MW Oslomej PV started ► Tender for Public Private Partnership for PV Oslomej of at least 80 MW announced
	Steps envisaged	Development of methodology for selection of best for location construction of solar and wind PP

Energy savings

Final energy	**Per year**	► n/a
	Cumulative	► n/a

Energy savings – Primary energy – Per year

ktoe	WEM	WAM	e-WAM
2020	0	0	0
2030	17.9	27.5	29.4
2040	515.5	656.8	846.4
Additional benefit - decrease of net import:			
2020	0	0	0
2030	43.1	65.7	70.5
2040	628.1	806.1	1039.4

Energy savings – Primary energy – Cumulative

ktoe	WEM	WAM	e-WAM
2017-2020	0	0	0
2021-2030	95.9	139.0	145.4
2031-2040	1626.4	2195.7	2685.3
Additional benefit - decrease of net import:			
2017-2020	0	0	0
2021-2030	225.5	324.7	339.8
2031-2040	2491.6	3404.0	4123.1

Estimated emission reductions

Gg CO2-eq	WEM	WAM	e-WAM
2020	0	0	0
2030	124.4	189.2	202.8
2040	1194.1	1587.6	2040.2

Timeframe: 2020 – 2040

Finance

Budget		WEM	WAM	e-WAM
	M€	777.0	1046.0	1325.4

Source of finance:
- ► Public-private partnerships, IPP, ESM

Costs (2030):
- ► WOM: 1,122 M€
- ► e-WAM: 1,121 M€

Specific costs (2030):
- ► -6 €/t CO_2-eq

Implementing entity	▶ Government of the Republic of North Macedonia ▶ Energy Regulatory Commission ▶ Ministry of Economy, Energy Agency ▶ JSC Macedonian Power Plants (ESM AD) ▶ Private investors
Progress indicators:	▶ Installed capacity (MW) ▶ Electricity generation (GWh) ▶ Emissions reductions (Gg CO2-eq)
Contribution for the achievement of the SDGs:	***direct***: 7 AFFORDABLE AND CLEAN ENERGY ***indirect***: 12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION

Table A- 47: Introduction of a CO2 Tax

Mitigation action: Introduction of CO_2 tax

Main objective: Penalize the CO_2 emitters

Description: Introduction of CO_2 tax in order to stimulate the investments in RES and to increase the penetration of energy efficiency measures

Information	**Type**			Regulatory
	Sector			Energy
	Relevant planning documents, legal and regulatory acts			▶ Strategy for Energy Development of North Macedonia up to 2040 ▶ Law on Energy ▶ Bylaws for renewable energy ▶ Law on Climate Change
	Gases			CO_2, CH_4, N_2O
	Methodology			Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions			Gradual introduction of CO_2 tax (2023 in WEM, 2025 in WAM and 2027 in e-WAM) based on the projected prices from WEO 2017.
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**		▶ Draft version of the Law on Climate Change ▶ Strategy for Energy Development of North Macedonia up to 2040
		Steps envisaged		▶ Adoption of the Law on Climate Change ▶ Adoption of the Strategy on Climate Action ▶ Adoption of the National Energy and Climate Plan ▶ Development of detailed CO_2 tax impact & legal assessment, taking into account the best practices from EU countries and countries in the region.
	Energy savings	**Final energy**	**Per year**	▶ n/a*
			Cumulative	▶ n/a*
		Primary energy	**Per year**	▶ n/a*
			Cumulative	▶ n/a*
	Estimated emission reductions			▶ n/a*
	Timeframe			2020– 2040
	Finance			▶ n/a
	Implementing entity			▶ Government of the Republic of North Macedonia ▶ Ministry of Environment and Physical Planning ▶ Ministry of Economy, Energy Agency ▶ Ministry of Finance
Progress indicators:				▶ Number of CO2 taxes issued per sectors ▶ Income achieved from CO2 taxes issued on annual bases /
Contribution for the achievement of the SDGs:				***direct***:  ***indirect***: 

* The exact contribution of this measure can not be calculated, as the implementation of this measure requires implementation of other measures (such as RES, energy efficiency, fuel switch etc.) which are needed to replace the CO_2 emitters.

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

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

Table A- 48: Energy Efficiency Obligation Schemes

Mitigation action: Energy efficiency obligation schemes

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

Information	**Type**			Technical, regulatory
	Sector			All sectors (excl. transport and part of the industry according to Annex I of the Directive 2003/87/EC)
	Relevant planning documents, legal and regulatory acts			Draft version of Law on energy efficiency Directive for EE
	Gases			CO_2, CH_4, N_2O
	Methodology			Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
	Assumptions			1. Final energy savings targets of: ► 0.5% in 2017 ► 0.7% in 2018 – 2020 ► 0.35% in 2021 – 2030 ► 0.2% in 2031 – 2040 of the average annual energy sales to final customers in the period 2014 – 2016 excluding the customers in the transport sector as well as industries of Annex I of the Directive 2003/87/EC 2. Up to 30% of the costs will be covered through subsidies by the distribution companies or suppliers.
Progress of implementation	**Steps taken or envisaged to achieve the action**		**Steps taken**	► Law on Energy Efficiency adopted
			Steps envisaged	► The process for development of the Decree for obligation scheme should start at the second half of 2020
	Energy savings	**Final energy**	**Per year**	► 13.2 ktoe in 2020 ► 44.4 ktoe in 2030 ► 87.6 ktoe in 2040
			Cumulative	► 46.6 ktoe in 2017- 2020 ► 291.1 ktoe in 2021- 2030 ► 672.5 ktoe in 2031- 2040
		Primary energy	**Per year**	► 10.8 ktoe in 2020 ► 67.8 ktoe in 2030 ► 306.6 ktoe in 2040
			Cumulative	► 51.3 ktoe in 2017- 2020 ► 487.0 ktoe in 2021- 2030 ► 1521.5 ktoe in 2031- 2040
	Estimated emission reductions			► 0 Gg CO2-eq in 2020 ► 162.8 Gg CO2-eq in 2030 Chapter 2 592.5 Gg CO2-eq in 2040
	Timeframe			2020 – 2040
	Finance			Budget: ► 182M€ Source of finance ► Consumers through their bills Costs (2030): ► WOM: 1,122 M€ ► WEM: 1,107 M€ Specific costs (2030): ► -88.7 €/t CO_2-eq
	Implementing entity			► Ministry of economy ► Distribution system operators ► Suppliers and traders of electricity and gas
Progress indicators:				► Energy savings (ktoe/GWh) ► Emissions reduction (Gg CO2-eq)
Contribution for the achievement of the SDGs:				***direct***: 7 AFFORDABLE AND CLEAN ENERGY ***indirect***: 12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION

Table A- 49: Solar Thermal Collectors

Mitigation action: Solar thermal collectors

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

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

Information	**Type**		Technical			
	Sector		Households and commercial sector			
	Relevant planning documents, legal and regulatory acts		► Strategy for Energy Development of North Macedonia up to 2040 ► Law on Energy ► Law on Energy Efficiency ► Bylaws for renewable energy ► Program for the promotion of renewable energy			
	Gases		CO_2, CH_4, N_2O			
	Methodology		Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology			
	Assumptions		Share of solar thermal collector in hot water useful demand in household/commercial sector by 2040:			
				WEM	WAM	e-WAM
			Share (%)	*10% / 8%*	*25% / 16%*	*45% / 30%*
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	Program for promotion of RES for 2020 adopted			
		Steps envisaged	Continuation of the incentive measures for solar thermal collectors installation			
	Energy savings – **Final energy**	**Per year**	ktoe	WEM	WAM	e-WAM
			2020	0.9	1.0	1.5
			2030	2.9	4.5	7.5
			2040	5.2	9.3	16.0
		Cumulative	ktoe	WEM	WAM	e-WAM
			2017-2020	3.0	3.2	3.7
			2021-2030	18.4	27.4	45.0
			2031-2040	42.1	70.4	120.8
	Energy savings – **Primary energy**	**Per year**	ktoe	WEM	WAM	e-WAM
			2020	0.9	1.0	1.4
			2030	2.6	5.4	10.7
			2040	33.0	59.8	98.1
		Cumulative	ktoe	WEM	WAM	e-WAM
			2017-2020	3.2	3.3	3.9
			2021-2030	17.6	34.7	68.2
			2031-2040	108.1	215.4	378.3
	Estimated emission reductions		Gg CO2-eq	WEM	WAM	e-WAM
			2020	0.2	0.4	0.7
			2030	1.3	7.2	21.5
			2040	39.5	90.8	165.4
	Timeframe		2020 – 2040			
	Finance		Budget	WEM	WAM	e-WAM
			M€	16.2	34.8	70.0
			Source of finance: ► Private, EE fund, incentives from the central government budget, donors Costs (2030): ► WOM: 1,121.9 M€ ► e-WAM: 1,121.8 M€ Specific costs (2030): ► -60 €/t CO_2-eq			
	Implementing entity		► Ministry of Economy, Energy Agency ► End-users			
Progress indicators:			► Number of installed solar collectors ► Average area per collector (m^2) ► Installed capacity (MW) ► Energy savings (ktoe/GWh) ► Emissions reduction (Gg CO2-eq)			
Contribution for the achievement of the SDGs:			***direct***		***indirect***	
			7 AFFORDABLE AND CLEAN ENERGY		12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION	

Table A- 50: Labeling of electric appliances and equipment

Mitigation action: Labeling of electric appliances and equipment				
Main objective: Penetration of appliances with higher efficiency (class A++, A+, A, B) *Description: Labelling of electric appliances and equipment to provide relevant information on the energy consumption of the products. The application of the labeling and eco-design of the products is necessary to ensure that the products sold in Macedonia comply with the EU regulations*				
Information	**Type**			Regulatory
	Sector			Household and commercial sector
	Relevant planning documents, legal and regulatory acts			► Strategy for Energy Development of North Macedonia up to 2040 ► Law on energy efficiency ► Third Energy Efficiency Action Plan ► Rulebook on labeling consumption of energy and other resources on devices using energy. ► Regulation on eco-design of products
	Gases			CO_2, CH_4, N_2O
	Methodology			Labeling of electric appliances and equipment. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions			As a result of this measure it is expected that by 2040 the share of energy efficient technologies will be 6% in the overall stock.
Progress of implementation	**Steps taken or envisaged to achieve the action**		**Steps taken**	New Rulebook on labeling consumption of energy and other resources on devices using energy adopted in September 2016 by the Ministry of Economy Draft version of the new Regulation on eco-design of products developed
			Steps envisaged	Adoption of the new Regulation on eco-design of products developed
	Energy savings	**Final energy**	**Per year**	► 4.6 ktoe in 2020 ► 19.0 ktoe in 2030 ► 40.0 ktoe in 2040
			Cumulative	► 17.8 ktoe in 2017-2020 ► 122.6 ktoe in 2021-2030 ► 291.1 ktoe in 2031-2040
		Primary energy	**Per year**	► 4.1 ktoe in 2020 ► 28.1 ktoe in 2030 ► 137.9 ktoe in 2040
			Cumulative	► 21.3 ktoe in 2017-2020 ► 197.6 ktoe in 2021-2030 ► 642.1 ktoe in 2031-2040
	Estimated emission reductions			► 13.1 Gg CO2-eq in 2020 ► 56.3 Gg CO2-eq in 2030 ► 236.7 Gg CO2-eq in 2040
	Timeframe			2020 – 2040
	Finance			Budget: 71 M€ Source of finance ► Private, EE fund Costs (2030): ► WOM: 1,121.9 M€ ► WEM: 1,117.1 M€ Specific costs (2030): ► -85.9 €/t CO_2-eq
	Implementing entity			► Ministry of Economy, Energy Agency ► Producers and suppliers of electrical equipment and household appliances ► End-users
Progress indicators:				► Number of devices sold (A++, A+, A, B) ► Energy savings (ktoe/GWh) ► Emissions reductions (Gg CO_2-eq)
Contribution for the achievement of the SDGs:				***direct***: 7 AFFORDABLE AND CLEAN ENERGY ***indirect***: 12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION

Table A- 51: Increased Use of Heat Pumps

Mitigation action: Increased use of heat pumps							
Main objective: More efficient use of electricity *Description: Phasing out heating devices with resistive heaters, as well as inefficient biomass stoves and their replacement with heat pumps in compliance with EU Climate and Energy Policy.*							
Information	**Type**			Regulatory, policy			
	Sector			Households and commercial sector			
	Relevant planning documents, legal and regulatory acts			► Strategy for Energy Development of North Macedonia up to 2040 ► Law on energy efficiency ► Third Energy Efficiency Action Plan ► EU Climate and Energy Policy			
	Gases			CO_2, CH_4, N_2O			
	Methodology			Adopting a Decision that will prevent the sale of heating devices with resistive heaters. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology			
	Assumptions			It is assumed that heating devices with resistive heaters will be gradually replaced with heat pumps. The share of heat pumps in useful heat demand is:			
					WEM	WAM	e-WAM
				Share (%)	14%	40%	55%
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**		/			
		Steps envisaged		Adopting a Decision to ban the sale of heating devices with resistive heaters.			
	Energy savings	**Final energy**	**Per year**	ktoe	WEM	WAM	e-WAM
				2020	21.4	31.9	48.0
				2030	56.1	84.7	139.3
				2040	114.4	176.3	256.1
			Cumulative	ktoe	WEM	WAM	e-WAM
				2017-2020	69.0	100.7	146.5
				2021-2030	401.6	594.4	933.8
				2031-2040	839.3	1320.7	2007.6
		Primary energy	**Per year**	ktoe	WEM	WAM	e-WAM
				2020	20.3	34.5	46.5
				2030	98.4	137.5	186.1
				2040	395.6	413.7	519.2
			Cumulative	ktoe	WEM	WAM	e-WAM
				2017-2020	91.0	138.3	187.6
				2021-2030	731.0	910.8	1192.2
				2031-2040	1976.6	2285.7	2873.1
	Estimated emission reductions			Gg CO2-eq	WEM	WAM	e-WAM
				2020	103.8	302.8	725.4
				2030	154.9	392.3	584.6
				2040	221.4	369.5	623.5
	Timeframe			2020 – 2040			
	Finance			Budget	WEM	WAM	e-WAM
				M€	235.0	330.6	474.4
				Source of finance: ► Private, EE fund, incentives from the central and local government budget, donors Costs (2030): ► WOM: 1,121.9 M€ ► e-WAM: 1,092.4 M€ Specific costs (2030): ► -79.9 €/t CO_2-eq			
	Implementing entity			► Ministry of Economy, Energy Agency ► End-users			
Progress indicators:				► Number of heat pump sold ► Energy savings (ktoe/GWh) ► Emissions reduction (Gg CO2-eq))			
Contribution for the achievement of the SDGs:				***direct***: 7 AFFORDABLE AND CLEAN ENERGY		***indirect***: 12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION	

Table A- 52: Public Awareness Campaigns and Network of Energy Efficiency (EE) info Centers

Mitigation action: Public awareness campaigns and network of energy efficiency (EE) info centers

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

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

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

Information	**Type**			Information			
Information	**Sector**			Household and commercial consumers			
Information	**Relevant planning documents, legal and regulatory acts**			► Strategy for Energy Development of North Macedonia up to 2040 ► Law on energy efficiency			
Information	**Gases**			CO_2, CH_4, N_2O			
Information	**Methodology**			Conducting information campaigns and opening information centers for energy efficiency. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology			
Information	**Assumptions**			Investment in public awareness rising campaigns that will increase the share of more efficient appliances (with higher class of efficiency) in overall stock by 2040 to:			
Information	**Assumptions**				WEM	WAM	e-WAM
Information	**Assumptions**			*Share (%)*	20	30	40
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**		► Platform for energy efficiency, for education of the population and journalists and experience sharing of the private sector for successfully implemented EE measures implemented. ► Info Center for Energy of the City of Skopje opened. ► Free advices to the customers for reasonable consumption of electricity enabled by EVN's Customer Service Centre			
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps envisaged**		► Broadcasting of TV spots, announcements, campaigns and documentary films ► Extension of the Platform for energy efficiency ► Continuous work of the existing and opening new information centers.			
Progress of implementation	**Energy savings**	**Final energy**	**Per year**	ktoe	WEM	WAM	e-WAM
				2020	15.6	17.8	24.3
				2030	48.2	53.2	67.8
				2040	90.0	96.3	110.4
			Cumulative	ktoe	WEM	WAM	e-WAM
				2017-2020	54.4	61.0	706.4
				2021-2030	332.9	371.5	758.6
				2031-2040	706.4	479.3	896.8
		Primary energy	**Per year**	ktoe	WEM	WAM	e-WAM
				2020	12.7	14.6	20.2
				2030	75.3	81.8	99.7
				2040	345.9	379.1	416.3
			Cumulative	ktoe	WEM	WAM	e-WAM
				2017-2020	60.0	67.3	88.9
				2021-2030	558.6	611.1	746.1
				2031-2040	1716.2	1890.8	2138.8
	Estimated emission reductions			Gg CO2-eq	WEM	WAM	e-WAM
				2020	41.6	45.3	56.6
				2030	169.7	177.0	201.5
				2040	641.3	201.5	716.4
	Timeframe			2020 – 2040			
	Finance	Budget			WEM	WAM	e-WAM
				M€	2	4	8
		Cost of investment in advanced technologies			WEM	WAM	e-WAM
				M€	630	658	704
		Source of finance ► Private sector, donors, central and local governments Costs (2030): ► WOM: 1,121.9 M€ ► e-WAM: 1,100.3 M€					

		Specific costs (2030): ► -107.6 €/t CO_2-eq
	Implementing entity	► Ministry of Economy, Energy Agency ► Energy suppliers ► End-users
Progress indicators:		► Number of devices sold (A++, A+, A) ► Energy savings (ktoe/GWh) ► Emissions reductions (Gg CO_2-eq)
Contribution for the achievement of the SDGs:		***direct***: 7 AFFORDABLE AND CLEAN ENERGY ***indirect***: 12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION

Table A- 53: Retrofitting of Existing Residential Buildings

Mitigation action: Retrofitting of existing residential buildings

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

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

Information	**Type**	Technical, regulatory
	Sector	Households
	Relevant planning documents, legal and regulatory acts	► Strategy for Energy Development of North Macedonia up to 2040 ► Law on energy efficiency
	Gases	CO_2, CH_4, N_2O
	Methodology	Retrofitting of existing residential buildings. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions	The existing residential buildings, while meet the standard for at least C class (90 kWh/m2). The following capacities annual renovation rates are considered:

	WEM	WAM	e-WAM
%	1	1	2

Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► 31 buildings for collective housing were renovated (EE measures implemented) under the USAID/Habitat Project for residential energy efficiency. ► Financial support for rehabilitation of buildings for collective housing with implementation of EE measures provided by some municipalities ► Call for applications for reimbursement of 50% of the costs for windows replacement and installation of PVC and aluminum windows, but not more than 500 €, provided by the Ministry of Economy ► Law on Energy Efficiency adopted
		Steps envisaged	► National Building Renovation Strategy ► Establishment of an Energy Efficiency Fund

