REPUBLIC *of* ARMENIA

SECOND BIENNIAL UPDATE REPORT

UNDER THE UNITED NATIONS FRAMEWORK

CONVENTION ON CLIMATE CHANGE

REPUBLIC OF ARMENIA
MINISTRY OF NATURE PROTECTION

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Armenia's Second Biennial Update Report has been developed by the Ministry of Nature Protection of the Republic of Armenia with the funding of the Global Environmental Facility and support of the United Nations Development Programme in Armenia within the framework of the "Development of Armenia's Fourth National Communication to the UNFCCC and Second Biennial Update Report" project.

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FOREWORD

On behalf of the Republic of Armenia, I am pleased to present the country's Second Biennial Report under the United Nations Framework Convention on Climate Change.

This report presents updated information on our First Biennial Update Report in a more transparent, accurate and complete way based upon the lessons learned from the International Consultation and Analysis.

Considering the importance of joint efforts to combat climate change, the Republic of Armenia has ratified the Doha Amendment of the Kyoto Protocol and Paris Agreement and submitted its Intended Nationally Determined Contributions which defines the country's pathway up to 2050 towards its contribution to implementing the Agreement. To this aim, Armenia continues mainstreaming and integrating climate change consideration into national and sectoral development policies, while energy efficiency and renewable energy are of high priority contributing also to economic and social goals.

Armenia has already taken tangible steps in this direction. The most recently adopted policy papers are aimed at promoting development of renewable energy sources, resulting, in particular, in the boost of solar energy installations.

In addition to the reporting on mitigation actions and their effects, the projections of Armenia's greenhouse gas emissions up to 2030 have been made. The projections have been done for the different development scenarios, enabling to assess greenhouse gas emissions growth risks as well as fully reflect energy efficiency and renewable energy potential.

I would also like to thank for the support received through multilateral and bilateral channels.
The support has a substantial contribution in addressing climate change mitigation needs and will enable Armenia as a developing country to further undertake its climate change activities and implement its contributions under Nationally Determined Contributions.

Finally, considering the importance of tracking progress made in implementing the nationally determined contributions and in achieving sustainable development goals, the Republic of Armenia will continue its efforts to enhance the transparency on reporting to the extent possible.

Artsvik Minasyan

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ABBREVIATIONS

AFOLU	Agriculture, forestry and other land use
AMD	Armenian dram
CCGT	Combined cycle gas turbine
CDM	Clean Development Mechanism
CJSC	Closed joint stock company
BAT	Best Available Technologies
BUR1	First Biennial Update Report
BUR2	Second Biennial Update Report
EE	Energy Efficiency
E5P	Eastern Europe Energy Efficiency and Environmental Partnership
EaP	EU Eastern Partnership
EBRD	European Bank for Reconstruction and Development
EE	Energy efficiency
EIB	European Investment Bank
EU	European Union
EUR	Euro
GCF	Green Climate Fund
GDP	Gross domestic product
GEF	Global Environment Facility
GGF	Green for Growth Fund.
GHG	Greenhouse gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GoA	Government of Armenia
GPG	Good practice guidance
GSP	Global Support Programme
GWP	Global warming potential
HPP	Hydropower plant
Hydromet Service	"Service of the Hydrometeorology and Active Influence on Atmospheric Phenomena" SNCO of the Ministry of Emergency Situations of the Republic of Armenia
IBRD	International Bank of Reconstruction and Development
ICA	International Consultation and Analysis
IFC	International Finance Corporation
INDC	Intended Nationally Determined Contributions
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial process and product use
KfW	German Bank for Reconstruction and Development
LEAP	Long-range Energy Alternatives Planning
LED	Light-emitting diode
LPG	Liquid petroleum gas
MoA	Ministry of Agriculture of the Republic of Armenia
MoENR	Ministry of Energy Infrastructures and Natural Resources of the Republic of Armenia
MNP	Ministry of Nature Protection of the Republic of Armenia
MRV	Measuring, Reporting and Verification
MSW	Municipal solid waste
NA	Not applicable
NAMA	Nationally appropriate mitigation actions
NE	Not estimated
NEEAP	National Energy Efficiency Action Plan
NGO	Non-governmental organization
NIR	National Inventory Report
NMC	National Mortgage Company
NO	Not occurring
NPP	Nuclear power plant
NSS	National Statistical Service of Republic of Armenia
OECD	Organisation for Economic Co-operation and Development
PPP	Purchasing power parity
PSRC	Public Services Regulatory Commission