Energy savings					
Final energy	**Per year**	ktoe	WEM	WAM	e-WAM
		2020	3.7	3.7	8.1
		2030	27.9	27.9	42.0
		2040	57.9	57.9	107.2
	Cumulative	ktoe	WEM	WAM	e-WAM
		2017-2020	7.5	7.5	11.8
		2021-2030	145.0	145.0	232.0
		2031-2040	437.4	437.4	750.0
Primary energy	**Per year**	ktoe	WEM	WAM	e-WAM
		2020	3.8	3.8	8.3
		2030	33.6	33.6	50.4
		2040	126.3	126.3	255.0
	Cumulative	ktoe	WEM	WAM	e-WAM
		2017-2020	8.2	8.2	12.6
		2021-2030	177.6	177.6	282.3
		2031-2040	654.2	654.2	1123.7

Estimated emission reductions	Gg CO2-eq	WEM	WAM	e-WAM
	2020	3.3	3.3	7.1
	2030	49.0	49.0	73.0
	2040	178.3	178.3	352.5

Timeframe	2020 – 2040

Finance				
Budget		WEM	WAM	e-WAM
	M€	941.8	941.8	1708.2

Source of finance:
- ► Private, donors through commercial EE loans, EE fund

Costs (2030):
- ► WOM: 1,121.9 M€
- ► e-WAM: 1,127.8 M€

Specific costs (2030):
- ► 88.6 €/t CO_2-eq

Implementing entity	► Ministry of Economy, Energy Agency ► Donors and financial institutions ► Households
Progress indicators:	► Area retrofitted (m^2) ► Energy consumption per heated/cooled area (kWh/m^2) ► Energy savings (ktoe/GWh) ► Emissions reduction (Gg CO2-eq)

	direct	indirect
Contribution for the achievement of the SDGs:	7 AFFORDABLE AND CLEAN ENERGY	1 NO POVERTY; 12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION

Table A- 54: Retrofitting of Existing Central Government Buildings

Mitigation action: Retrofitting of existing central government buildings

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

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

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

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

<table>
<tr><td rowspan="6">Information</td><td colspan="3">**Type**</td><td colspan="4">Technical, regulatory</td></tr>
<tr><td colspan="3">**Sector**</td><td colspan="4">Central government buildings</td></tr>
<tr><td colspan="3">**Relevant planning documents, legal and regulatory acts**</td><td colspan="4">▶ Strategy for Energy Development of North Macedonia up to 2040
▶ Law on energy efficiency</td></tr>
<tr><td colspan="3">**Gases**</td><td colspan="4">CO_2, CH_4, N_2O</td></tr>
<tr><td colspan="3">**Methodology**</td><td colspan="4">Retrofitting of existing public buildings. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.</td></tr>
<tr><td colspan="3">**Assumptions**</td><td colspan="4">Annual renovation rate of the existing central government buildings:
<table><tr><td></td><td>WEM</td><td>WAM</td><td>e-WAM</td></tr><tr><td>Rate (%)</td><td>1</td><td>2</td><td>3</td></tr></table></td></tr>
<tr><td rowspan="30">Progress of implementation</td><td colspan="2" rowspan="2">**Steps taken or envisaged to achieve the action**</td><td>**Steps taken**</td><td colspan="4">▶ Draft National Program for energy efficiency in public buildings in the Republic of Macedonia (Phase I) was developed under the GEF Sustainable Energy Project
▶ “Resilient Skopje” – Climate Change Strategy for the City of Skopje developed.</td></tr>
<tr><td>**Steps envisaged**</td><td colspan="4">▶ National Building Renovation Strategy to be developed and adapted
▶ Establishment of an Energy Efficiency Fund</td></tr>
<tr><td rowspan="16">**Energy savings**</td><td rowspan="8">**Final energy**</td><td rowspan="4">**Per year**</td><td>ktoe</td><td>WEM</td><td>WAM</td><td>e-WAM</td></tr>
<tr><td>2020</td><td>0.1</td><td>0.3</td><td>0.4</td></tr>
<tr><td>2030</td><td>1.5</td><td>3.2</td><td>4.8</td></tr>
<tr><td>2040</td><td>3.3</td><td>6.7</td><td>10.1</td></tr>
<tr><td rowspan="4">**Cumulative**</td><td>ktoe</td><td>WEM</td><td>WAM</td><td>e-WAM</td></tr>
<tr><td>2017-2020</td><td>0.1</td><td>0.2</td><td>0.3</td></tr>
<tr><td>2021-2030</td><td>8.9</td><td>18.4</td><td>28.0</td></tr>
<tr><td>2031-2040</td><td>24.6</td><td>50.5</td><td>76.4</td></tr>
<tr><td rowspan="8">**Primary energy**</td><td rowspan="4">**Per year**</td><td>ktoe</td><td>WEM</td><td>WAM</td><td>e-WAM</td></tr>
<tr><td>2020</td><td>0.1</td><td>0.3</td><td>0.4</td></tr>
<tr><td>2030</td><td>2.1</td><td>4.3</td><td>6.6</td></tr>
<tr><td>2040</td><td>9.6</td><td>20.8</td><td>32.2</td></tr>
<tr><td rowspan="4">**Cumulative**</td><td>ktoe</td><td>WEM</td><td>WAM</td><td>e-WAM</td></tr>
<tr><td>2017-2020</td><td>0.1</td><td>0.3</td><td>0.4</td></tr>
<tr><td>2021-2030</td><td>12.1</td><td>25.4</td><td>38.7</td></tr>
<tr><td>2031-2040</td><td>53.0</td><td>104.7</td><td>157.4</td></tr>
<tr><td colspan="3" rowspan="4">**Estimated emission reductions**</td><td>Gg CO2-eq</td><td>WEM</td><td>WAM</td><td>e-WAM</td></tr>
<tr><td>2020</td><td>0.4</td><td>0.8</td><td>1.1</td></tr>
<tr><td>2030</td><td>6.1</td><td>12.6</td><td>19.2</td></tr>
<tr><td>2040</td><td>20.6</td><td>42.5</td><td>66.8</td></tr>
<tr><td colspan="3">**Timeframe**</td><td colspan="4">2020 – 2040</td></tr>
<tr><td colspan="3" rowspan="2">**Finance**</td><td colspan="4"><table><tr><td rowspan="2">Budget</td><td></td><td>WEM</td><td>WAM</td><td>e-WAM</td></tr><tr><td>M€</td><td>55</td><td>155</td><td>170</td></tr></table></td></tr>
<tr><td colspan="4">Source of finance:
▶ Central government budget, donors
Costs (2030):
▶ WOM: 1,121.9 M€
▶ e-WAM: 1,122.2 M€
Specific costs (2030):
▶ 17.5 €/t CO_2-eq</td></tr>
<tr><td colspan="3">**Implementing entity**</td><td colspan="4">▶ Ministry of Economy, Energy Agency
▶ Ministry of Finance
▶ Local self-government
▶ Municipal public enterprises
▶ Donors and financial institutions</td></tr>
</table>

Progress indicators:	▶ Area retrofitted (m^2) ▶ Energy consumption per heated/cooled area (kWh/m^2) ▶ Energy savings (ktoe/GWh) ▶ Emissions reduction (Gg CO2-eq)	
Contribution for the achievement of the SDGs:	***direct***	***indirect***
	7 AFFORDABLE AND CLEAN ENERGY	12 RESPONSIBLE CONSUMPTION AND PRODUCTION 13 CLIMATE ACTION

Table A- 55: Retrofitting of existing local self-government buildings

Mitigation action: Retrofitting of existing local self-government buildings

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

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

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

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

Information	**Type**			Technical, regulatory			
	Sector			Local self-government buildings			
	Relevant planning documents, legal and regulatory acts			▶ Strategy for Energy Development of North Macedonia up to 2040 ▶ Law on energy efficiency			
	Gases			CO_2, CH_4, N_2O			
	Methodology			Retrofitting of existing public buildings. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.			
	Assumptions			Annual renovation rate of the existing local self government buildings:			
					WEM	WAM	e-WAM
				Rate (%)	0.5	1	1.5
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**		▶ Draft National Program for energy efficiency in public buildings in the Republic of Macedonia (Phase I) was developed under the GEF Sustainable Energy Project ▶ "Resilient Skopje" – Climate Change Strategy for the City of Skopje developed ▶ Law on Energy Efficiency adopted			
		Steps envisaged		▶ National Building Renovation Strategy to be developed and adapted ▶ Establishment of an Energy Efficiency Fund			
	Energy savings	**Final energy**	**Per year**	ktoe	WEM	WAM	e-WAM
				2020	0.1	0.3	0.4
				2030	1.6	3.1	4.7
				2040	3.3	6.7	10.1
			Cumulative	ktoe	WEM	WAM	e-WAM
				2017-2020	0.1	0.3	0.4
				2021-2030	9.0	17.7	26.3
				2031-2040	25.2	50.7	76.6
		Primary energy	**Per year**	ktoe	WEM	WAM	e-WAM
				2020	0.1	0.3	0.4
				2030	2.2	4.4	6.7
				2040	14.1	27.0	39.5
			Cumulative	ktoe	WEM	WAM	e-WAM
				2017-2020	0.1	0.3	0.4
				2021-2030	12.8	25.4	37.8
				2031-2040	67.2	124.7	181.8
	Estimated emission reductions			Gg CO2-eq	WEM	WAM	e-WAM
				2020	0.4	0.7	1.1
				2030	6.6	13.2	19.8
				2040	26.9	52.6	78.3
	Timeframe			2020– 2040			
	Finance			Budget	WEM	WAM	e-WAM
				M€	50	100	150
				Source of finance: ▶ Local self-government budget, donors Costs (2030): ▶ WOM: 1,121.9 M€ ▶ e-WAM: 1,122.0 M€ Specific costs (2030): ▶ 4.9 €/t CO_2-eq			
	Implementing entity			▶ Ministry of Economy, Energy Agency ▶ Ministry of Finance ▶ Local self-government ▶ Municipal public enterprises ▶ Donors and financial institutions			
Progress indicators:				▶ Area retrofitted (m^2) ▶ Energy consumption per heated/cooled area (kWh/m^2) ▶ Energy savings (ktoe/GWh) ▶ Emissions reduction (Gg CO2-eq)			

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

Table A- 56: Retrofitting of existing commercial buildings

Mitigation action: Retrofitting of existing commercial buildings

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

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

Information	**Type**			Technical, regulatory
	Sector			Commercial sector
	Relevant planning documents, legal and regulatory acts			► Strategy for Energy Development of North Macedonia up to 2040 ► Law on energy efficiency
	Gases			CO_2, CH_4, N_2O
	Methodology			Retrofitting of existing commercial buildings. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology
	Assumptions			Annual renovation rate of 1.5% of the existing commercial buildings.
Progress of implementation	**Steps taken or envisaged to achieve the action**		**Steps taken**	► Law on Energy Efficiency adopted
			Steps envisaged	► Annual renovation rate of 1% for the existing commercial buildings
	Energy savings	**Final energy**	**Per year**	► 11.2 ktoe in 2020 ► 26.5 ktoe in 2030 ► 48.1 ktoe in 2040
			Cumulative	► 43.9 ktoe in 2017-2020 ► 183.0 ktoe in 2021-2030 ► 375.3 ktoe in 2031-2040
		Primary energy	**Per year**	► 10.8 ktoe in 2020 ► 35.7 ktoe in 2030 ► 179.4 ktoe in 2040
			Cumulative	► 41.5 ktoe in 2017-2020 ► 252.0 ktoe in 2021-2030 ► 843.0 ktoe in 2031-2040
	Estimated emission reductions			► 30.6 Gg CO2-eq in 2020 ► 98.2 Gg CO2-eq in 2030 ► 359.2 Gg CO2-eq in 2040
	Timeframe			2020 – 2040
	Finance			Budget: 530 M€ Source of finance: ► Private, donors through commercial EE loans, EE fund Costs (2030): ► WOM: 1,121.9 M€ ► WEM: 1,122.5 M€ Specific costs (2030): ► 6.3 €/t CO_2-eq
	Implementing entity			► Ministry of Economy, Energy Agency ► Ministry of Finance ► Commercial building owners
Progress indicators:				► Area retrofitted (m^2) ► Energy savings (ktoe/GWh) ► Emissions reduction (Gg CO2-eq)
Contribution for the achievement of the SDGs:				***direct***: 7 AFFORDABLE AND CLEAN ENERGY ***indirect***: 12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION

Table A- 57: Construction of new buildings

Mitigation action: Construction of new buildings

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

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

Information	**Type**		Technical, regulatory			
	Sector		Households			
	Relevant planning documents, legal and regulatory acts		► Strategy for Energy Development of North Macedonia up to 2040 ► Law on energy efficiency			
	Gases		CO_2, CH_4, N_2O			
	Methodology		Construction of new residential buildings. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.			
	Assumptions		Construction of new residential buildings, while meeting the standard for at least C class (90 kWh/m^2)			
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► Financial support for construction of new buildings at municipality level ► Law on Energy Efficiency adopted			
		Steps envisaged	► National Building Renovation Strategy to be developed and adapted ► Establishment of an Energy Efficiency Fund			
	Energy savings – Final energy	**Per year**	ktoe	WEM	WAM	e-WAM
			2020	2.1	2.0	2.0
			2030	15.9	12.0	12.0
			2040	30.5	15.6	15.6
		Cumulative	ktoe	WEM	WAM	e-WAM
			2017-2020	4.3	4.2	4.2
			2021-2030	82.8	68.3	68.3
			2031-2040	252.4	149.4	149.4
	Energy savings – Primary energy	**Per year**	ktoe	WEM	WAM	e-WAM
			2020	2.2	2.1	2.1
			2030	19.2	14.3	14.3
			2040	65.6	26.9	26.9
		Cumulative	ktoe	WEM	WAM	e-WAM
			2017-2020	4.7	4.6	4.6
			2021-2030	101.9	83.5	83.5
			2031-2040	364.1	186.9	186.9
	Estimated emission reductions		Gg CO2-eq	WEM	WAM	e-WAM
			2020	1.9	1.8	1.8
			2030	28.9	19.8	19.8
			2040	95.8	40.4	40.4
	Timeframe		2020 – 2040			
	Finance	Budget	M€	WEM: 474.1	WAM: 282.7	e-WAM: 282.7
			Source of finance: ► Private, donors through commercial EE loans, EE fund Costs (2030): ► WOM: 1,121.9 M€ ► e-WAM: 1,123.2 M€ Specific costs (2030): ► 64.6 €/t CO_2-eq			
	Implementing entity		► Ministry of Economy, Energy Agency ► Donors and financial institutions ► Investors (households)			
Progress indicators:			► Area (m^2) ► Energy savings (ktoe/GWh) ► Emissions reduction (Gg CO2-eq)			
Contribution for the achievement of the SDGs:			***direct***: 7 Affordable and clean energy		***indirect***: 1 No poverty; 12 Responsible consumption and production; 13 Climate action	

Table A- 58: Construction of passive buildings

Mitigation action: Construction of passive buildings							
Main objective: After 31.12.2020 all new building should be nearly zero-energy buildings *Description: The measure considers construction of new passive residential buildings in compliance with the EU Directive 2010/31/EU. This measure will provide issuing of certificates for energy performance of buildings, as a prerequisite for putting the building into operation*							
Information	**Type**			Technical, regulatory			
	Sector			Households			
	Relevant planning documents, legal and regulatory acts			► Strategy for Energy Development of North Macedonia up to 2040 ► Law on energy efficiency			
	Gases			CO_2, CH_4, N_2O			
	Methodology			ıpter 3 Construction of passive buildings. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.			
	Assumptions			Construction of new passive buildings, while meeting the standard for at least A+ class (15 kWh/m^2) starting from 2020 and continuously increasing their number so that in 2040, 85% of new buildings are assumed to be passive.			
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**		► Financial support for construction of new buildings at municipality level ► Law on Energy Efficiency adopted			
		Steps envisaged		► National Building Renovation Strategy to be developed and adapted ► Establishment of an Energy Efficiency Fund			
	Energy savings – **Final energy**	**Per year**		ktoe	WEM	WAM	e-WAM
				2020	0.0	0.0	0.0
				2030	0.0	8.5	8.5
				2040	0.0	30.0	30.0
		Cumulative		ktoe	WEM	WAM	e-WAM
				2017-2020	0.0	0.0	0.0
				2021-2030	0.0	36.5	36.5
				2031-2040	0.0	206.4	206.4
	Energy savings – **Primary energy**	**Per year**		ktoe	WEM	WAM	e-WAM
				2020	0.0	0.0	0.0
				2030	0.0	10.5	10.5
				2040	0.0	86.9	86.9
		Cumulative		ktoe	WEM	WAM	e-WAM
				2017-2020	0.0	0.0	0.0
				2021-2030	0.0	46.5	46.5
				2031-2040	0.0	382.9	382.9
	Estimated emission reductions			Gg CO2-eq	WEM	WAM	e-WAM
				2017-2020	0	0.3	0.3
				2021-2030	0	17.0	17.0
				2031-2040	0	123.2	123.2
	Timeframe			2020 – 2040			
	Finance			Budget	WEM	WAM	e-WAM
				M€	0.0	1068.0	1068.0
				Source of finance: ► Private, donors through commercial EE loans, EE fund, financial support for construction of new buildings at municipality level Costs (2030): ► WOM: 1,121.9 M€ ► e-WAM: 1,125.9 M€ Specific costs (2030): ► 231.2 €/t CO_2-eq			
	Implementing entity			► Ministry of Economy, Energy Agency ► Donors and financial institutions ► Investors (households)			
Progress indicators:				► Area (m^2) ► Energy savings (ktoe/GWh) ► Emissions reduction (Gg CO2-eq)			
Contribution for the achievement of the SDGs:				***direct***: 7 AFFORDABLE AND CLEAN ENERGY		***indirect***: 1 NO POVERTY; 12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION	

Table A- 59: Phasing out of incandescent lights

Mitigation action: Phasing out of incandescent lights

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

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

Information	**Type**	Regulatory, policy
	Sector	Households and commercial sector
	Relevant planning documents, legal and regulatory acts	▶ Strategy for Energy Development of North Macedonia up to 2040 ▶ Law on energy efficiency ▶ Commision Regulation(EC) No 244/2009 implementing Directive 2005/32/EC of the European Parlament and of the Council with regard to ecodesign requirements for non-directional household lamps
	Gases	CO_2, CH_4, N_2O
	Methodology	ıpter 4 Introducing a Regulation that will prohibit sales of incandescent light bulbs. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions	It is assumed that a Regulation will be adopted on prohibiting sales of incandescent light bulbs, its implementation will start in 2020, and it is assumed that there will be 2-3 years of transition period.
Progress of implementation	**Steps taken or envisaged to achieve the action** — **Steps taken**	/
	Steps taken or envisaged to achieve the action — **Steps envisaged**	Adoption of a Regulation that will prohibit sales of incandescent light bulbs.