PV	Photovoltaics
QA/QC	Quality assurance and quality control
R2E2 Fund	Armenia Renewable Resources and Energy Efficiency Fund
RA	Republic of Armenia
RE	Renewable energy
SHPP	Small hydropower plant
SME	Small and medium enterprise
SNCO	State non-commercial organization
SPAN	Specially protected area of nature
SREP	Scaling up Renewable Energy Program
SW	Solid waste
TNA	Technology Needs Assessment
TNC	Third National Communication
TPES	Total primary energy supply
TPP	Thermal power plant
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change

Chemical Combinations

CO_2	Carbon dioxide
CH_4	Methane
N_2O	Nitrous oxide
CFCs	Chlorofluorocarbons
HFCs	Hydrofluorocarbons
PFCs	Perfluorocarbons
SF_6	Sulfur hexafluoride
CO	Carbon monoxide
NOx	Nitrous oxides
SO_2	Sulfur dioxide
NMVOC	Non-methane volatile organic compounds
USAID	United States Agency of International Development
USD	United States Dollar
USSR	Union of Soviet Socialist Republics
WAM	With additional measures
WB	World Bank
WM	With measures
WOM	Without measures
WWF	World Wildlife Fund

Measurement Units

^0C	degree Celsius
eq.	equivalent
Gcal	gigacalorie (10^9 calorie)
Gg	gigagram (10^9 g, or thousand t)
GWh	gigawatt hours (10^9 Wh)
MW	megawatt
PJ	petajoule (10^{15}J)
t	tonne
TJ	terajoule (10^{12}J)
toe	tonne of oil equivalent (1 toe = 1.43 t equivalent fuel)

Energy units conversion

1 PJ = 277.8 GWh =$23.88 * 10^3$ toe

1 toe = 41. 868 GJ

Executive Summary

The Second Biennial Update Report of the Republic of Armenia is developed according to the United Nations Framework on Climate Change (UNFCCC) Decisions 1/CP.16 and 2/CP.17 and provides the updated information reported in the First Biennial Update Report on national circumstances, greenhouse gas inventory, progress in mitigation policies and actions, Measurement, reporting and verification system as well as on support received and needs.

The Report also provides projections and assessment of Energy sector development scenarios up to 2030, considering that Energy is a strategic sector for the country and has the highest mitigation potential.

S-1. National Circumstances

State structure: The Republic of Armenia (RA) was established on September 21, 1991. Armenia made transition from a semi-presidential system to a parliamentary republic as a result of constitutional amendments pursuant to the referendum held on December 6, 2015. The Republic of Armenia is a sovereign, democratic, social and legal state. The state power is administered pursuant to the Constitution and the laws based on the principle of separation of the legislative, executive and judicial powers.

Location: Armenia is a mountainous landlocked country covering 29,743 km^2. Located in the Southern Caucasus bordering Georgia to the north, Azerbaijan to the east, Iran to the south and Turkey to the southwest.

Population: As of 2014, the population is 3010.6 thousand people, 63.5 per cent is urban population.

Economy: As of 2014, GDP is 4,829 billion AMD (11,610 million, current US$); GDP, PPP - 23,166 million; GDP per capita, PPP -7,694 (both in constant 2011 international $). Trade and services play a key role in national economy- 45.3 per cent of GDP in 2014, and are on a continuous growth trend.

Fuel and Energy Resources: Armenia lacks domestic industrial-scale fossil fuel resources and meets its demand for fuel through imports.

In 2014, nearly 69 per cent of Total primary energy supply (TPES) of Armenia was imported considering nuclear energy as an indigenous resource.

Climate: The climate is highland continental, dry with four seasons.

The average annual temperature ranges from -8°C in high-altitude mountainous regions (2,500 m and higher) to 12-14°C in low-traced valleys.

The temperature significant increase trends were observed in recent decades: by 0.4°C for the period of 1929-1996, by 0.85°C for the period of 1929-2007 and by 1.23°C for the period of 1929-2016.

The average annual precipitation is 592 mm.

S-2. National Greenhouse Gas Inventory

The inventory of greenhouse gases reported in the BUR2 covers the years 2013 and 2014. It compiled according to the *2006 IPCC Guidelines for national greenhouse gas inventories* for Energy, Industrial Processes and Product Use (IPPU), Agriculture, Forestry and Other Land Use (AFOLU) and Waste sectors. The greenhouse gas inventory covers emissions and removals of four direct greenhouse gases –carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and hydrofluorocarbons (HFCs) – in a series of time from 2000 to 2014. It includes also estimates of so-called indirect greenhouse gases - carbon monoxide (CO), nitrogen oxides (NOx), non-methane volatile organic compounds (NMVOCs) and sulfur dioxide (SO_2).

The estimated CH_4, N_2O, HFCs emissions were converted to CO_2 equivalent ($CO_{2eq.}$) using Global Warming Potential (GWP) values provided by the IPCC in its Second Assessment Report ("1995 IPCC GWP Values") based on the effects of greenhouse gases over a 100-year time horizon.

The Armenia's greenhouse gas total emissions in 2014 amounted to 10,450.71 Gg $CO_{2eq.}$ and net emissions - 9,973.57 Gg $CO_{2eq.}$. The total greenhouse gas emissions were some 4 per cent (434.5 $CO_{2eq.}$) higher than those in 2012. This change is mainly due to the increase in F-gases emissions from refrigeration and cooling devices, increase in livestock populations and in emissions from managed soils attributed to fertilizer use.

The greenhouse gas emissions per unit of GDP in 2014 was 0.94 t $CO_{2eq.}$ that shows a relatively stable level since 2010. However the per capita GHG emissions 3.31 t $CO_{2eq.}$ shows slight increase resulted from the reduction of population.

S-3. Mitigation Actions and Their Effects

Energy is a strategic sector for the country, playing a key role in achieving economic growth, national security and environmental goals. The sector predominates in the country's total emissions (with the share of over 67 per cent in 2014) with the highest mitigation potential. Therefore, the Energy sector has been the focus while assessing mitigation actions and making projections of Armenia's greenhouse gas emissions to align the strategy of the sector with the Armenia's environmental objectives and implementation of the country's contribution under INDC.

The Energy sector development strategy is based upon development and expansion of economically viable and technically available renewable energy sources, development of nuclear energy, promotion of energy efficiency/ energy savings, diversification of fuel supply chains along with regional cooperation and integration. This strategy is reflected in the most recently (2013-2017) adopted policy papers, development concepts, investment programs as well as amendments to the RA Energy Law and RA Energy Saving and Renewable Energy Law which along with on-going/ planned mitigation actions have formed the basis for the greenhouse gas emissions projections.

GDP energy intensity in 2014 was 0.287 toe/ thousand USD, showing a continuous downward trend since 2000. Per the projections, this trend will be maintained up to 2030 as a result of the implementation of mitigation actions.

In 2014 the greenhouse gas emissions per unit of TPES were 2.2 t CO_2 eq. /toe, showing a relatively stable level since 2010.

S-4. Support Received and Needs

The Republic of Armenia has received support including technology transfer, capacity building and climate finance from external sources through multilateral and bilateral channels.

The support has a substantial contribution in addressing climate change mitigation needs of Armenia through the implementation of the sectoral policies and programs and promotion of environmentally friendly business solutions. It will enable Armenia as a developing country to further undertake its climate change activities and implement its contributions under INDC.

The constraints and gaps identified while developing BUR2 are mainly related to the lack of institutional/formal arrangements as it is in case of data collection for inventory and mitigation actions, and to the absence of MRV comprehensive framework as a whole.

S-5. Measurement, Reporting and Verification

The Paris Agreement calls to enhance the transparency framework for action and support, indicating that all Parties should work on common modalities, procedures and guidelines, building on experience from the arrangements related to transparency under the Convention including national communications, biennial update reports and international consultation and analysis process for developing countries. In so doing, the support shall be provided to developing country Parties to build transparency framework.

According to the RA Government Protocol Decision N 49-8 of December 8, 2016 "On approval of the list of measures to be implemented in the fulfilment of the Republic of Armenia's Obligations Emanated from a number of International Environmental Conventions", the MRV system should be established in 2019 and the Ministry of Nature Protection of RA is responsible for coordination of that process.