Energy savings					
		ktoe	WEM	WAM	e-WAM
Final energy	**Per year**	2020	5.8	20.7	20.7
		2030	17.9	66.0	66.0
		2040	32.6	119.4	119.4
	Cumulative	ktoe	WEM	WAM	e-WAM
		2017-2020	23.8	66.2	66.2
		2021-2030	123.0	454.1	454.1
		2031-2040	255.5	959.7	959.7
Primary energy	**Per year**	ktoe	WEM	WAM	e-WAM
		2020	4.6	15.9	15.9
		2030	32.0	118.4	118.4
		2040	186.0	667.7	667.7
	Cumulative	ktoe	WEM	WAM	e-WAM
		2017-2020	27.1	80.1	80.1
		2021-2030	253.8	797.9	797.9
		2031-2040	812.6	3053.3	3053.3

Estimated emission reductions	Gg CO2-eq	WEM	WAM	e-WAM
	2020	22.7	99.9	99.9
	2030	102.7	401.8	401.8
	2040	390.3	1417.3	1417.3

Timeframe	2020 – 2040
Finance	Budget: M€ — WEM 177.6; WAM 558.0; e-WAM 558.0 Source of finance: ▶ Central government budget, private Costs (2030): ▶ WOM: 1,121.9 M€ ▶ e-WAM: 1,097.2 M€ Specific costs (2030): ▶ 61.5 €/t CO_2-eq
Implementing entity	▶ Government of the Republic of North Macedonia ▶ Ministry of Economy, Energy Agency ▶ End-users
Progress indicators:	▶ Number of bulbs sold (LED, CFL) ▶ Installed capacity (W) ▶ Electricity consumption (MWh) ▶ Energy savings (ktoe/GWh)

	► Emissions reduction (Gg CO_2-eq)	
Contribution for the achievement of the SDGs:	***direct***	***indirect***
		

Table A- 60: Improvement of the street lighting in the municipalities

Mitigation action: Improvement of the street lighting in the municipalities

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

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

Information	**Type**			Technical			
	Sector			Local self-government			
	Relevant planning documents, legal and regulatory acts			► Strategy for Energy Development of North Macedonia up to 2040 ► Law on energy efficiency			
	Gases			CO_2, CH_4, N_2O			
	Methodology			Replacement of the mercury lamps with sodium and LED lamps. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology			
	Assumptions			The improvement rate of street lighting by 2040:			
					WEM	WAM	e-WAM
				Rate (%)	60	60	100
3Progress of implementation	**Steps taken or envisaged to achieve the action**		**Steps taken**	► Street lighting at some location replaced ► Promotional activities for the implementation of public-private partnership (PPP) taken			
			Steps envisaged	► Continuing the promotional activities for the implementation of public-private partnership			
	Energy savings	**Final energy**	**Per year**	ktoe	WEM	WAM	e-WAM
				2020	2.5	2.5	3.2
				2030	6.6	6.6	7.8
				2040	9.1	9.1	9.6
			Cumulative	ktoe	WEM	WAM	e-WAM
				2017-2020	12.0	12.0	14.9
				2021-2030	46.4	46.4	59.7
				2031-2040	81.3	81.3	87.1
		Primary energy	**Per year**	ktoe	WEM	WAM	e-WAM
				2020	2.3	2.3	2.7
				2030	12.1	12.1	14.2
				2040	55.1	55.1	57.7
			Cumulative	ktoe	WEM	WAM	e-WAM
				2017-2020	15.0	15.0	18.0
				2021-2030	90.1	90.1	119.3
				2031-2040	259.9	259.9	276.1
	Estimated emission reductions			Gg CO2-eq	WEM	WAM	e-WAM
				2020	5.8	5.8	8.9
				2030	32.5	32.5	37.9
				2040	111.9	111.9	117.1
	Timeframe			2020 – 2040			
	Finance			Budget	WEM	WAM	e-WAM
				M€	19.5	19.5	25.3
				Source of finance ► Central and local government budget, ESCO Costs (2030): ► WOM: 1,121.9 M€ ► e-WAM: 1,119.2 M€ Specific costs (2030): ► -73.2 €/t CO_2-eq			
	Implementing entity			► Government of the Republic of North Macedonia ► Energy Regulatory Commission ► Ministry of Environment and Physical Planning ► Ministry of Economy, Energy Agency ► Local self-government			
Progress indicators:				► Number of bulbs replaced (LED, CFL) ► Installed capacity (W) ► Electricity consumption (MWh) ► Energy savings (ktoe/GWh) ► Emissions reduction (Gg CO2-eq)			
				direct		***indirect***	

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

Table A- 61: “Green procurements”

Mitigation action: “Green procurements”

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

Description: According to Article 6 from the EE Directive, central governments can purchase only products, services and buildings with high energy-efficiency performance. Intensified activities should take place to ensure legal and technical knowledge and skills of public sector entities for inclusion and evaluation of requirements for energy efficiency in public procurement procedures by applying the criteria of most economically advantageous tender.

Information	**Type**			Regulatory			
	Sector			Public bodies			
	Relevant planning documents, legal and regulatory acts			▶ Strategy for Energy Development of North Macedonia up to 2040 ▶ Law on energy efficiency			
	Gases			CO_2, CH_4, N_2O			
	Methodology			Implementation of energy efficiency criteria. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.			
	Assumptions			Increased rate of advanced energy efficiency technology due to public procurement:			
					WEM	WAM	e-WAM
				Rate (%)	5	5	7
3Progress of implementation	**Steps taken or envisaged to achieve the action**		**Steps taken**	▶ Law on Energy Efficiency adopted ▶ Law on Public procurements adopted			
			Steps envisaged	▶ By laws from the Law on Energy efficiency to be developed			
	Energy savings	**Final energy**	**Per year**	ktoe	WEM	WAM	e-WAM
				2020	0.2	0.2	0.3
				2030	1.8	1.8	2.5
				2040	4.2	4.2	5.9
			Cumulative	ktoe	WEM	WAM	e-WAM
				2017-2020	0.3	0.3	0.5
				2021-2030	10.0	10.0	14.1
				2031-2040	29.9	29.9	42.4
		Primary energy	**Per year**	ktoe	WEM	WAM	e-WAM
				2020	0.2	0.2	0.3
				2030	2.4	2.4	3.4
				2040	14.2	14.2	20.3
			Cumulative	ktoe	WEM	WAM	e-WAM
				2017-2020	0.4	0.4	0.5
				2021-2030	13.1	13.1	18.4
				2031-2040	64.6	64.6	91.8
	Estimated emission reductions			Gg CO2-eq	WEM	WAM	e-WAM
				2020	0.5	0.5	0.8
				2030	6.6	6.6	9.4
				2040	22.4	22.4	32.7
	Timeframe			2020 – 2040			
	Finance			Budget	WEM	WAM	e-WAM
				M€	16	16	24
				Source of finance ▶ Central and local government budget Costs (2030): ▶ WOM: 1,121.9 M€ ▶ e-WAM: 1,121.8 M€ Specific costs (2030): ▶ -61.2 €/t CO_2-eq			
	Implementing entity			▶ Ministry of Economy, Energy Agency ▶ Public Procurement Bureau ▶ Local self-government			
Progress indicators:				▶ Number of devices purchase (A++, A+, A) ▶ Energy savings (ktoe/GWh) ▶ Emissions reductions (Gg CO_2-eq)			
Contribution for the achievement of the SDGs:				***direct***		***indirect***	
				7 AFFORDABLE AND CLEAN ENERGY		12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION	

Table A- 62: Increased use of central heating systems

Mitigation action: Increased use of central heating systems				
Main objective: Reduction of local air pollution, as household heating is one of the main sources for local pollution. *Description: Increased use of the existing central heating systems through the implementation of information campaigns for connecting new consumers, including those who have been disconnected from the system in the past.*				
Information	**Type**			Technical, information
	Sector			Households and commercial
	Relevant planning documents, legal and regulatory acts			▶ Strategy for Energy Development of North Macedonia up to 2040 ▶ Law on energy efficiency ▶ Study for determining the techno-economic optimal and environmentally sustainable structure of heating and implementation of the central supply of sanitary hot water in the City of Skopje
	Gases			CO_2, CH_4, N_2O
	Methodology			apter 5 Implementation of information campaigns. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions			Information campaigns will contribute to maximize the utilization of the existing network as well as to enable construction of new network, which will increase the heat consumption for for at least 40%.
Progress of implementation	**Steps taken or envisaged to achieve the action**		**Steps taken**	▶ Studies for analysis of the central heating system and implementation of central supply of sanitary hot water developed ▶ Information campaigns for re-connection of the previously disconnected consumers and attraction of new consumers implemented ▶ Reduced the VAT from 18% to 5%
			Steps envisaged	▶ Continuing the implementation of the information campaigns
	Energy savings	**Final energy**	**Per year**	▶ 0.4 ktoe in 2020 ▶ 1.3 ktoe in 2030 ▶ 13.3 ktoe in 2040
			Cumulative	▶ 0.4 ktoe in 2020 ▶ 10.5 ktoe in 2030 ▶ 51.0 ktoe in 2040
		Primary energy	**Per year**	▶ 0.7 ktoe in 2020 ▶ 2.1 ktoe in 2030 ▶ 26.3 ktoe in 2040
			Cumulative	▶ 0.7 ktoe in 2020 ▶ 4.1 ktoe in 2030 ▶ 190 ktoe in 2040
	Estimated emission reductions			▶ 4 Gg CO2-eq in 2020 ▶ 9.3 Gg CO2-eq in 2030 ▶ 560 Gg CO2-eq in 2040
	Timeframe			2020 – 2040
	Finance			Budget: 3.2 M€ Source of finance: ▶ Private, EE fund, incentives from the central and local government budget Costs (2030): ▶ WOM: 1,121.9 M€ ▶ WEM: 1,120.9 M€ Specific costs (2030): ▶ -105.6 €/t CO_2-eq
	Implementing entity			▶ Ministry of Economy, Energy Agency ▶ Balkan energy Dooel Skopje ▶ JSC Skopje Sever ▶ “Energetika” –Skopje, subsidiary to JSC Macedonian Power Plants (ESM AD) ▶ Private investors
Progress indicators:				▶ Increase of heat consumption (form central heating systems) (GWh) ▶ Increase in the number of consumers connected to the central heating system ▶ Emissions reduction (Gg CO2-eq)
Contribution for the achievement of the SDGs:				***direct*** ***indirect***

Energy -- Manufacturing industries and construction

In the subcategory Manufacturing industries and construction three measures are modelled and analyzed. The most relevant information for these measures/policies is given in the tables below.

Table A- 63: Energy management in manufacturing industries

Mitigation action: Energy management in manufacturing industries				
Main objective: Efficient management of manufacturing processes in the industry aiming to increase production using the same energy consumption. *Description: This measure considers the implementation of obligatory energy audits of large companies and implementation of ISO 50001 standard, as well as advanced measurement and introduction of new IT technologies. This will enable prevention of defects, better process control and quicker response times in manufacturing using advanced data analysis and predictive technologies.*				
Information	**Type**			Regulatory, technical
	Sector			Industry
	Relevant planning documents, legal and regulatory acts			▶ Strategy for Energy Development of North Macedonia up to 2040 ▶ Law on energy efficiency
	Gases			CO_2, CH_4, N_2O
	Methodology			Implementation of the ISO 50001 standard. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions			Improvement of the systems efficiency in manufacturing industries at annual rate of 0.15%.
Progress of implementation	**Steps taken or envisaged to achieve the action**		**Steps taken**	▶ Promotion of ISO 50001 standards completed ▶ Training on implementation of energy management in industry organized ▶ Certificates for energy auditors issued ▶ USAID project for energy management in the industry realized in 17 companies ▶ UNIDO/GEF Project in which one of the activities is Program for energy management in industrial companies according to ISO 50001 standard and the UNIDO Methodology. Initial results achieved in 12 companies and additionally Program for replications of the energy management systems realized in 5 companies.
			Steps envisaged	▶ Continuation of the implementation of ISO 50001 standard in more industrial companies (manufacturing industries). ▶ Implementation of obligatory energy audits.
	Energy savings	**Final energy**	**Per year**	▶ 0.9 ktoe in 2020 ▶ 15.7 ktoe in 2030 ▶ 43.4 ktoe in 2040
			Cumulative	▶ 0.9 ktoe in 2017-2020 ▶ 84.1 ktoe in 2021-2030 ▶ 290.8 ktoe in 2031-2040
		Primary energy	**Per year**	▶ 0.9 ktoe in 2020 ▶ 18.8 ktoe in 2030 ▶ 103.7 ktoe in 2040
			Cumulative	▶ 0.9 ktoe in 2017-2020 ▶ 105.6 ktoe in 2021-2030 ▶ 474.2 ktoe in 2031-2040
	Estimated emission reductions			▶ 2.9 Gg CO2-eq in 2020 ▶ 67.8 Gg CO2-eq in 2030 ▶ 259.3 Gg CO2-eq in 2040
	Timeframe			2020 – 2040
	Finance			Budget: Negligible (the implementation of ISO 500001 is 0.15 mill. EUR/big company[25]) Source of finance ▶ Private, donors through commercial EE loans Costs (2030): ▶ WOM: 1,121.9 M€ ▶ WEM: 1,118.8 M€ Specific costs (2030): ▶ -45.7 €/t CO_2-eq
	Implementing entity			▶ Ministry of Economy, Energy Agency ▶ Private companies
Progress indicators:				▶ Energy savings (ktoe/GWh) ▶ Emissions reduction (Gg CO2-eq)
Contribution for the achievement of the SDGs:				***direct***: 7 AFFORDABLE AND CLEAN ENERGY ***indirect***: 12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION

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

Table A- 64: Introduction of efficient electric motors

Mitigation action: Introduction of efficient electric motors

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

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

Information	**Type**	Technical
	Sector	Industry
	Relevant planning documents, legal and regulatory acts	▶ Strategy for Energy Development of North Macedonia up to 2040 ▶ Law on energy efficiency
	Gases	CO_2, CH_4, N_2O
	Methodology	Installation of efficient electric motors. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions	It is envisaged that the share of efficient electric motors by 2040 will be

	WEM	WAM	e-WAM
Share (%)	40	40	60

Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	New efficient electric motors installed in a number of companies.
		Steps envisaged	Replacement of the existing electric motors from the production processes in the industry facilities in Macedonia with more efficient ones

Energy savings			WEM	WAM	e-WAM
Final energy – **Per year**	ktoe				
	2020		0.1	0.1	0.3
	2030		2.5	2.5	5.0
	2040		7.1	7.1	7.9
Final energy – **Cumulative**	ktoe				
	2017-2020		0.1	0.1	0.3
	2021-2030		13.0	13.0	25.9
	2031-2040		46.9	46.9	64.2
Primary energy – **Per year**	ktoe				
	2020		0.2	0.2	0.3
	2030		4.1	4.1	7.8
	2040		35.6	35.6	39.9
Primary energy – **Cumulative**	ktoe				
	2017-2020		0.2	0.2	0.3
	2021-2030		24.8	24.8	46.2
	2031-2040		134.4	134.4	168.4

Estimated emission reductions	Gg CO2-eq	WEM	WAM	e-WAM
	2020	0.4	0.4	0.7
	2030	14.9	14.9	28.8
	2040	74.7	74.7	83.8
Timeframe	2020 – 2040			
Finance	Budget M€	99.7 (WEM)	99.7 (WAM)	113.0 (e-WAM)
	Source of finance ▶ Private, donors through commercial EE loans Costs (2030): ▶ WOM: 1,121.9 M€ ▶ e-WAM: 1,121.3 M€ Specific costs (2030): ▶ -21.7 €/t CO_2-eq			
Implementing entity	▶ Ministry of Economy, Energy Agency ▶ Private companies			
Progress indicators:	▶ Number of motors replaced ▶ Electricity consumption (GWh) ▶ Energy savings (ktoe/GWh) ▶ Emissions reduction (Gg CO2-eq)			

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

Table A- 65: Introduction of more advanced technologies

Mitigation action: Introduction of more advanced technologies

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

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

Information	**Type**	Technical
	Sector	Industry
	Relevant planning documents, legal and regulatory acts	► Strategy for Energy Development of North Macedonia up to 2040 ► Law on energy efficiency
	Gases	CO_2, CH_4, N_2O
	Methodology	Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions	The share of more advanced technologies , from all technologies, in the industry facilities in Macedonia by 2040 is:

	WEM	WAM	e-WAM
Share (%)	15	30	60

Progress of implementation

Steps taken or envisaged to achieve the action	**Steps taken**	► Construction of gas network in Macedonia ► Klechovce-Valve station 5 (Stip), finished in 2016 ► Valve station 5(Stip)-Negotino, finished in 2019
	Steps envisaged	► Finishing the construction of gas network in Macedonia ► Negotino (Kavadarci)-Bitola, 76.36% realized November 2019 ► Skopje-Tetovo-Gostivar, 53.1% realized November 2019 ► Gostivar-Kicevo, in a process of obtaining building permit (by 2022) ► Kicevo-Ohrid (to be finished by 2025) ► Valve station 5 (Stip)-Radovis-Strumica

Energy savings			ktoe	WEM	WAM	e-WAM
	Final energy	**Per year**	2020	1.8	4.1	6.7
			2030	13.4	38.7	59.4
			2040	32.5	89.0	119.2
		Cumulative	ktoe	WEM	WAM	e-WAM
			2017-2020	6.4	13.2	21.3
			2021-2030	82.6	234.7	380.0
			2031-2040	225.3	628.8	888.0
	Primary energy	**Per year**	ktoe	WEM	WAM	e-WAM
			2020	1.8	4.2	6.7
			2030	15.3	40.9	62.5
			2040	58.8	124.0	186.1
		Cumulative	ktoe	WEM	WAM	e-WAM
			2017-2020	6.8	14.1	22.4
			2021-2030	98.2	252.5	401.0
			2031-2040	306.2	736.3	1075.0

Estimated emission reductions	Gg CO2-eq	WEM	WAM	e-WAM
	2020	5	12	20
	2030	49.8	128.3	206.0
	2040	148.8	317.3	474.4

Timeframe	2020 – 2040

Finance			WEM	WAM	e-WAM
	Budget	M€	141.8	344.8	438.6

Source of finance:
- ► Private, donors through commercial EE loans, EE fund

Costs (2030):
- ► WOM: 1,121.9 M€
- ► e-WAM: 1,113.3 M€

Specific costs (2030):
- ► -42.1 €/t CO_2-eq

Implementing entity	► Government of the Republic of North Macedonia ► Ministry of Environment and Physical Planning ► Ministry of Economy, Energy Agency ► Private investors
Progress indicators:	► Installed capacity (MW) ► Energy consumption (GWh) ► Energy savings (ktoe/GWh) ► Emissions reduction (Gg CO2-eq)
	direct ***indirect***

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

Energy – Transport

In the Transport subcategory six measures in total are modelled and analyzed. The most relevant information for these measures/policies is given from the tables below.