The proposed arrangement for MRV should be implemented gradually, proceeding from national circumstances and existing local capacities and taking into account the best practices of other countries. It envisages institutional reforms aimed at coordinating all activities related to preparation of national communications and biennial update reports, including: establishment of legal/formal arrangements, identification of common approaches for assessing mitigation actions, as well as procedures for verification and archiving of information.

CHAPTER 1

National Circumstances

1.1 Location and Natural Resources

Location: The Republic of Armenia is a mountainous landlocked country located in the South Caucasus region of Eurasia. Armenia borders Turkey in the west, Georgia in the north, Azerbaijan in the east and Iran in the south. The area of the country is 29,743 km^2, ranked as the 138th in the world.

Relief: Around 90 per cent of the area is at 1,000 m above sea level, with 40 per cent exceeding 2,000 m. The highest point of Armenia is 4,090 m (the top of Mount Aragats), the lowest point is 375 m. The average altitude above sea level is 1,830 m. The country's southwest is occupied by rather flat Ararat Valley (average height is 850-1,000 m) which is the most important agricultural region. Rugged terrain and slope processes have resulted in active exogenous processes, contributing to landslides, soil erosion and degradation.

Climate: The climate of Armenia is highland continental, dry with four seasons. Almost all types of climatic patterns can be observed in Armenia – from arid subtropical to cold, high mountainous. The average annual temperature ranges from -8°C in high-altitude mountainous regions (2,500 m and higher) to 12-14°C in low-traced valleys.

The average annual precipitation in Armenia is 592 mm. Armenia is characterized by the significant intensity of solar radiation: the average annual amount of solar energy flow per square meter of horizontal surface is about 1,700 kWh and the annual sunshine is 2,500 hours.

The temperature significant increase was observed in recent decades. The annual average ambient air temperature increased by 0.4°C for the period of 1929-1996; by 0.85°C for the period of 1929-2007; and by 1.23°C for the period of 1929-2016.

The decrease tendency of precipitation is observed: annual average precipitation is decreased by 6 per cent for the period of 1935-1996 and by almost 9 per cent for the period of 1935-2016.

The territory of Armenia is characterized by hazardous hydrometeorological phenomena causing significant losses to the population and the economy.

Land Resources: According to the 2015 land balance, agricultural lands occupy 68.8 per cent of the territory of the country, lands of specially protected areas of nature (SPAN) – 11.3 per cent, forest lands – 11.2 per cent, wetlands – 0.9 per cent, settlement, industrial, communication, transport, utility infrastructure lands – 6.6 per cent and other lands –1.2 per cent.

Water resources: Rivers in Armenia are tributaries of the large Araks and Kura rivers in South Caucasus. About 9,500 small and midsize rivers flow in the territory of Armenia with the total length of 25 thousand km. The density of the river network varies significantly across the country (0 - 2.5 km/km^2). The irregularity of river flow distribution, both annually and multi-annually, is typical for the rivers of Armenia. As of 2016, the annual average flow of surface waters totaled to 7.7 billion m^3 while ground water resources were estimated at about 4.017 billion m^3.

Natural resources: Armenia is rich in copper, molybdenum, polymetallics, constructional stone, mineral water and precious metals.

1.2 Population

The population of the Republic of Armenia is 2,998.6 thousand people (as of January 1, 2016). The majority of the population lives in urban areas (1,907 thousand people or 63.6 per cent) and approximately 38 per cent of the population lives in Yerevan. Rural population is 1,091.6 thousand people (36.4 per cent). Population density is 101 person/km^2. The distribution of the population is extremely uneven because of the country's mountainous relief and the different levels of economic development. The highest population density of 686 person/km^2 is in the zones up to 1,000 m above sea level and the lowest density of 22 persons per km^2 is in high-altitude zones at up to 2,000-2,500 m above sea level.
The economically active population was 1,316.4 thousand people as of 2015.

There has been a steady decline in the population of Armenia after 1990 because of the fall of natural growth rate and emigration. The population decreased by 516 thousand people (14.6 per cent) in 2015 as compared to 1990, while the rate of natural growth fell 3.5 times (Table 1.1).