Table A- 66: Increased use of the railway

Mitigation action: Increased use of the railway			
Main objective: Improve the energy efficiency in the transport sector using cheap and efficient railway transport. *Description: Although the rail transport is cheap, official statistical data show that in the last three years there is a downward trend. Using this mode of transport as one of the most efficient can also improve the competitiveness of the companies. Therefore, at least several listed measures should be implemented, aiming to return the utilization level of this transport as of three years ago, and further increase it. The measure includes: implement raising awareness campaigns, invest in stations (rehabilitation of existing ones) and improve the "access to the stations", increase the network security and expand the network coverage*			
Information	**Type**		Technical, information
	Sector		Transport
	Relevant planning documents, legal and regulatory acts		▶ National Transport Strategy ▶ Strategy for Energy Development of North Macedonia up to 2040
	Gases		CO_2, CH_4, N_2O
	Methodology		Conducting campaigns and modernization of the railway. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions		By 2040, 3% of the passenger kilometers of cars, 1% of passenger kilometers of busses and 6.6% of tonnes kilometers of heavy duty vehicles will be realized by railway transport.
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	▶ 150 freight cars and six compositions consisting of a locomotive and passenger cars were bought by the Government as part of a project with EBRD. ▶ Campaigns for cheaper/free driving of certain categories of passengers (young people, pensioners, etc.) carried out
		Steps envisaged	▶ Implement promotional campaigns for raising public awareness ▶ Continuing the campaigns for cheaper/free driving ▶ Enabling additional conditions for companies
	Energy savings – **Final energy**	**Per year**	▶ 7.9 ktoe in 2020 ▶ 14.8 ktoe in 2030 ▶ 23.2 ktoe in 2040
		Cumulative	▶ 23.9 ktoe in 2017-2020 ▶ 116.2 ktoe in 2021-2030 ▶ 192.6 ktoe in 2031-2040
	Energy savings – **Primary energy**	**Per year**	▶ 7.9 ktoe in 2020 ▶ 12.3 ktoe in 2030 ▶ 4.3 ktoe in 2040
		Cumulative	▶ 24.0 ktoe in 2017-2020 ▶ 94.8 ktoe in 2021-2030 ▶ 108.0 ktoe in 2031-2040
	Estimated emission reductions		▶ 25.7 Gg CO2-eq in 2020 ▶ 37.2 Gg CO2-eq in 2030 ▶ 24.3 Gg CO2-eq in 2040
	Timeframe		2020 – 2040
	Finance		Budget: 180.6 M€ Source of finance: ▶ Central government budget Costs (2030): ▶ WOM: 1,121.9 M€ ▶ WEM: 1,111.3 M€ Specific costs (2030): ▶ -286.2 €/t CO_2-eq
	Implementing entity		▶ Government of the Republic of North Macedonia ▶ Ministry of Transport and Communications ▶ Ministry of Economy, Energy Agency ▶ JSC Macedonian Railway Transport ▶ End-users ▶ Private companies
Progress indicators:			▶ Passenger km in railway transport (pkm) ▶ Tonnes km in railway transport (tkm) ▶ Energy savings (ktoe/GWh) ▶ Emissions reduction (Gg CO2-eq)
Contribution for the achievement of the SDGs:			***direct*** ***indirect***

Table A- 67: Renewing of the national car fleet

Mitigation action: Renewing of the national car fleet

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

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

Obligations of public institutions to purchase vehicles with low CO2 emissions (up to 90 gCO2/km by 2020 and 50 gCO2/km by 2025). The quantified effects of this measure should also be analytically modelled and mitigation costs assessed

Information

Type	Regulatory, policy, information
Sector	Transport
Relevant planning documents, legal and regulatory acts	► National Transport Strategy ► Strategy for Energy Development of North Macedonia up to 2040 ► Law on vehicles ► Law on vehicle tax
Gases	CO_2, CH_4, N_2O
Methodology	Introducing a Regulation that will prohibit the purchase of cars with a standard lower than EURO5. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
Assumptions	It is assumed that only new vehicles and vehicles not older than eight years will be sold, i.e. vehicles that meet EU standards such as CO2 emissions in 2020 of 95 g CO2/km, and 70 g CO2/km by 2025. In addition, advanced technologies such as diesel and gasoline HEV will be used with the following share in the total passenger km from cars by 2040:

	WEM	WAM	e-WAM
Share (%)	6	14	35

Progress of implementation

Steps taken or envisaged to achieve the action	
Steps taken	► Law on vehicles adopted (August 2019) ► Law on vehicle tax bylaws to be adopted
Steps envisaged	► Implementation of the program for subsidizing for purchasing vehicles stipulated in the Law on vehicles, ► Revision of the Law on excise duty to be prepared (excise duties of diesel fuel and petrol need to be gradually equalled), based on detailed analyzes on its impact on economy entities, population and society as a whole.

Energy savings

		ktoe	WEM	WAM	e-WAM
Final energy	**Per year**	2020	7.4	8.4	10.2
		2030	5.0	7.5	13.9
		2040	15.4	23.5	31.1
	Cumulative	ktoe	WEM	WAM	e-WAM
		2017-2020	13.0	16.0	21.9
		2021-2030	167.0	208.1	241.1
		2031-2040	31.0	57.3	140.3
Primary energy	**Per year**	ktoe	WEM	WAM	e-WAM
		2020	7.4	8.4	10.2
		2030	5.1	7.5	13.9
		2040	28.6	39.8	47.3
	Cumulative	ktoe	WEM	WAM	e-WAM
		2017-2020	13.1	16.0	21.9
		2021-2030	166.9	208.1	241.0
		2031-2040	72.7	116.7	199.7

Estimated emission reductions

Gg CO2-eq	WEM	WAM	e-WAM
2020	22.9	26.2	33.3
2030	16.0	24.0	43.1
2040	65.5	73.0	98.6

Timeframe: 2020– 2040

Finance

Budget		WEM	WAM	e-WAM
	M€	1599.5	1659.5	2167.7

Source of finance:
- ► Private, EE fund, incentives from the central government budget

Costs (2030):
- ► WOM: 1,121.9 M€
- ► e-WAM: 1,118.5 M€

Specific costs (2030):
- ► -78.1 €/t CO_2-eq

Implementing entity
- ► Government of the Republic of North Macedonia
- ► Ministry of Transport and Communications
- ► Ministry of Economy, Energy Agency
- ► End-users

Progress indicators:
- ► Number of vehicles per type

	► Energy savings (ktoe/GWh) ► Emissions reduction (Gg CO2-eq)	
Contribution for the achievement of the SDGs:	***direct***	***indirect***
	12 RESPONSIBLE CONSUMPTION AND PRODUCTION	7 AFFORDABLE AND CLEAN ENERGY 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE 13 CLIMATE ACTION

Table A- 68: Renewing of other national road fleet (light duty and heavy goods vehicles and buses)

Mitigation action: Renewing of other national road fleet (light duty and heavy goods vehicles and buses)

Main objective: Reduction of local air pollution (SO_2, NO_x, $PM_{2.5}$ etc.)

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

Information	**Type**			Regulatory, policy			
	Sector			Transport			
	Relevant planning documents, legal and regulatory acts			▶ National Transport Strategy ▶ Strategy for Energy Development of North Macedonia up to 2040 ▶ Law on vehicles ▶ Law on vehicle tax			
	Gases			CO_2, CH_4, N_2O			
	Methodology			Introducing a Regulation that will prohibit the purchase of cars with a standard lower than EURO6. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.			
	Assumptions			It is assumed that only new advanced vehicles such that meet EU standards for exhaust fumes will be sold.			
Progress of implementation	**Steps taken or envisaged to achieve the action**		**Steps taken**	▶ First phase (Kumanovo - Beljakovce) is under construction, 67% constructed at the end of 2019 ▶ Tender for the second phase is announced.			
			Steps envisaged	▶ First phase (Kumanovo - Beljakovce) to be finished by the end of 2020 ▶ Tender for the third phase to be announced.			
	Energy savings	**Final energy**	**Per year**	ktoe	WEM	WAM	e-WAM
				2020	0.2	0.2	0.2
				2030	20.3	20.3	20.8
				2040	46.5	46.5	47.9
			Cumulative	ktoe	WEM	WAM	e-WAM
				2017-2020	0.7	0.7	0.8
				2021-2030	40.7	40.7	43.6
				2031-2040	338.9	338.9	349.8
		Primary energy	**Per year**	ktoe	WEM	WAM	e-WAM
				2020	0.2	0.2	0.2
				2030	20.3	20.3	20.8
				2040	43.4	43.4	44.9
			Cumulative	ktoe	WEM	WAM	e-WAM
				2017-2020	0.7	0.7	0.8
				2021-2030	40.6	40.6	43.5
				2031-2040	332.9	332.9	343.8
	Estimated emission reductions			Gg CO2-eq	WEM	WAM	e-WAM
				2020	1.2	1.2	1.2
				2030	64.6	64.6	66.4
				2040	142.8	142.8	147.3
	Timeframe			2020 – 2040			
	Finance			Budget: ~2300 M€ Source of finance: ▶ Private Costs (2030): ▶ WOM: 1,121.9 M€ ▶ e-WAM: 1,116.5 M€ Specific costs (2030): ▶ -80.7 €/t CO_2-eq			
	Implementing entity			▶ Government of the Republic of North Macedonia ▶ Ministry of Transport and Communications ▶ Ministry of Interior Affairs ▶ Ministry of Economy, Energy Agency ▶ Private companies			
Progress indicators:				▶ Number of vehicles per type ▶ Energy savings (ktoe/GWh) ▶ Emissions reduction (Gg CO2-eq)			
Contribution for the achievement of the SDGs:				***direct***		***indirect***	

Table A- 69: Advanced mobility

Mitigation action: Advanced mobility

Main objective: Reduction of the local air pollution (SO_2, NO_x, $PM_{2.5}$ etc.)

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

Information	**Type**			Regulatory, technical, information
Information	**Sector**			Transport
Information	**Relevant planning documents, legal and regulatory acts**			▶ National Transport Strategy ▶ Strategy for Energy Development of North Macedonia up to 2040 ▶ Decisions made by municipalities to subsidize buying of new bicycles
Information	**Gases**			CO_2, CH_4, N_2O
Information	**Methodology**			Implementation of campaigns/subsidies, parking policies. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
Information	**Assumptions**			By 2040, 3% of short distance passenger kilometres will be replaced by walking, using bicycles or electric scooters.
Progress of implementation	**Steps taken or envisaged to achieve the action**		**Steps taken**	▶ Subsidies and campaigns for buying new bicycles/electric scooters implemented ▶ Systems for bicycles renting implemented ▶ Bicycles tracks constructed ▶ Zonal parking implemented ▶ New multi-level car parks constructed
Progress of implementation	**Steps taken or envisaged to achieve the action**		**Steps envisaged**	▶ Continue the implementation of the campaigns and subsidies for buying new bicycles and renting bicycles ▶ Continue the construction of new bicycles tracks
Progress of implementation	**Energy savings**	**Final energy**	**Per year**	▶ 0.7 ktoe in 2020 ▶ 1.2 ktoe in 2030 ▶ 2.0 ktoe in 2040
Progress of implementation	**Energy savings**	**Final energy**	**Cumulative**	▶ 2.2 ktoe in 2017-2020 ▶ 9.8 ktoe in 2021-2030 ▶ 15.8 ktoe in 2031-2040
Progress of implementation	**Energy savings**	**Primary energy**	**Per year**	▶ 0.7 ktoe in 2020 ▶ 1.2 ktoe in 2030 ▶ 2.0 ktoe in 2040
Progress of implementation	**Energy savings**	**Primary energy**	**Cumulative**	▶ 2.2 ktoe in 2017-2020 ▶ 9.8 ktoe in 2021-2030 ▶ 16.0 ktoe in 2031-2040
Progress of implementation	**Estimated emission reductions**			▶ 2.1 Gg CO2-eq in 2020 ▶ 3.6 Gg CO2-eq in 2030 ▶ 6.4 Gg CO2-eq in 2040
Progress of implementation	**Timeframe**			2020 – 2040
Progress of implementation	**Finance**			Budget: / Source of finance: ▶ Private, EE fund, incentives from the central and local government budget, donors Costs (2030): ▶ WOM: 1,121.9 M€ ▶ WEM: 1,118.4 M€ Specific costs (2030): ▶ -983.0 €/t CO_2-eq
Progress of implementation	**Implementing entity**			▶ Ministry of Economy, Energy Agency ▶ Local self-government ▶ End-users
Progress indicators:				▶ Number of bicycles/electric scooters ▶ Energy savings (ktoe/GWh) ▶ Emissions reduction (Gg CO2-eq)
Contribution for the achievement of the SDGs:				***direct***: 7 AFFORDABLE AND CLEAN ENERGY ***indirect***: 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE; 13 CLIMATE ACTION; 12 RESPONSIBLE CONSUMPTION AND PRODUCTION

Table A- 70: Construction of the railway to the Republic of Bulgaria

Mitigation action: Construction of the railway to the Republic of Bulgaria

Main objective: Connecting North Macedonia with Bulgaria and extending the export to external markets, not just in the neighboring countries but in the Southeast Europe and Turkey region, using the railway transport.

Description: Construction of the railway to the Republic of Bulgaria

Information	**Type**			Technical, policy
	Sector			Transport
	Relevant planning documents, legal and regulatory acts			▶ Work Program of the Government of the Republic of North Macedonia ▶ National Transport Strategy
	Gases			CO_2, CH_4, N_2O
	Methodology			Chapter 6 Construction of the railway. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.
	Assumptions			By 2040 up to 5% of the tonne kilometers (to the Republic of Bulgaria) of the heavy goods vehicles will be replaced by the railroad transport.
Progress of implementation	**Steps taken or envisaged to achieve the action**		**Steps taken**	▶ First phase (Kumanovo - Beljakovce) is under construction, 67% constructed at the end of 2019 ▶ Tender for the second phase is announced.
			Steps envisaged	▶ First phase (Kumanovo - Beljakovce) to be finished by the end of 2020 ▶ Tender for the third phase to be announced.
	Energy savings	**Final energy**	**Per year**	▶ 5.1 ktoe in 2020 ▶ 10.2 ktoe in 2030 ▶ 14.4 ktoe in 2040
			Cumulative	▶ 5.1 ktoe in 2017-2020 ▶ 79.9 ktoe in 2021-2030 ▶ 127.2 ktoe in 2031-2040
		Primary energy	**Per year**	▶ 5.0 ktoe in 2020 ▶ 8.2 ktoe in 2030 ▶ 4.7 ktoe in 2040
			Cumulative	▶ 5.0 ktoe in 2017-2020 ▶ 62.6 ktoe in 2021-2030 ▶ 65.7 ktoe in 2031-2040
	Estimated emission reductions			▶ 16.7 Gg CO2-eq in 2020 ▶ 24.6 Gg CO2-eq in 2030 ▶ 32.3 Gg CO2-eq in 2040
	Timeframe			2023– 2040
	Finance			Budget: 720 M€ (infrastructure+trains) Source of finance: ▶ Central government budget Costs (2030): ▶ WOM: 1,121.9 M€ ▶ WEM: 1,128.6 M€ Specific costs (2030): ▶ 270.0 €/t CO_2-eq
	Implementing entity			▶ Government of the Republic of North Macedonia ▶ Ministry of Transport and Communications ▶ Ministry of Economy, Energy Agency
Progress indicators:				▶ Energy savings (ktoe/GWh) ▶ Tonnes km in the railway transport (tkm) ▶ Emissions reduction (Gg CO2-eq)
Contribution for the achievement of the SDGs:				***direct***: 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE ***indirect***: 7 AFFORDABLE AND CLEAN ENERGY; 12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION

Table A- 71: Electrification of the transport

Mitigation action: Electrification of the transport

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

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

- *Based the methodologies for calculation of environmental taxes on CO2*
- *Direct subsidizing of electric vehicles, 5000 EUR in the period 2020-2023*
- *Reserve green parking in all public parking lots*
- *Obligation to place fast chargers at all gas stations on motorways (at every 100 km by 2020)*

<table>
<tr><td rowspan="11">Information</td><td colspan="3">Type</td><td colspan="4">Regulatory, policy, information</td></tr>
<tr><td colspan="3">Sector</td><td colspan="4">Transport</td></tr>
<tr><td colspan="3">Relevant planning documents, legal and regulatory acts</td><td colspan="4">► National Transport Strategy
► Strategy for Energy Development of North Macedonia up to 2040
► Law on vehicles
► Law on vehicle tax</td></tr>
<tr><td colspan="3">Gases</td><td colspan="4">CO_2, CH_4, N_2O</td></tr>
<tr><td colspan="3">Methodology</td><td colspan="4">apter 7 Introducing a Regulation that will prohibit the purchase of cars with a standard lower than EURO6. Bottom-up modeling and least-cost optimization using the MARKAL model. IPCC Methodology.</td></tr>
<tr><td colspan="3" rowspan="3">Assumptions</td><td colspan="4">It is envisaged that by 2040 the share of electric vehicles and "plug-in" hybrid electric vehicles in the total passenger km from cars will be:</td></tr>
<tr><td></td><td>WEM</td><td>WAM</td><td>e-WAM</td></tr>
<tr><td>Rate (%)</td><td>10</td><td>40</td><td>45</td></tr>
<tr><td colspan="7"></td></tr>
<tr><td colspan="7"></td></tr>
<tr><td colspan="7"></td></tr>
<tr><td rowspan="30">Progress of implementation</td><td colspan="2" rowspan="2">Steps taken or envisaged to achieve the action</td><td>Steps taken</td><td colspan="4">► Chargers installed at specific locations in the City of Skopje
► Law on vehicles adopted (August 2019)
► Law on vehicle tax and bylaws adopted
► Exemption from paying excise duty for electric vehicles</td></tr>
<tr><td>Steps envisaged</td><td colspan="4">► Development of studies for determining the best locations for installation of electric vehicles chargers from the aspect of the power grid.
► Money from the budget should be allocated for the realization of the Program for subsidizing new vehicles</td></tr>
<tr><td rowspan="16">Energy savings</td><td rowspan="8">Final energy</td><td rowspan="4">Per year</td><td>ktoe</td><td>WEM</td><td>WAM</td><td>e-WAM</td></tr>
<tr><td>2020</td><td>0.6</td><td>2.5</td><td>3.4</td></tr>
<tr><td>2030</td><td>5.2</td><td>22.5</td><td>30.5</td></tr>
<tr><td>2040</td><td>12.8</td><td>53.6</td><td>61.3</td></tr>
<tr><td rowspan="4">Cumulative</td><td>ktoe</td><td>WEM</td><td>WAM</td><td>e-WAM</td></tr>
<tr><td>2017-2020</td><td>0.6</td><td>3.4</td><td>3.4</td></tr>
<tr><td>2021-2030</td><td>33.0</td><td>201.8</td><td>201.8</td></tr>
<tr><td>2031-2040</td><td>87.6</td><td>465.5</td><td>464.5</td></tr>
<tr><td rowspan="8">Primary energy</td><td rowspan="4">Per year</td><td>ktoe</td><td>WEM</td><td>WAM</td><td>e-WAM</td></tr>
<tr><td>2020</td><td>0.6</td><td>2.5</td><td>3.4</td></tr>
<tr><td>2030</td><td>3.6</td><td>14.6</td><td>20.9</td></tr>
<tr><td>2040</td><td>-10.5</td><td>-67.3</td><td>-75.1</td></tr>
<tr><td rowspan="4">Cumulative</td><td>ktoe</td><td>WEM</td><td>WAM</td><td>e-WAM</td></tr>
<tr><td>2017-2020</td><td>0.6</td><td>2.5</td><td>3.3</td></tr>
<tr><td>2021-2030</td><td>21.7</td><td>92.9</td><td>131.2</td></tr>
<tr><td>2031-2040</td><td>64</td><td>10.9</td><td>-4.6</td></tr>
<tr><td colspan="3" rowspan="4">Estimated emission reductions</td><td>Gg CO2-eq</td><td>WEM</td><td>WAM</td><td>e-WAM</td></tr>
<tr><td>2020</td><td>1.9</td><td>8.2</td><td>11.3</td></tr>
<tr><td>2030</td><td>9.8</td><td>41.9</td><td>61.6</td></tr>
<tr><td>2040</td><td>-10.0</td><td>-61.4</td><td>-78.8</td></tr>
<tr><td colspan="3">Timeframe</td><td colspan="4">2020 – 2040</td></tr>
<tr><td colspan="3" rowspan="3">Finance</td><td rowspan="2">Budget</td><td>WEM</td><td>WAM</td><td>e-WAM</td></tr>
<tr><td>M€ 1201.7</td><td>4132.0</td><td>5058.5</td></tr>
<tr><td colspan="4">Source of finance:
► Private, EE fund, incentives from the central government budget
Costs (2030):
► WOM: 1,121.9 M€
► e-WAM: 1127.6 M€
Specific costs (2030):
► 91.8 €/t CO_2-eq</td></tr>
<tr><td colspan="3">Implementing entity</td><td colspan="4">► Government of the Republic of North Macedonia
► Ministry of Transport and Communications
► Ministry of economy</td></tr>
<tr><td colspan="7"></td></tr>
<tr><td colspan="7"></td></tr>
<tr><td colspan="7"></td></tr>
<tr><td colspan="7"></td></tr>
<tr><td colspan="4">Progress indicators:</td><td colspan="4">► Number of electric vehicles and PHEV
► Energy savings (ktoe/GWh)</td></tr>
</table>

	► Emissions reduction (Gg CO2-eq)	
Contribution for the achievement of the SDGs:	***direct***	***indirect***
	12 RESPONSIBLE CONSUMPTION AND PRODUCTION	7 AFFORDABLE AND CLEAN ENERGY; 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE; 11 SUSTAINABLE CITIES AND COMMUNITIES; 13 CLIMATE ACTION

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

AFOLU – Livestock

Table A- 72: Reduction of CH4 emissions from enteric fermentation

Mitigation action: Reduction of CH_4 emissions from enteric fermentation in dairy cows by 3%

Main objective: Decrease level of CH_4 emission from enteric fermentation in highly productive dairy cows

Description: By modification of the feed composition and nutrition practice in dairy cows, the emission of CH_4 due to enteric fermentation can be reduced by 20%. It is foreseen that the number of dairy cows under intensive farming system will be increased form present 1% to 30% in 2040. Because of highly productive cows involved the CH4 emission will also increase. But, with modification of feed content (adding carbohydrates, high quality forages and tannins) into TMR, the CH_4 emission will be decreased by 20%. The mitigation measure can be easily applied on dairy farms, by nutrition management. It is also cost effective; do not require additional subsidies or incentives. Practical training and demonstration for farmers will be sufficient.

Information	**Type**		Livestock, enteric fermentation in dairy cow
	Sector		AFLOU-Livestock
	Relevant planning documents, legal and regulatory acts		► Strategy for Agriculture Development ► IPARD program
	Gases		CH_4
	Methodology		Feed composition and nutrition management in up to 30% of dairy cows.
	Assumptions		► Increased number of highly productive dairy cows under intensive farming, ► Introduced modified TMR and nutrition management. ► Expected to be on organized in farms with more than 50 heads
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	TMR with partly modified feed composition in already used on two intensive farms that account about 1% of the dairy cow population
		Steps envisaged	► Development advisory package for TMR modified feed and nutrition management for the intensive dairy farms with more than 50 cows, ► Incentives for dissemination of the advisory package to target farmers, ► Monitoring of the effect of TMR modified feed and nutrition management, and further improvements.
	Estimated emission reductions		► 3.2 Gg CO2-eq in 2020 ► 35.0 Gg CO2-eq in 2030 ► 63.6 Gg CO2-eq in 2040
	Timeframe		2020 – 2040
	Finance		Budget: 0.2 mil. Euro Costs (2030): ► WOM: 0 M€ ► WEM: 0.01 M€ Specific costs (2030): ► 0.2 €/t CO_2-eq
	Implementing entity		► Ministry of Agriculture Forestry and Water Economy
Progress indicators:			► Number of farms (dairy cows as a percentage of the total population) used TMR modified feed and nutrition management on biannual base. ► Emissions reduction (Gg CO2-eq)
Contribution for the achievement of the SDGs:			***direct***: 2 ZERO HUNGER ***indirect***: 13 CLIMATE ACTION

Table A- 73: Reduction of N2O emissions from manure management in dairy cows by 20%

Mitigation action: Reduction of N_2O emissions from manure management in dairy cows by 20%			
Main objective: Decrease level of N_2O emission from manure management in highly productive dairy cows			
Description: By modification of the manure management in dairy cows, the emission of N_2O can be reduced up to 20%. It is foreseen that the number of dairy cows under intensive farming system with more than 50 heads will be increased form present 1% to 30% in 2040. All those farms will need to apply improved manure management in order to reduce N loss, and NxO emissions. Therefore, on farm manure management system needs to modify. The mitigation measure, consider on farm adaption on existing farms and moderate investments on newly established farms. It will require subsidies for adapting and incentives in farm design and construction.			
Information	**Type**		Livestock, manure management in dairy cow
	Sector		AFLOU-Livestock
	Relevant planning documents, legal and regulatory acts		► Law for Nature Protection ► IPARD program, ► Agro-ecology measures in national program
	Gases		N_2O; CH_4
	Methodology		Modified manure management in up to 30% of dairy cows.
	Assumptions		► Target group are the farms with more than 50 heads. The manure management practice is expected to be change from solid fraction (N loss factor 40), to below animal (N loss factor 28). It can be applied to 10% of the population and shift toward practice is expected to be done in 15% of the farms by 2025. The proportion of the high productive dairy cows is expected to reach 25% in 2040. In such action the reduction of the N_2O emissions in manure management on dairy cows will be up to 25% by 2040. ► Increased number of highly productive dairy cows under intensive farming, ► On farm modified manure management.
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► None
		Steps envisaged	► Adaption in manure management on intensive dairy farms with more than 50 cows, ► Design and construction of intensive dairy farms with more than 50 cows, ► Monitoring of the effect modified manure management in the intensive dairy farms with more than 50 cows.,
	Estimated emission reductions		► 0.2 Gg CO2-eq in 2020 ► 2.1 Gg CO2-eq in 2030 ► 3.9 Gg CO2-eq in 2040
	Timeframe		2020 – 2040
	Finance		Budget: 1 mil. Euro Costs (2030): ► WOM: 0 M€ ► WEM: 0.1 M€ Specific costs (2030): ► 13 €/t CO_2-eq
	Implementing entity		► Ministry of Agriculture Forestry and Water Economy
Progress indicators:			► Number of farms (dairy cows as a percentage of the total population) used modified manure management on 2-5 years base. ► Emissions reduction (Gg CO2-eq)
Contribution for the achievement of the SDGs:			***direct***: 2 ZERO HUNGER ***indirect***: 13 CLIMATE ACTION

Table A- 74: Reduction of N2O emissions from manure management in swine farms

Mitigation action: Reduction of NO_2 emissions from manure management in swine farms by 13%

Main objective: Decrease level of NO_2 emission from manure management in highly productive swine farms

Description: By modification of the manure management in swine farms, the emission of N_2O can be reduced up to 50%. It is foreseen that number of fatteners and number of fatteners per sow will increase, while the total number of sows will remain stable over period. Number of swine farms with more than 1000 fatteners and/or 350 sows will also increase and they need to adapt improved manure management system, in order to reduce N loss. In 2040 is expected that 90% of fatteners will be produced on those farms, accounting for 75% of sow in the country. The mitigation measure, consider on farm adaption on existing farms and moderate investments on newly established farms. It will require subsidies for adapting and incentives in farm design and construction.

Information	**Type**		Livestock, manure management in swine farms
	Sector		AFLOU-Livestock
	Relevant planning documents, legal and regulatory acts		► Law for Nature Protection ► IPARD program, ► Agro-ecology measures in national program
	Gases		N_2O; CH_4
	Methodology		Modified manure management in swine farms with more than 1000 fatteners and/or 350 sows
	Assumptions		► Swine production system is expected to shift towards intensification that will bring modification of the swine farms. The management practice is supposed to shift form solid manure towards below animal (practice that already exists on large swine farms). Then the fraction of N loss will be reduced by 50%. The implementation of shift will be slightly over years in category sows and finishing pigs (e.g. sows from 55% in 2020 to 75% in 2040; finishing pigs from 70% in 2020 to 92% in 2040 ► Increased number of highly productive swine farms with more than 1000 fatteners and/or 350 sows, ► On farm modified manure management
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► Existing swine farms with more than 1000 fatteners and/or 350 sows are working on modification in manure management system
		Steps envisaged	► Adaption in manure management on intensive swine farms with more than 1000 fatteners and/or 350 sows, ► Design and construction of intensive swine farms with more than 1000 fatteners and/or 350 sows, ► Monitoring of the effect modified manure management in the intensive swine farms with more than 1000 fatteners and/or 350 sows
	Estimated emission reductions		► 0 Gg CO2-eq in 2020 ► 0.4 Gg CO2-eq in 2030 ► 0.7 Gg CO2-eq in 2040
	Timeframe		2020 – 2040
	Finance		Budget: 1 mil. Euro Costs (2030): ► WOM: 0 M€ ► WEM: 0.05 M€ Specific costs (2030): ► 77.4 €/t CO_2-eq
	Implementing entity		► Ministry of Agriculture Forestry and Water Economy
Progress indicators:			► Number of farms (fatteners and sows as a percentage of the total population) used modified manure management on 2-5 years base. ► Emissions reduction (Gg CO2-eq)
Contribution for the achievement of the SDGs:			***direct***: 2 ZERO HUNGER ***indirect***: 13 CLIMATE ACTION

Table A- 75: Reduction of N2O emissions from manure in dairy cows by 20% for farms below 50 Livestock Units

Mitigation action: Reduction of N_2O emissions from manure in dairy cows by 20% for farms below 50 Livestock Units			
Main objective: Decrease level of N_2O emission from manure management in dairy cows on farm farms below 50 Livestock Units			
Description: By modification of the manure management in dairy cows, the emission of N_2O can be reduced up to 30%. In discussion with farmers, the most common system is dry manure management, where manure together with bedding (mostly wheat or barley straw) are taken out of the barn daily or within week. The manure than is composting on pile near the farm. Farmers do not use any cover of manure nor tanks for collecting liquid drainage of the pile. Fermentation is usually mixed where in bottom parts is anaerobic, but on the surface, due to aeration it is aerobic. Manure is used as fertilizer mostly within 2-3 months (depending on storage capacity on the farm and field availability). Depending on manure fermentation the loss of N can be up to 60%. The N loss and reduction of the N_2O emissions can be reached by prolonging fermentation period up to 6 months and covering the pile. Hence the measure is to support farmers with less than 50 cows to provide proper manure storage places for longer period.			
Information	**Type**		Livestock, manure management in dairy cow
Information	**Sector**		AFLOU-Livestock
Information	**Relevant planning documents, legal and regulatory acts**		► IPARD program, ► Agro-ecology measures in national program
Information	**Gases**		N_2O
Information	**Methodology**		Modified manure management in dairy cows.
Information	**Assumptions**		► Replaced low productive with high productive dairy cows, ► On farm modified manure management for farms with 10 to 50 cows. ► Dairy cow produce manure about 7% of the life weight per day. Milking cows are weighted between 500 and 650 kg, depending on breed and conditions. Heifers 1-2 year, calves 3-12 months and young calves 0-3 months are transformed into adult cow by coefficient 2, 4 and 10, respectively. For simplicity, animal units (AU) should be used as a base (1 AU = 500 kg). Based on usual feed consumption, bedding material (annual average use of 8% wheat/barley straw) it can be expected about 0.04 m^3 manure per AU/day. ► The manure has about 40% moisture and during the storage reduce volume for 40%. For the period of 6 months total volume of 5 m^3 per AU should be expected. For pile composting, a trench with clay or concreate floor with inclination of 4% is required. The pile needs to be protected from rainfall (either by roof or covered by plastic foil. Aeration is occurring when fresh manure is adding, taking care that old and already fermented one should be always on top. By prolonging manure storage and covering period the reduction of N_2O emission will be for 30% is expected.
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► None
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps envisaged**	► Provide incentives to build on farm manure storage place, ► Train farmers for BAT in manure management, ► Monitoring of the effect modified manure management.
Progress of implementation	**Estimated emission reductions**		► 0.1 Gg CO_2-eq in 2020 ► 0.7 Gg CO_2-eq in 2030 ► 1.2 Gg CO_2-eq in 2040
Progress of implementation	**Timeframe**		2020 - 2040
Progress of implementation	**Finance**		Budget: 1 mil. Euro Costs (2030): ► WOM: 0 M€ ► WEM: 0.1 M€ Specific costs (2030): ► 44.2 €/t CO_2-eq
Progress of implementation	**Implementing entity**		► Ministry of Agriculture Forestry and Water Economy
Progress indicators:			► Number of farms (dairy cows as a percentage of the total population) used modified manure management in 7 years. ► Emissions reduction (Gg CO2-eq)
Contribution for the achievement of the SDGs:			***direct*** ***indirect***

Land use and Agricultural subsector

On the base of the existing pan-European graphical data-set CORINE land cover, and DTM for the country, several categories of agricultural land on inclined terrain has been identified (5-15% and above 15% inclination). Areas that will be encompassed with mitigation measures were calculated on the base of the total areas under each land use category and capacities of the farmers and institutions to support the process of implementation of mitigation measures.

Table A- 76: Conversion of land use of field crops above 15% inclination

<table>
<tr><td colspan="4">Mitigation action: Conversion of land use of field crops above 15% inclination</td></tr>
<tr><td colspan="4">Main objective: To reduce the intensity of soil erosion and loss of soil organic matter</td></tr>
<tr><td colspan="4">Description: Cultivation of land on inclined terrain causes intensive processes of soil erosion and mineralization of sol organic matter. These processes lead to intensive decomposition of soil organic matter and emission of soil carbon into atmosphere. Conversion of such areas into perennial grassland (pastures, meadows) will significantly decrease intensity of soil organic matter depletion and emission of soil carbon and will lead to carbon sink. Areas above 15% inclination by law should not be cultivated and are not considered as agricultural land. This conversion supposes land use change and change of the production system, which might influence the net annual income of primary producers. Due to this, its implementation should be supported with incentives, especially in the first years of conversion, in order to bridge possible loss of incomes in farm holds.</td></tr>
<tr><td rowspan="6">Information</td><td colspan="2">Type</td><td>Land management and land use change in the category of cropland</td></tr>
<tr><td colspan="2">Sector</td><td>AFLOU-Land</td></tr>
<tr><td colspan="2">Relevant planning documents, legal and regulatory acts</td><td>► Law on agricultural land
► Rulebook on GAP
► Rulebook on cross compliance for minimum requirements of GAP and environmental protection</td></tr>
<tr><td colspan="2">Gases</td><td>CO_2</td></tr>
<tr><td colspan="2">Methodology</td><td>Land use change through conversion of almost 3000 ha of arable land that has been identified on inclined terrain above 15%, to grassland.</td></tr>
<tr><td colspan="2">Assumptions</td><td>► The total area of almost 3000ha is intensively cultivated which leads to decreasing of SOM as a result of its intensive decomposition and intensive soil erosion processes. If conversion to grass land is implemented, the estimated SOM increase is for more than 2% which for the total converted area of 2975 ha.
The conversion of land use, should:
► Stop the intensive process of erosion of the top soil layer which leads to loss of soil organic matter and its intensive ex-city mineralization,
► Stop on site mineralization of soil organic matter due to intensive processes of cultivation,
► Intensify carbon sink through accumulation of soil organic matter,</td></tr>
<tr><td rowspan="6">Progress of implementation</td><td rowspan="2">Steps taken or envisaged to achieve the action</td><td>Steps taken</td><td>► The effects of conversion of crop land to grass land has been monitored on two experimental fields in the past four years,
► Land Parcel Identification System has been established and will serve as a tool for control of the process of conversion</td></tr>
<tr><td>Steps envisaged</td><td>► Establishment of system for systematic control of land use and land use change on national level,
► Institutional support to primary producers with subsiding the process of conversion of crop fields into grassland,</td></tr>
<tr><td colspan="2">Estimated emission reductions</td><td>► 1.0 Gg CO_2-eq in 2020
► 3.7 Gg CO_2-eq in 2030
► 5.3 Gg CO_2-eq in 2040</td></tr>
<tr><td colspan="2">Timeframe</td><td>2020 – 2040</td></tr>
<tr><td colspan="2">Finance</td><td>Budget: 1.5 M€
Costs (2030):
► WOM: 0 M€
► WEM: 0.1 M€
Specific costs (2030):
► 21 €/t CO_2-eq</td></tr>
<tr><td colspan="2">Implementing entity</td><td>► Ministry of Agriculture Forestry and Water Economy</td></tr>
<tr><td colspan="3">Progress indicators:</td><td>► Area converted on yearly base (ha/year)
► Percentage of soil organic matter increase and carbon sink per ha.</td></tr>
<tr><td colspan="3"></td><td>direct indirect</td></tr>
</table>

Contribution for the achievement of the SDGs:	

Table A- 77: Contour cultivation on areas under field crops on inclined terrains (5-15%)

Mitigation action: Contour cultivation on areas under field crops on inclined terrains (5-15%)

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

Description: Regular cultivation in crop production means a massive disturbance of top soil layer, which cause intensive mineralization of soil organic matter (SOM) and CO2 emissions. Downslope cultivation of cropland usually causes intensive processes of soil erosion. Field experiments showed that the quantity of eroded sediment is multiply higher if compared to contour cultivation. This eroded sediment is reach with SOM which in such circumstances is rapidly mineralized, due to what significant quantity of soil carbon is released into atmosphere. Contour cultivation means that all agro-technical operations should be across the slope. This measure is easy to be implemented, since it does not require a special technical capacities and know-how. In practice, farmers usually are not aware of its importance and influence of the overall soil fertility. With a systematic campaign for increasing the awareness of the farmers this measure can be widely adopted.

Information	**Type**	Land management and land use change in the category of cropland
Information	**Sector**	AFLOU-Land
Information	**Relevant planning documents, legal and regulatory acts**	► Law on agricultural land ► Law on water ► Rulebook on Good Agricultural Practices ► Rulebook on cross compliance for minimum requirements of GAP and environmental protection
Information	**Gases**	CO_2
Information	**Methodology**	Land cultivation system change from downslope to contour cultivation
Information	**Assumptions**	► 14,000 ha (30%) of the total 47,090 ha of no-irrigated land on inclined terrines (above 5%) are planned for this measure ► Decreasing of soil erosion processes of the top soil layer and SOM loss with contour ploughing of inclined cropland, ► Increasing of soil carbon with preservation of SOM in the top soil layer
Progress of implementation	**Steps taken or envisaged to achieve the action** – **Steps taken**	► Contour cultivation tested in practice of two experimental sites, ► Contour cultivation promoted among farmers within several national and international Projects
Progress of implementation	**Steps taken or envisaged to achieve the action** – **Steps envisaged**	► Incorporation of contour cultivation as an agro-ecological measure into strategic documents, ► Promotion of contour cultivation among farmers, ► Institutional support to primary producers with subsiding the process of adoption of the system of contour cultivation
Progress of implementation	**Estimated emission reductions**	► 5.0 Gg CO_2-eq in 2020 ► 28.0 Gg CO_2-eq in 2030 ► 39.7 Gg CO_2-eq in 2040
Progress of implementation	**Timeframe**	2020 – 2040
Progress of implementation	**Finance**	Budget: 1.0 M€ Costs (2030): ► WOM: 0 M€ ► WEM: 0.1 M€ Specific costs (2030): ► 2 €/t CO_2-eq
Progress of implementation	**Implementing entity**	► Ministry of Agriculture Forestry and Water Economy
Progress indicators:		► Area in ha with contour cultivation (ha) ► Percentage of soil organic matter increase and carbon sink per ha ► Quantity of reduced soil sediment loss in (t/ha)
Contribution for the achievement of the SDGs:		***direct*** / ***indirect***

Table A- 78: Perennial grass in orchard and vineyards on inclined terrains (>5%)

Mitigation action: Perennial grass in orchard and vineyards on inclined terrains (>5%)

Main objective: Reducing of soil erosion and increasing of SOM in vineyards and orchards on inclined terrains (5-15% slope)

Description: In vineyards and orchard on locations where rows are oriented downslope, as a result of intensive classical system of cultivation, an intensive processes of soil erosion and depletion of SOM occur, which lead to intensive emissions of soil carbon. Simple change of cultivation system with establishment of perennial grass, can significantly mitigate the process of SOM loss and emissions of soil carbon. The measure is easy to be implemented with low initial cost.

Information	**Type**		Land management and land use change in the category of cropland
	Sector		AFLOU-Land
	Relevant planning documents, legal and regulatory acts		► Law on agricultural land ► Law on water ► Rulebook on GAP ► Rulebook on cross compliance for minimum requirements of GAP and environmental protection
	Gases		CO_2
	Methodology		Establishing of perennial grass between rows in vineyards and orchards for replacement of classical type of land cultivation system, on an inclined terrain (5-15%)
	Assumptions		► The total areas of orchards and vineyard on inclined terrains >5% slope are in total 10,630 ha for vineyards and 1250 ha for orchards. ► Decreasing of soil erosion processes of the top soil layer and SOM loss when classical type of cultivation system with deep plowing is replaced with perennial grass and no-tillage system ► Increasing of soil carbon with accumulation of SOM in the top soil layer due to mulching of moved biomass and accumulation of biomaterial in the root zone of the perennial grass.
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► Perennial grass in vineyards and orchards as a cover crop tested in practice in two regions, ► Perennial grass in vineyards and orchards as an agro-ecological measure promoted among farmers within several national and international Projects
		Steps envisaged	► To foresee cover crops in perennial plantations (vineyards and orchards) as an agro-ecological measure into strategic documents, ► To promote the effects of cover crops among vine and fruit growers, ► Institutional support to primary producers with subsiding the process of implementing the measure
	Estimated emission reductions		► 1.6 Gg CO_2-eq in 2020 ► 8.9 Gg CO_2-eq in 2030 ► 12.6 Gg CO_2-eq in 2040
	Timeframe		2020 – 2040
	Finance		Budget: 1 M€ Costs (2030): ► WOM: 0 M€ ► WEM: 0.1 M€ Specific costs (2030): ► 5.9 €/t CO_2-eq
	Implementing entity		► Ministry of Agriculture Forestry and Water Economy
Progress indicators:			► Area in ha of vineyards and orchards under perennial grass (ha) ► Percentage of soil organic matter increase and carbon sink per ha ► Quantity of reduced soil sediment loss in (t/ha)
Contribution for the achievement of the SDGs:			***direct*** / ***indirect*** indirect: 

Table A- 79: Use of biochar for carbon sink on agricultural land

Mitigation action: Use of biochar for carbon sink on agricultural land			
Main objective: Carbon sink by negative emission technology.			
Description: The agricultural soils in the country are characterized as soils with relatively low carbon content and with average to low fertility. The application of biochar can improve soil water holding capacity, nutrients storage into the soil, and increase yield. Biochar can capture even 3 times more CO2 compared to its weight, because of its high carbon concentration. Biochar was included for the first time as a promising negative emission technology in the new IPCC special report "An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty" published in 2018. The process of application of biochar should go through several steps: i) research, ii) development the suitable technology for various soil/crop combination iii) experimental/demonstrative sites, iv) development the measure for support from national programs for support of agriculture v) promotion of measure. This is new measure, need some research, therefore, in period 2017 – 2040 estimated only 15 years of active use of the measure.			
Information	**Type**		Land management of the category of cropland
	Sector		AFLOU-Land/Agriculture
	Relevant planning documents, legal and regulatory acts		► Biochar is not present in any strategic document in the country
	Gases		CO_2
	Methodology		Research on use of biochar, development of measures, initiate national production from waste biomass that will be burnt in open fires/, introducing the measure in national system for support of the agriculture, start with active use in 2026 and achieving the annual increase by 1000 ha, reaching 15 000
	Assumptions		► Increasing of soil carbon content with adding of biochar as persistent carbon source. Most of the biochar will remain in the in the top soil layer due to available application technology incorporation biochar by plow on the ploughing depth. ► The positive effects on the soil fertility and soil health ► Local production of the biochar by using residual biomass that is usually burnt in open fires
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► None
		Steps envisaged	► To conduct experimental research and to determine optimal biochar application rates for different soil/crop combinations ► To foresee application of biochar on arable land as an agro-ecological measure into strategic documents, ► To promote the effects of biochar on soil health, yield and environment, ► Institutional support to primary producers with subsiding the process of implementing the measure
	Estimated emission reductions		► 0 Gg CO2-eq in 2020 ► 110.0 Gg CO2-eq in 2030 ► 330.3 Gg CO2-eq in 2040
	Timeframe		2026 – 2040
	Finance		Budget: 30 M€ Costs (2030): ► WOM: 0 M€ ► WEM: 3.4 M€ Specific costs (2030): ► 30.5 €/t CO_2-eq
	Implementing entity		► Ministry of Agriculture Forestry and Water Economy
Progress indicators:			► Area in ha of agricultural arable land with applied biochar (ha) ► Amount of carbon sink per ha and total
Contribution for the achievement of the SDGs:			***direct*** / ***indirect***: 13 CLIMATE ACTION (indirect)

Table A- 80: Photovoltaic irrigation

Mitigation action: Photovoltaic Irrigation			
Main objective: Mitigation by replacing the non-renewable energy sources for water pumping with renewable, thus reducing the CO_2 emission.			
Description: Installation of photovoltaic system for irrigation purposes with 2.4 kW installed capacity, capable to run 1.1 kW 3 phase pump. The two cases are considered as mitigation practice, replacing the petrol pump with consumption of 0,3l petrol per hour (one of the most popular pumps in the country) with 3 phase AC pump and adding photovoltaic and replacing 1.1 kW electricity pump with 3 phase AC pump and adding the photovoltaic. The measure is suitable for already established on farm irrigation systems, but also for new establishing of the irrigation systems with on-farm water source. The measure is compatible with IPARD 2 measure "Production of energy from renewable resources for self-consumption, through processing of plant and animal products from primary and secondary biomass (except biomass from fishery products) for production of biogas and/or biofuels, use of solar energy, windmills, geo-thermal energy etc".			
Information	**Type**		Agriculture – irrigation replacing fossil energy with renewables
	Sector		AFLOU-Land/Agriculture
	Relevant planning documents, legal and regulatory acts		► Law on Agriculture and Rural Development ► National strategy on Agriculture and Rural Development ► IPARD2
	Gases		CO_2
	Methodology		Installation of photovoltaic system for irrigation purposes with 2.4 kW installed capacity, capable to run 1.1 kW 3 phase pump.
	Assumptions		► About 1000 installations annually in the period of 20 years, reaching about than 20 000 hectares irrigated by photovoltaic as energy source.
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► There is possibility for getting support from IPARD2 funds. The measure provide up to 65% of co-financing and promoting of photovoltaic irrigation if the frame of this measure is feasible.
		Steps envisaged	► To promote the photovoltaic irrigation as mitigation measure ► To include the measure in agri-environmental scheme ► To investigate possibilities for diversification of farm incomes trough distributing the excess of electricity produced into the network,
	Estimated emission reductions		► 0 Gg CO2-eq in 2020 ► 93.3 Gg CO2-eq in 2030 ► 186.6 Gg CO2-eq in 2040
	Timeframe		2021 – 2040
	Finance		Budget: 47 M€ Costs (2030): ► WOM: 0 M€ ► WEM: 3.4 M€ Specific costs (2030): ► 36.0 €/t CO_2-eq
	Implementing entity		► Ministry of Agriculture Forestry and Water Economy
Progress indicators:			► Area in ha of agricultural irrigated land irrigated by electricity produced from photovoltaics (ha) ► Amount of carbon sink per ha and total ► Installed capacity (MW)
Contribution for the achievement of the SDGs:			***direct***: 7 AFFORDABLE AND CLEAN ENERGY ***indirect***: 12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION

Forest and forestry

Table A- 81: Establishing integrated management of forest fires

Mitigation action: Establishing integrated management of forest fires			
Main objective: Reducing the average annual burned area for 6000 ha			
Description: Forest fires are already detected as a very significant problem of forest loss and source of GHG emissions. In the period from 1999 to 2019 year the average annual number of forest fires is 229 fires, average annual burned area is 10,985 ha and average annual damage is estimated on 6,9 million Euro. The total burned forest area in the same period is around 219,163 ha with the total damage of around 138 million. This measure includes the protection of the forest area by preventing the forest fires and the damages resulting from forest fires			
Information	**Type**		Forest fires reduction
	Sector		AFLOU-Forestry
	Relevant planning documents, legal and regulatory acts		► Law on forest, ► Special rule book for forest fire protection, ► Strategy for development of the forest fire protection, diseases and insects with action plan for realization of the projects and procurements for the needs of PE "Makedonski sumi"
	Gases		CO_2
	Methodology		Effective and fast initial action with well-trained and equipped teams
	Assumptions		► Up to 3000 ha will be burned annually on average
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	The location for building and establishment of a forest fire training center in the frame of the PE "National forests" is already chosen, the plan prepared and 8 vehicles are purchased.
		Steps envisaged	► **Phase I** - Procurement of vehicles for initial attack, had tools and personal protective equipment (PPE) Duration: one year Vehicles procurement: 25 specialized vehicles for initial attack 25 vehicles x 40,000 € = 1,000,000 € 50 sets of hand tools and PPE for 50 crews of five fire fighters (two per vehicle) 1 set of hand tools and PPE = 4,000 € 50 sets x 5,000 € = 250,000 € ► **Phase II** - Specialized training for fire fighters (six days) 50 craws x 5 persons = 250 fire fighters 250 fire fighters x 800 € = 200,000 €
	Estimated emission reductions		► 345.0 Gg CO2-eq in 2020 ► 345.0 Gg CO2-eq in 2030 ► 345.0 Gg CO2-eq in 2040
	Timeframe		2020 – 2040
	Finance		Budget: 1.45 M€ Costs (2030): ► WOM: 5.3 M€ ► WEM: 2.1 M€ Specific costs (2030): ► -9.3 €/t CO_2-eq
	Implementing entity		► Ministry of Agriculture Forestry and Water Economy, through PE "National forests"
Progress indicators:			► Forest area (ha)
Contribution for the achievement of the SDGs:			***direct***:  ***indirect***: 

Table A- 82: Afforestation of 5000 ha of barren land with Oak (Quercus Spp.)

Mitigation action: Afforestation			
Main objective: Afforestation of 5000 ha of barren land with Oak (Quercus spp.)			
Description: Afforestation and reforestation may change landscapes and may have an impact on the provision of landscape-related goods and services. The supply with goods and services benefiting people and societies and the conservation of traditional cultural landscapes, as well as landscape ecology, need to be taken into account. According to the many strategic documents there are about 1,500,000 ha barren land aimed for afforestation or reforestation.			
Information	**Type**		Afforestation of Barren Land
	Sector		AFLOU-Forestry
	Relevant planning documents, legal and regulatory acts		► Law on forests
	Gases		CO_2
	Methodology		Empirical modeling, based on scientific paper
	Assumptions		► The oak is species resistant on high air temperature and small amount of precipitations-dry conditions (conditions that are expected in agreement with the official national scenarios on climate change for Macedonia) and lees sensitive to forest fires, as well. Besides, the economic and technical value of the timber mass is high. The afforestation could be done on one location (all 5,000 ha) or distributed but not to more than five location. ► Minimum 80 % of the seedlings have to be alive after third year of the afforestation and with good health and morphological condition should be maintained
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► There are already existed nurseries for production of more than 8.000.000 seedlings annually
		Steps envisaged	► Area for afforestation should be chosen, around 7.5 million Oak seedlings should be produced, afforestation to be done with proper care in the next 5 years ► **Phase I – seedling production** Duration: 3 years Amount of seedlings: 2,500 seedlings/ha x 5,000 ha = 12,500,000 seedlings Costs for seedling production: 12,500,000 seedlings x 20 den. = 250,000,000=4,100,000 € ► **Phase II – soil preparation and afforestation** Sub phase - soil preparation Duration: four months Costs: 5,000 ha x 15,000 den = 75,000,000 den = 1,250.000 € Sub phase - afforestation Duration: six months Costs: 5,000 ha x 20,000 den = 100,000,000 den = 1,650,000 € ► **Phase III – maintenance and protection** Duration: five years Costs: 5.000 ha x 10.000 den = 50.000.000 den = 800.000 €
	Estimated emission reductions		► 0 Gg CO2-eq in 2020 ► 312.5 Gg CO2-eq in 2030 ► 312.5 Gg CO2-eq in 2040
	Timeframe		2020 – 2040
	Finance		Budget: 7.8 M€ Costs (2030): ► WOM: 0 M€ ► WEM: 0.4 M€ Specific costs (2030): ► 1.3 €/t CO_2-eq
	Implementing entity		► Ministry of Agriculture Forestry and Water Economy
Progress indicators:			► Forest area (ha) ► Forest planted/covered with new seedlings (ha) ► Number of seedlings planted and alive
Contribution for the achievement of the SDGs:			***direct***  ***indirect*** 

Waste

In the Waste sector four measures are modelled and analyzed. The most relevant information for these measures/policies is given

Table A- 83: Landfill gas flaring

<table>
<tr><td colspan="4">Mitigation action: Landfill gas flaring</td></tr>
<tr><td colspan="4">Main objective: Environmental protection and meeting the highest European standards
Description: Rehabilitation of the existing non-compliant landfills and "wild" dumpsites with very high, high and medium risk in each of the five waste management regions. The rehabilitation includes covering on the existing non-compliant landfills, supplemented by gas extraction and flaring.
This measure depends on the realization of the measure "Mechanical and biological treatment (MBT) of waste in new landfills with composting", because the opening of the new regional landfills should incorporate systems for mechanical and biological treatment together with gas flaring system. At the same time the opening of the new regional landfills will result in closure of the existing non-compliant landfills and "wild" dumpsites.</td></tr>
<tr><td rowspan="7">Information</td><td colspan="2">Type</td><td>Technical</td></tr>
<tr><td colspan="2">Sector</td><td>Waste – Solid waste disposal</td></tr>
<tr><td colspan="2">Relevant planning documents, legal and regulatory acts</td><td>► National Waste Management Plan
► Strategy for Waste Management in the Republic of Macedonia
► Regional Waste Management Plans (Northeast, East, Southeast, Southwest, Pelagonia, Vardar, Polog and Skopje region) – final and draft versions</td></tr>
<tr><td colspan="2">Gases</td><td>CO_2, CH_4</td></tr>
<tr><td colspan="2">Methodology</td><td>Covering on the existing non-compliant landfills, supplemented by gas extraction and flaring, which will convert the CH_4 emissions into CO_2 emissions. Modelling using the custom-made software tool in excel, performing calculations based on the IPCC Methodology.</td></tr>
<tr><td colspan="2">Assumptions</td><td>Closing of existing and opening of new landfills by waste management regions in the following order:
► Skopje – 2023
► East and Northeast – 2025
► Polog – 2026
► Southeast – 2029
► Pelagonia and Southeast – 2029
► Vardar
The main assumption is that the overall quantity of gas will be burned and for one t of CH_4, instead of 25 CO_2-eq, 2.75 CO_2-eq will be produced. CO_2 produced from full combustion of unit mass of methane is equal to 2.75 (According to the IPCC methodology[26]).</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td rowspan="7">Progress of implementation</td><td rowspan="2">Steps taken or envisaged to achieve the action</td><td>Steps taken</td><td>► Regional waste management plans developed
► EU funds provided for construction of a regional landfill for the East and Northeast planning region provided, construction of six transfer stations and closing of all non-compliant landfills.</td></tr>
<tr><td>Steps envisaged</td><td>► Obtaining funds for the other regions
► Starting the construction of the new regional landfill for the East and Northeast planning region
► Covering on the existing non-compliant landfills and installation of gas flaring systems where it is feasible</td></tr>
<tr><td colspan="2">Results achieved and estimated outcomes</td><td>Expected annual burned emissions of CH_4:
► 0 kt CH4 in 2020
► 22.0 kt CH4 in 2030
► 24.8 kt CH4 in 2040</td></tr>
<tr><td colspan="2">Estimated emission reductions</td><td>► 0 Gg CO2-eq in 2020
► 489.7 Gg CO2-eq in 2030
► 552.3 Gg CO_2-eq in 2040</td></tr>
<tr><td colspan="2">Timeframe</td><td>2020 – 2040</td></tr>
<tr><td colspan="2">Finance</td><td>Budget: 20.5 M€
Costs (2030):
► WOM: 0 M€
► WEM: 1.0 M€
Specific costs (2030):
► 1.42 €/t CO_2-eq</td></tr>
<tr><td colspan="2">Implementing entity</td><td>► Ministry of Environment and Physical Planning
► Public municipal enterprises for waste management
► State Environmental Inspectorate</td></tr>
</table>

[26] https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_4_Ch4_Fugitive_Emissions.pdf

	► Inter-Municipal Waste Management Board ► Authorized Inspectors of Environment (Municipalities)	
Progress indicators:	► Amount of CH_4 burned (kt) ► Emissions reduction (Gg CO_2-eq)	
Contribution for the achievement of the SDGs:	***direct***	***indirect***
		

Table A- 84: Mechanical and biological treatment (MBT) of waste in new landfills with composting

Mitigation action: Mechanical and biological treatment (MBT) of waste in new landfills with composting

Main objective: Environmental protection and meeting the highest European standards

Description: Opening of new regional landfills in all waste management regions with installed system for mechanical and biological treatment and composting.

Information	**Type**		Technical
	Sector		Waste – Solid waste disposal
	Relevant planning documents, legal and regulatory acts		▶ National Waste Management Plan ▶ Strategy for Waste Management in the Republic of Macedonia ▶ Regional Waste Management Plans (Northeast, East, Southeast, Southwest, Pelagonia, Vardar, Polog and Skopje region) – final and draft versions
	Gases		CO_2, CH_4, N_2O
	Methodology		Opening of new regional landfills in all planning regions with installed system for mechanical and biological treatment and composting. Modelling using the custom-made software tool in excel, performing calculations based on the IPCC Methodology.
	Assumptions		Opening of the regional landfills in the following order: ▶ Skopje – 2023 ▶ East and Northeast – 2025 ▶ Polog – 2026 ▶ Southeast – 2029 ▶ Pelagonia and Southeast – 2029 ▶ Vardar
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	▶ Regional waste management plans developed ▶ EU funds provided for construction of a regional landfill for the East and Northeast planning region provided, construction of six transfer stations and closing of all non-compliant landfills.
		Steps envisaged	▶ Obtaining funds for the other regions ▶ Starting the construction of the new regional landfill for the East and Northeast planning region
	Results achieved and estimated outcomes		Amount of compost: ▶ 0 kt in 2020 ▶ 78 kt in 2030 ▶ 80 kt in 2040
	Estimated emission reductions		▶ 0 Gg CO2-eq in 2020 ▶ -12.2 Gg CO2-eq in 2030 (108 Gg CO2-eq in 2030**) ▶ 23.8 Gg CO2-eq in 2040 (109.3 Gg CO2-eq in 2030**)
	Timeframe		2020 – 2035
	Finance		Budget: 36.1 M€ Costs (2030): ▶ WOM: 0.1 M€ ▶ WEM: 2.1 M€* Specific costs: ▶ 12.8 €/t CO_2-eq**
	Implementing entity		▶ Ministry of Environment and Physical Planning ▶ Public municipal enterprises for waste management ▶ State Environmental Inspectorate ▶ Inter-Municipal Waste Management Board ▶ Authorized Inspectors of Environment (Municipalities)
Progress indicators:			▶ Amount of compost produced (kt) ▶ Emissions reduction (Gg CO2-eq)
Contribution for the achievement of the SDGs:			***direct***:  ***indirect***: 

*The costs include the profit from the sale of compost

** Total reduction when including the emissions realized after 2040

Table A- 85: Selection of waste - paper

Mitigation action: Selection of waste - paper			
Main objective: Environmental protection and meeting the highest European standards *Description: Installation of containers for collection of selected waste, mainly paper*			
Information	**Type**		Technical
	Sector		Waste – Solid waste disposal
	Relevant planning documents, legal and regulatory acts		► National Waste Management Plan ► Strategy for Waste Management in the Republic of Macedonia ► Regional Waste Management Plans (Northeast, Southeast, Pelagonia, Polog and Skopje region) – final and draft versions
	Gases		CO_2, CH_4
	Methodology		Installation of containers for collection of selected waste. Modelling using the custom-made software tool in excel, performing caluculations based on the IPCC Methodology.
	Assumptions		Gradual increase of paper selection compared to WOM, starting from 2% upto 50% in 2040.
Progress of implementation	**Steps taken or envisaged to achieve the action**	**Steps taken**	► Regional waste management plans developed ► Containers for waste selection installed in several cities in Macedonia, mostly in Skopje. ► Private companies – digitalization of information (bills) realized
		Steps envisaged	► Installation of containers for waste selection in all cities in Macedonia. ► Promoting the reduction of paper consumption and dematerialization of the information using ICT (Information and Communication Technologies)
	Results achieved and estimated outcomes		Expected annual amount of paper waste: ► 2 kt in 2020 ► 22 kt in 2030 ► 40 kt in 2040
	Estimated emission reductions		► 0 Gg CO_2-eq in 2020 ► 10.1 Gg CO_2-eq in 2030 (62.5 Gg CO_2-eq in 2030*) ► 36.2 Gg CO_2-eq in 2040 (109.5 Gg CO_2-eq in 2030*)
	Timeframe		2020 – 2035
	Finance		Budget: 2 M€ Costs (2030): ► WOM: 0 M€ ► WEM: 0.1 M€ Specific costs: ► 2.1 €/t CO_2-eq*
	Implementing entity		► Ministry of Environment and Physical Planning ► Public municipal enterprises for waste management ► State Environmental Inspectorate ► Inter-Municipal Waste Management Board ► Authorized Inspectors of Environment (Municipalities)
Progress indicators:			► Amount of paper collected (kt) ► Emissions reduction (Gg CO2-eq)
Contribution for the achievement of the SDGs:			***direct***: 11 SUSTAINABLE CITIES AND COMMUNITIES; 12 RESPONSIBLE CONSUMPTION AND PRODUCTION ***indirect***: 13 CLIMATE ACTION

* Total reduction when including the emissions realized after 2040

Table A- 86: Improved waste and materials management at industrial facilities

Mitigation action: Improved waste and materials management at industrial facilities		
Main objective: Set targets for the reduction of generation, selection, reuse, recycling and treatment of waste at industrial installations *Description: On an individual assessment, each IPPC installation operator shall submit proposals for 1) waste generation, 2) waste selection, 3) waste reuse, 4) waste recycling, 5) waste treatment.* *Goals are set in integrated environmental permits.* *Goals are set for a 5-year framework (progressive goals for each year) that will be updated as appropriate after the deadline.* *Two levels of goals: mandatory and higher incentives (through tax or financial incentives).*		
Information	**Type**	Regulation, technical
	Sector	Waste – Solid waste disposal
	Relevant planning documents, legal and regulatory acts	► National Waste Management Plan ► Strategy for Waste Management in the Republic of Macedonia ► Law on Waste Management and bylaws ► Law on Finance and bylaws ► Regional Waste Management Plans (Northeast, East, Southeast, Southwest, Pelagonia, Vardar, Polog and Skopje region) – final and draft versions
	Gases	CO_2, CH_4
	Methodology	Amendments to the law, introduction of legal incentives
	Assumptions	Conducted substantive analysis, international experiences analyzed. The percentage of industrial waste treatment will increase from 5% in 2024 up to 30% in 2040.
Progress of implementation	**Steps taken or envisaged to achieve the action** – **Steps taken**	
	Steps taken or envisaged to achieve the action – **Steps envisaged**	► Analysis of possible tax and financial options to encourage the achievement of higher goals ► Analysis done; opportunities/mechanisms identified ► Modified and issued environmental permits ► Regular annual implementation oversight ► Regular annual reporting by IPPC operators
	Results achieved and estimated outcomes	Expected annual amount of industrial waste: ► 0 kt in 2020 ► 302 kt in 2030 ► 892 kt in 2040
	Estimated emission reductions	► 0 Gg CO_2-eq in 2020 ► 3.3 Gg CO_2-eq in 2030 ► 17.5 Gg CO_2-eq in 2040
	Timeframe	► 1 year preparation, ► 2 years to implement permit changes, and ► 5 years for implementation of goals
	Finance	Budget: n/a Costs for WOM (2030): ► 0 M€ Costs for WEM (2030): ► 0 M€ Specific costs: ► 0 €/t CO_2-eq
	Implementing entity	► Ministry of Environment and Physical Planning ► Municipalities and city of Skopje ► State Environmental Inspectorate ► Inter-Municipal Waste Management Board ► Authorized Inspectors of Environment (Municipalities)
Progress indicators:		► Industrial waste collected (kt) ► Emissions reduction (Gg CO2-eq)
Contribution for the achievement of the SDGs:		***direct***:  ***indirect***: 

Annex 7. Pipeline of IPA-Funded Activities

The table below provides information on projects identified as needing support in the energy, transport and environmental sector that are planned for financing under new EU/IPA programming for the period 2014-2020.

Table A- 87 Financial support needs in terms of EU/IPA Planned projects in the programming period 2014-2020[27]

Activity/project	Status (ongoing/ planned/ completed)	Overall support needed (a) (in million EUR)	Support received (b) (in mil. EUR)	Additional support needed (c) (in mil. EUR)
Law and Strategy on Climate Change	planned	1.5		
Construction of WWTP for Skopje and supervision activities	planned	120		
Construction of the selected infrastructure facilities, closure of the noncompliance landfills/dumpsites and supply of equipment for handling and transferring of waste in the East and Northeast regions.	planned	24		
Construction of waste management facilities in Pelagonia Region and supervision activities	planned	20		
Construction of waste management facilities in Southwest Region and supervision activities	planned	20		
Construction of waste management facilities in Polog Region and supervision activities	planned	20		
Construction of waste management facilities in Vardar Region and supervision activities	planned	20		
Construction of WWTP and upgrading and extension of the sewage network in Debar and supervision activities	planned	9.5		
Construction of WWTP and upgrading and extension of the sewage network in Gostivar and supervision activities	planned	23.5		
Construction of WWTP and upgrading and extension of the sewage network in Kavadarci and supervision activities	planned	12.5		
Construction of waste management facilities in Southeast Region and supervision activities	planned	20		

[27] Source: http://cfcd.finance.gov.mk/?page_id=852 , http://www.sep.gov.mk/

Activity/project	Status (ongoing/ planned/ completed)	Overall support needed (a) (in million EUR)	Support received (b) (in mil. EUR)	Additional support needed (c) (in mil. EUR)
Construction of WWTP and upgrading and extension of the sewage network in Stip and supervision activities	planned	9.5		
Construction of WWTP and upgrading and extension of the sewage network in Veles and supervision activities	planned	16.5		
Clean-up Activities for Alpha-HCH, Beta- HCH and Lindane Contaminated Sites at OHIS	planned	35		
Excavation and on or off site remediation of the chromium dumpsite in Jegunovce	planned	12.7		
Excavation and off site remediation of the lead, zinc and cadmium dumpsite in Veles	planned	23.6		
Sanation and recultivation of the lead and zinc dumpsite in Probishtip.	planned	4.2		
Excavation and slag recycling of the dumpsite in Zelezara, Skopje	planned	8		
Development of new natural friendly forms for accommodation in national parks Mavrovo, Pelister and Galicica	planned	5.05		
Construction of bio-corridors of roads and railways in R. Macedonia	planned	2.5		
Construction of wastewater treatment plants in towns with a population of 2.000 to 15.000 inhabitants (Centar Zupa)	planned	6		
Construction of wastewater treatment plants in towns with a population of 2.000 to 15.000 inhabitants (Demir Kapija)	planned	6		
Construction of wastewater treatment plants in towns with a population more than 15.000 inhabitants (Lipkovo)	planned	2		
Construction of wastewater treatment plants in towns with a population more than 15.000 inhabitants (Tearce,)	planned	2		
Construction of wastewater treatment plants in towns with a population more than 15.000 inhabitants (Negotino)	planned	2		
Construction of Wastewater Treatment Plants for Settlements with Population over 2,000 in the Strumica River Basin District – Novo Selo	planned	2		

Activity/project	Status (ongoing/ planned/ completed)	Overall support needed (a) (in million EUR)	Support received (b) (in mil. EUR)	Additional support needed (c) (in mil. EUR)
Construction of Wastewater Treatment Plants for Settlements with Population over 2,000 in the Strumica River Basin District – Vasilevo	planned	2		
Construction of Wastewater Treatment Plants for Settlements with Population over 2,000 in the Strumica River Basin District- Bosilovo	planned	2		
Interconnection (South West of Macedonia) Bitola(Macedonia) – Elbasan (Albania), North Macedonia's part and 400/110Kv SS Ohrid	planned	63.7		
Main gas pipeline section 3 branch Stip- Hamzali Main gas pipeline section 4 Hamzali- Stojakovo (border with Greece) , Main gas pipeline section 13 Hamzali – Novo Selo (border with Republic of Bulgaria)	planned	71		
Central Heating In Bitola, Novaci, And Mogila – Stage I	planned	47		
Main gas pipeline section 1 Klechovce–Negotino, part Stip-Negotino	planned	17		
Main gas pipeline section 5 Skopje- Tetovo-Gostivar-Kichevo	planned	50		
Hydro Power Plant Boskov Most (Boskov Most, Tresonce village, near city of Debar)	planned	143.9		
Hydropower Plant Cebren	planned	338.4		
Wind Park Bogdanci - 2nd phase	planned	21		
Main gas pipeline section 2 Negotino- Bitola	planned	40		
Main gas pipelines: - Branch to Tetovo - branch to TEC Negotino - branch to Kavadarci	planned	10		
Main gas pipeline sections II phase: Sveti Nikole-Veles - Branch to Gevgelija - Branch to DemirKapija - Matka – Gracani - Vrshakovo-Kocani-Razlovci - Branch to TEC Oslomej - Branch to Probistip - Klechovce-Sopot - Kicevo-Ohrid - Ohrid-Struga-Kafasan	planned	80		
Lukovo Pole and intake of Korab waters (NP Mavrovo, Rostuse, Gostivar)	planned	83.7		
Hydro Power Plant Galiste (Crna River)	planned	200		

Activity/project	Status (ongoing/ planned/ completed)	Overall support needed (a) (in million EUR)	Support received (b) (in mil. EUR)	Additional support needed (c) (in mil. EUR)
Hydro Power Plant Spilje II	planned	21.1		
Modernization of Thermal power plant Oslomej (Oslomej, Kicevo)	planned	125.4		
400/110 kV substation Kumanovo	planned	15		
Modernization and rehabilitation of REK Bitola phase III – reduction of SOx and dust, expanded to include the impact of all harmful emissions	planned	80		
110 kV in-out connection to 110 kV OHTL HPP Vrutok – SS Skopje 1	planned	1.87		
Revitalization/reconstruction of 110 kV transmission lines	planned	5.82		
400 kV interconnection Skopje 5 - New Kosovo	planned	6		
TenovoKozjak Hydro Power Project (Channel from Tenovo to Kozjak Storage)	planned	6		
Combined cycle gas power plant Energetika (Skopje, adjacent to ELEM's existing plant Energetika)	planned	120		
Hydro Power System Vardarska Dolina (Vardar river valley)	planned	1,062		
Hydro Power Plant Globocica II	planned	30		
TESLA gas pipeline system	planned	415		
Construction of the Beljakovce-border rail section with Bulgaria	planned	470		
Construction of road section Gostivar- Kicevo	planned	280		
Construction of road section Drenovo - Interchange Gradsko	planned	35		
Construction works of the railway section Kicevo – Border with Albania	planned	470		
Construction of road section Skopje - Kosovo border	planned	70		
Rehabilitation of road section Negotino - DemirKapija	planned	9		
Rehabilitation of road section Prilep - Raec Bridge	planned	4.78		
Rehabilitation of road section Gevgelija - Greece border (Bogorodica)	planned	1.15		

Activity/project	Status (ongoing/ planned/ completed)	Overall support needed (a) (in million EUR)	Support received (b) (in mil. EUR)	Additional support needed (c) (in mil. EUR)
Rehabilitation of road section Medzitlija (Greece Border) - Interchange Krklino	planned	1.94		
Rehabilitation of road Interchange Krklino - Prilep	planned	2.85		
Reconstruction of road section from Katlanovo to Petrovec	planned	NA		
Rehabilitation of road section Gradsko - Negotino	planned	4.4		
Rehabilitation of road section Veles - Gradsko	planned	4.59		
Rehabilitation of road section Miladinovci - Skopje	planned	5.49		
Rehabilitation of road section Tetovo - Gostivar	planned	5.59		
Rehabilitation of road section Kumanovo -Rankovce	planned	9		
Rehabilitation of road section Skopje - Tetovo	planned	9.93		
Construction and supply of ITS on Coridor X	planned	20		
Rehabilitation of Local roads with an amount of 0.5-1 MEUR for each local road	planned	1		
Construction of Regional roads with an amount up to 10MEUR for each project	planned	10		
Construction of railway section along the corridor X Dracevo – Veles	planned	550		
Reconstruction of road section from Kriva Palanka to Deve Bair	planned	NA		
Construction of road section Trebeniste - Struga	planned	45		
Construction of road section Struga - Kjafasan	planned	80		
Revitalization of existing HPPs	2012-2015	70		
Construction of LHPPs, Chebren and Galiste	2012-2019	519		
Construction LHPPs Boskov Most	2012-2016	70		
Construction of LHPPs Lukovo Pole with HPP Crn Kamen	2010-2014	45		
Construction of LHPP Gradec	2014-2021	156		
Construction of SHPPs (100 MW)	/	200		

Activity/project	Status (ongoing/ planned/ completed)	Overall support needed (a) (in million EUR)	Support received (b) (in mil. EUR)	Additional support needed (c) (in mil. EUR)
Geothermal energy	/	60		
WPPs (230 W)	/	230		
Photovoltaic system (20MW)	/	80		
Solar System for hot water (80000 households)	/	60		
TPP-HP using waste biomass and TPP using biogas (20MW)	/	30		
Revitalization of the equipment in the TPP Bitola, TPP Oslomej and TPP Negotino	2010-2012 2014-2017 2010-2012	260		
Revitalization of the existing HPP	2012-2015	67		
CHP using natural gas	2010-2014	250		
TPP Bitola 4, TPP Mariovo and TPP Negotino, lignite fired	2014-2018 2020-2024	1,120		
Development of the transmission grid	Planned	109.3		
Activities in the heating infrastructure	/	56.3		
Gasification	/	240		

Annex 8. Overview of Climate Change Projects and international support received

A number of reports available on the Republic of North Macedonia Climate Change Web Portal analyze the current state and provide summary tables of research and development (R&D), innovation and technology transfer and provide an overview of climate change projects and international support received. The research made in close collaboration with the national R&D scientific institutions, policy makers, projects implementing agencies, as well as the donor programmes operating in the country.

According to the assessment of the current state in the recent years (2014-2020) [1], as well as results for the previous 5 years period (2009-2013). The country has made a significant movement to enable an environment for the development of ecosystems with innovative and R&D infrastructure, as a good basis for the continuous improvement of the national conditions, which is essential for the countries international and EU aspirations and commitments. According to the analyzed results for the period 2014-2020, it can be concluded that North Macedonia receives significant financial (granting and lending schemes), capacity building, technical and technological support by international donor organizations, developed countries and international financial institutions for research, development, innovation and technology transfer related to climate projects. Furthermore, the country, through its national and local institutional budgets, has also funded a number of projects with direct or indirect impact on the climate change mitigation and adaptation in the country.

Detailed analysis and summary tables of ongoing and realized projects presented by programmes, by donors, by implementing agencies and financial institutions, as well as summarized information about the overall support received are presented in the Annexes of the following reports:

1. Rapid Assessment Report: Current status of the research, development, innovation and technology transfer related to climate change in the Republic of North Macedonia, part of the project “Macedonia’s Fourth National Communication (NC) and Third Biennial Update Report (BUR) on Climate Change under the UNFCCC (4th NC/3rd BUR)”, funded by GEF and UNDP, January 2020. (Author: V. Gecevska). See this link for more details.
2. Final report: Current assistance and lessons learned from international multilateral and bilateral donors in Republic of Macedonia, part of the process of development of a new Country Partnership Competitiveness Strategy for Republic of Macedonia for the period 2014-2017, funded by World Bank, July 2014. (Authors: V. Gecevska, R. Polenakovik, B.R. Jovanovski).

Annex 9. Climate Change Research Activities in The Republic of North Macedonia

Table A- 88: Macedonian research related to climate change mitigation and MRV (2012-2020)

Publication	Sector	Scope
Pavlina Zdraveva, Teodora Obradovic Grncarovska, Natasa Markovska, Elena Gavrilova, Emilija Poposka, Igor Ristovski, (2014): "Building a sustainable greenhouse gases inventory system in Macedonia", Management of Environmental Quality: An International Journal, Vol. 25 Issue: 3, pp.313-323, https://doi.org/10.1108/MEQ-11-2013-0131	MRV	Climate policy
P. Zdraveva, T. Obradovikj Grncharovska*, N. Markovska, E. Gavrilova, E. Poposka, I. Ristovski: Building a sustainable greenhouse gases inventory system in Macedonia. Management of Environmental Quality, An international Journal, Volume 25, Number 3, 2014	MRV	Climate policy
Gjoshevski Ivan: Decarbonising the Macedonian Economy Evaluating Consistency and Coherence of Climate and Energy Policies. Thesis for the fulfilment of the Master of Science in Environmental Management and Policy. The International Institute for Industrial Environmental Economics. Lund, Sweden, September 2016.	Mitigation	Climate policy
Aleksandar Dedinec [a]*, Verica Taseska-Gjorgievska [a], Natasa Markovska [a], Teodora Obradovic Grncarovska b, Neven Duic c, Jordan Pop-Jordanov [a], Gligor Kanevce [a], Gary Goldstein [b], Steve Pye [b], Rubin Taleski [c]: Low emissions development pathways of the Macedonian energy sector. Elsevier, Renewable and Sustainable Energy Reviews, Volume 53, January 2016, Pages 1202-1211.	Mitigation	Energy
Aleksandar Dedinec [a]*, Verica Taseska-Gjorgievska [a], Natasa Markovska [a], Teodora Obradovic Grncarovska [b], Neven Duic [c], Jordan Pop-Jordanov [a], Rubin Taleski [d]: Towards post-2020 climate change regime: Analyses of various mitigation scenarios and contributions for Macedonia. Elsevier EnergyVolume 94, 1 January 2016, Pages 124-137.	Mitigation	Energy
Aleksandar Dedinec, Aleksandra Dedinec, Natasa Markovska: Optimization Of Heat Saving In Buildings Using Unsteady Heat Transfer Model. Thermal Science, volume 19, issue 3, (2015)	Mitigation	Energy
Lazarevska A. M., Mladenovska D., 2016: “Multi-criteria assessment of natural gas supply options – The Macedonian case”, International Journal of Contemporary Energy, Vol. 2, No. 1, pp 54-62 (2016) (DOI: 10.14621/ce.20160107)	Mitigation	Energy
D. MLADENOVSKA[a] *, A. M. LAZAREVSKA[b] , M. KOCHUBOVSKI[c]: ASSESSING ALTERNATIVES FOR NATURAL GAS SUPPLY IN MACEDONIA VERSUS ENVIRONMENTAL INDICATORS. Journal of Environmental Protection and Ecology 18, No 2, 632–640 (2017).	Mitigation	Energy

Publication	Sector	Scope
Gligor Kanevče, Aleksandar Dedinec, Aleksandra Dedinec: OPTIMAL USAGE OF BIOMASS FOR ENERGY PURPOSES TOWARD SUSTAINABLE DEVELOPMENT - A CASE OF MACEDONIA. THERMAL SCIENCE, volume 20, issue 11, (2016).	Mitigation	Energy
Aleksandra Dedinec[1] , Igor Tomovski[2] , Ljupčo Kocarev[1]: OPTIMIZATION MODEL FOR VARIABLE RENEWABLE ENERGY SOURCES GENERATION: MACEDONIAN CASE STUDY. Contemporary Materials (Renewable energy sources), VI−2 (2015). pp. 204 – 212.	Mitigation	Energy
Lazarevska A. M., Bakreska Kormushoska N., Kochov A., 2015: “Complementarity and Overlapping among Energy Performance Indicators as part of the Sustainable Development and RECP Indicators in Cement Industry”, International Journal of Contemporary Energy, Vol. 1, No. 1, pp 20-26 (2015) (DOI: 10.14621/ce.20150203)	Mitigation	IPPU
D. DIMITROVSKI, V. DJINLEV, M. M. DIMITROVSKI, Z. SAPURIC: Determining Hot Carbon Monoxide (CO) Emissions from Passenger Vehicles as a Parameter for Multisectoral Decision Making Process. Journal of Environmental Protection and Ecology, Vol. 16, No. 4 (2015).	Mitigation	Transport
Aleksandar Dedinec [a],* Natasa Markovska [a], Igor Ristovski [b], Gjogi Velevski [c], Verica Taseska Gjorgjievska [a], Teodora Obradovic Grncarovska [b], Pavlina Zdraveva [c]: Economic and environmental evaluation of climate change mitigation measures in the waste sector of developing countries. Journal of Cleaner Production 88 (2015) 234-241.	Mitigation	Waste
Dedinec, Aleksandar, Markovska, Natasa, Ristovski, Igor, Velevski, Gjogi, Gjorgjievska, Verica Taseska, Grncarovska, Teodora Obradovic, Zdraveva, Pavlina Economic and environmental evaluation of climate change mitigation measures in the waste sector of developing countries. Elsevier, Journal of cleaner production 2015 v.88 pp. 234-241.	Mitigation	Waste
Z. SAPURIC, D. DIMITROVSKI, M. DIMITROVSKI, M. KOCHUBOVSKI: European Union Regulations and Standards of Waste Management and Its Implementation in FYR Macedonia. Journal of Environmental Protection and Ecology, Vol. 16, No.2 (2015).	Mitigation	Waste
Antonio Jovanovski, Aleksandar Trpkovski "Opportunities for young people in times of climate change and energy transition" - Macedonia, Kosovo, Serbia and Croatia	Mitigation	Cross sectoral

Annex 10. Making Climate Change Mitigation Process More Gender Responsive

Within the TBUR, a set of activities were undertaken with a purpose of ensuring and strengthening the implementation of the Draft Action Plan for Gender Mainstreaming in Climate Change developed under the climate change projects implemented by the Ministry of Environment and Physical Planning with the support of the UNDP, in close work with the Ministry of Labor and Social Policy. The Gender issues in the TBUR, mitigation assessment are addressed in the table below.

Table A- 89: Making Climate Change Mitigation Process More Gender Responsive

	Y/N	*More info*
Making Mitigation Assessment More Gender Responsive	Y	To certain extend. ● Making Mitigation Assessment More Gender Responsive: contextual analysis of the needs, priorities, roles and experiences of women and men shall be developed. ● Gender Responsive Mitigation planning ensured by following gender perspectives: gender balanced team and identification of gender based concerns/needs/priorities. ● Both women and men were involved in development of baseline scenarios and mitigation-related parameters, as well as represented by various stakeholders such as NGO sector, academia, business sector. However, the institutional gender machinery has not been included at this point. ● However, the Implementation phase will mean that all actors involved were aware that they will have to meet the gender requirements. The planned training on gender issues for participants from all implementing organizations will be a great opportunity to set the directions for achievement the gender perspective foreseen with this report, and at the same time to increase their capacity related to gender issues.
Ensure work plan highlights categories where gendered divisions of labor indicate scope for in-depth gender analysis	Y	● The number of green jobs calculated for the policies and measures of each of the scenarios has been disaggregated by gender i.e. at least around 27% of the maximum number of job positions in 2035 can be assigned to women; ● The gender specialist has identified mitigation measures relevant from gender aspects.
Establish criteria for all terms of reference to include a collection of sex-disaggregated data, establishment of a small set of gender-specific indicators, and employment of gender specialist to conduct gender analysis of mitigation findings	Y	● Gender specialist engaged to conduct gender analysis of mitigation findings
Ensure women and men are involved in the development of baseline scenarios and mitigation-related parameters	Y	● The national process for the development of mitigation scenarios incorporated well balanced gender team: 44% women and 56% men. Additional efforts have been made to integrate gender responsive considerations into the GHG inventory to the extent possible, following the national Action plan on gender and climate change and the UNDP Gender Responsive National Communications Toolkit.

Annex 11. EU Instrument for Pre-Accession Assistance Project

Table A- 90: Summary of EU Instrument for Pre-Accession Assistance Project

Project Description (identical to ToR)**[1]**	
Overall Objective:	*To support the Beneficiary Country in achieving the long-term goals of climate action: full transposition/implementation of the EU acquis enabling a low carbon emissions and climate resilient development of the Beneficiary Country.*
Purpose:	• *To carry out the necessary analyses of the current situation and conditions in the Beneficiary country and assessments in preparation of the long-term Strategy and the Law on Climate Action, and in support of the adoption and implementation.* • *To establish a strong and sustainable framework for coordinating climate action by development the national strategic and legal framework for climate action through the long-term Strategy and Law on Climate Action (Law), including the Action Plan for the initial phase of implementation.* • *To establish the monitoring mechanism of GHG emissions in line with the EU Monitoring Mechanism Regulation No 525/2013 and its implementing provisions.* • *To strengthen the administrative capacity in line with EU accession in achieving low carbon competitive economy and climate resilient society/economy.* • *To raise awareness on climate action, support the stakeholders' consultations and facilitate inter-ministerial and inter-sectoral cooperation on the Strategy and Law.*
Expected Results:	• Completed analysis that includes background analytical and technical reports on specific strategic and legal issues that will serve as background and input to the Strategy and Law. The reports should be concise, directed at policy-makers, and focus on providing input to Strategy and Law (indicative max. length of each report 30-50 pages). • Prepared Report on assessment of the capacity, administrative and financial needs for implementation of Strategy and Law, and on the legal competences of governmental and executive bodies, with conclusion on the Strategy and Law. • Prepared Report on the road map for transposition and implementation of EU climate acquis, with recommendations on the legal framework to be established by the Law on Climate Action. • Prepared Report on assessment of the current knowledge and research results as well as gaps on GHG scenarios and low emissions and climate resilient development paths, assessment of mitigation measures, including the assessment of economic impact, and on the research and decision-making framework for the path towards future targets, with policy-relevant conclusions to be included in Strategy and Law. • Prepared Report on the country's vulnerability to climate change, based on available studies, with identification of priority adaptation/climate resilience objectives, including the research and decision-making framework, with policy-relevant conclusions to be included in Strategy and Law. • Completed draft long-term Strategy on Climate Action. • Completed draft legal text of the Law on Climate Action with secondary legislation. • Completed Secondary legislation transposing MMR and consequent amendments and Implementation plan of MMR developed. • Completed draft Action Plan on implementation of the initial phase of Strategy and Law. • Completed Implementation plan and legal framework for the system for the monitoring mechanism of GHG emissions, in line with the EU Monitoring Mechanism Regulation No 525/2013. • Completed Strategic Environmental Impact Assessment report on the long-term Strategy on Climate Action. • Completed training activities, supporting the strategic and legal framework for climate action.

	• Concluded awareness raising, visibility events and stakeholder consultation activities.
Key Activities:	• ***Activity 1:*** *Inception phase* • ***Activity 2:*** *Preparatory analysis/assessment for the long-term Strategy and Law on Climate Action* • ***Activity 3:*** *Development of the draft long-term Strategy on Climate Change* • ***Activity 4:*** *Alignment of national legislation to the monitoring and reporting regulation MMR and consequent amendments* • ***Activity 5:*** *Development and drafting of the Law on Climate Action* • ***Activity 6:*** *Development of the draft Action Plan on Climate Change* • ***Activity 7:*** *Training programme on implementation of the strategic and legal framework for climate action* • ***Activity 8:*** *Awareness raising, visibility and stakeholder consultations*
Key Stakeholders and Target Groups:	- *Government institutions and inter-institutional bodies, state agencies and authorities, such as: Ministry of Environment and Physical Planning, Ministry of Economy, (departments on energy and industry) Cabinet of vice-prime minister in charge for economic affairs, Secretariat for European Affairs, Ministry of agriculture, forestry and water supply (from departments in charge on agriculture, forestry and water supply), Ministry of Transport and Communications and Agency for energy.* - *Societal stakeholders, including industrial and business associations, e.g. Chambers of Commerce, and environmental NGOs.* - *Educational and research institutions such as MANU, Faculty on information technologies (FINKI).* - *International organizations and donors and international and national financing institutions and trust funds.*

Annex 12. References

Center for Climate Change, Gevgelija (2017). “Constraints and gaps, and related financial, technical and capacity needs for climate change mainstreaming in Macedonia.” Prepared by Mladenovska, D., Stojanovski, F., and R. Pisturovski. Skopje: UNDP-GEF project documentation.

City of Skopje (2017). *Resilient Skopje: Climate Change Strategy* (published February 2017). Skopje: City of Skopje, Nature and Environmental Protection Department.

Dimovski, Metodija (2017). “Report on the Results of the Mapping of the Existing Relevant MRV Systems.” Skopje: UNDP-GEF project documentation.

European Environment Agency (2017). EIONET Reporting Obligations Database. http://rod.eionet.europa.eu/ Accessed 17 October 2017.

Ibid. (2016). *EMEP/EEA Air Pollution Inventory Guidebook 2016: Technical Guidance to Prepare National Emission Inventories.* EEA Report 21/2016. Luxembourg: Publications Office of the European Union.

European Commission (2020). Report on institutional analysis and assessment of administrative capacity needs for climate action (draft). *Part of the EU-funded initiative: Preparation of Long-term Strategy and Law on Climate Action” - Republic of North Macedonia.*

European Union (2016). “Reform Programme developed within the EU IPA-funded project ‘Strengthening capacities for implementation of environmental legislation on local level,’ implemented 2015-2016.” Project ID: MK-Skopje: IPA — Strengthening capacities for implementation of environmental legislation at local level 2013/S 036-055783

Gecevska, V. (2020). Rapid Assessment Report: Current status of the research, development, innovation and technology transfer related to climate change in the Republic of North Macedonia.

GEF, MOEPP, UNDP (2017). *National Climate Change Platform.* http://www.klimatskipromeni.mk/default.aspx Accessed 16 October 2017.

Gjorgjievski, Mate and Mila Stankovic (2012). “Using EU Funds in North Macedonia: Potential and Constraints for the Regional Development.” In *The Use of EU Funds in Macedonia: Efficiency, Impact, and Absorption Capacity – A Collection of Studies*. Skopje: EPI.

Government of North Macedonia (2010). *Strategy for improvement of the energy efficiency in North Macedonia until 2020* (Official Gazette of North Macedonia No. 143/2010).

Government of North Macedonia (2008). *Waste Management Strategy of North Macedonia (2008-2020).* Skopje, March 2008.

IPCC (2006). *2006 IPCC Guidelines for National Greenhouse Gas Inventories.* Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds.). Japan: IGES.

Iseni, Drilon, et. al. (2013). *The Use of EU Funds in North Macedonia*. Skopje: European Policy Institute Skopje, March 2013. http://www.epi.org.mk/docs/use_of_eu_funds_in_rm_en.pdf Accessed 20 Oct 2017.

Kanevce, G., et al (2017). “National Inventory Report: Republic of Macedonia.” Prepared for the Ministry of Environment and Physical Planning. Skopje: Research Center for Energy and Sustainable Development, Macedonian Academy of Science and Arts (RCESD-MASA).

Ibid. (2017). Second Biennial Update Report on Climate Change of North Macedonia (Climate Change Mitigation). Prepared for the Ministry of Environment and Physical Planning. Skopje:

Research Center for Energy and Sustainable Development, Macedonian Academy of Science and Arts (RCESD-MASA).

Markovska, Natasa (2016). “National Climate Change Perspectives after Paris: National Requirements and Synergies in Climate Change Reporting towards UNFCCC and EU: Final Version.” Skopje: UNDP-GEF project documentation, 15 Nov 2016.

Milieukontakt (2017). “Municipal Climate Change Strategies Project.” Additional information available at http://milieukontakt.mk/mccsp/ Accessed 16 October 2017.

Ministry of Economy (2015). Rulebook on Energy Balances and Energy Statistics. Skopje.

Ibid. (2010). Strategy for Energy Development in North Macedonia until 2030. Skopje:

Ministry of Economy. http://www.ea.gov.mk/projects/unece/docs/legislation/Macedonian_Energy_Strategy_until_2030_adopted.pdf Accessed 20 Oct 2017.

Ministry of Transport and Communications (2007). National Transport Strategy of North Macedonia, 2007-2017. http://www.seetoint.org/wp-content/uploads/downloads/2014/01/FYRM_Transport-Strategy-2007-2017.pdf Accessed 20 Oct 2017.

Tehnolab (2013). “Report on National CO_2 and non-CO_2 emission factors.” Skopje: Tehnolab.

UNDP (2016). “A solution for ‘smart recycling’ triumphs in Skopje climate challenge contest.” Press release, 27 June 2016. Skopje: UNDP.

UNDP and MOEPP (2014). Climate change perception and awareness level: an online survey of the citizens of North Macedonia. November 2014. http://klimatskipromeni.mk/UNDP/SURVEY/SurveyResultsMK.html Accessed 20 Oct 2017.

UNDP, UNEP, GEF (2015). *Gender Responsive National Communications Toolkit.* See: http://www.un-gsp.org/news/gender-responsive-national-communications-toolkit. Accessed 20 Oct 2017.

UNFCCC (2015) “Summary Report on the Technical Analysis of the first biennial update report of the Former Yugoslav Republic of Macedonia submitted on 26 February 2015.” FCCC/SBI/ICA/2015/TASR.1/MDK (29 September 2015). UNFCCC.

[Author not identified] (2016). GAP ANALYSIS: SDG Mainstreaming into the National Sustainable Development Planning for the Period 2016-2030.