Table 1.1 Population of the Republic of Armenia

Indicator	1990	2000	2010	2012	2014	2015
Number (thousand people)	3,515	3,215	3,035	3,027	3,011	2,999
Rate of natural growth (per 1000 people)	16.3	3.1	5.5	4.9	5.1	4.6

Source: Statistical Yearbook of Armenia (2016)

1.3 Economy

Macroeconomic indicators: After the fall of the USSR followed by the sharp economic downturn (53 per cent) in 1991-1993, the country stepped on the path of transition to a market-driven economy with a shift from heavy industry to services, managed to overcome the difficulties of the transition period and to ensure an economic growth. Armenia's GDP increased annually by 5.4 per cent in average during 1995-2000 and the average annual GDP growth was 12.4 per cent during 2001-2006. This annual growth slowed down to 2.2 per cent, in average, during 2007-2010 because of the worldwide financial crisis. The average annual growth for 2011-2015 was 4.4 per cent (Table 1.2).

Table 1.2 Main macroeconomic indicators

Indicator	1995	2000	2010	2012	2014	2015
GDP, billion AMD	522	1,031	3,460	4,266	4,829	5,032
GDP (constant 2010 US$), M	3,357	4,311	9,260	10,394	11,123	11,457
GDP, PPP (constant 2011 international $), M	6,992	8,978	19,286	21,646	23,166	23,860
GDP per capita, PPP	2,145	2,793	6,355	7,151	7,694	7,956
Inflation (per cent annual)	176	-0.8	8.2	2.6	3.00	3.7
Export (million US$)	271	300	1,041	1,380	1,547	1,485
Import (million US$)	674	885	3,749	4,261	4,424	3,239

Source: Statistical Yearbook of Armenia (1996, 2001, 2011- 2016),
http://data.worldbank.org/indicator/NY.GDP.MKTP.PP.CD
http://data.worldbank.org/indicator/NY.GDP.PCAP.PP.CD

Armenia is a country with a small domestic market and its economy depends substantially on competitiveness in foreign markets[1]. Hence, innovative development of the main sectors of economy is the issue of top priority.

Armenia has implemented extensive business environment reforms and improved investment climate in the country during the recent years.

Armenia improved its Doing Business ranking in 2014–2016, reaching 35th position out of 189 economies. The World Economic Forum's Global Competitiveness ranking improved from 98th position in 2010–2011 (out of 139) to 82nd in 2015–2016 (out of 140).[2]

The structural changes in the economy have been reflected in the GDP composition as follows:

Table 1.3 GDP Composition, (%)

Components	1990	2000	2005	2010	2012	2014	2015
Industry, including energy	32.7	23.7	21.8	15.5	16.1	16.0	16.2
Agriculture, forestry, fishery	17.2	25.1	19.9	17.0	16.1	18.1	17.3
Construction	19.1	11.1	19.6	17.3	11.7	9.3	9.5
Trade and services	23.0	31.0	31.0	39.0	43.6	45.3	46.4
Net taxes	8.0	9.1	8.6	11.2	10.7	11.3	10.6

Source: Statistical Yearbook of Armenia (1991, 2001, 2011-2016)

Social indicators: The unemployment rate was 17.5 per cent[3]; the poverty totaled 30 per cent[4]; the UNDP human development index was 0.733 (85th in the world) in 2014[5].

1.4 Energy

Fuel and Energy Resources

Armenia lacks domestic industrial-scale fossil fuel resources and meets its demand for fuel through imports; natural gas is imported from the Russian Federation and Iran while certain quantities of oil products – from the other countries as well. Vast majority of natural gas come from Russia - nearly 84 per cent in 2014. Hence, it is the urgent need for Armenia to increase its indigenous energy production, improve the transmission infrastructure and reduce its dependence upon external suppliers.

Armenia relies on electricity and natural gas to meet the majority of its energy consumption needs. Imported natural gas predominates in total primary energy supply in Armenia accounting for 63 per cent of Armenia's TPES and 84.8 per cent of the fossil fuel consumption in 2014. Almost 80 per cent of CO_2 emissions from fuel combustion in 2014 originated from natural gas. This is due to a very high gas deliverability level in the country - 94.6 per cent - and the widespread use of natural gas for heating and cooking purposes, because it is less expensive than electricity, as well as the widespread use of natural gas in transport as it is less expensive than petrol or diesel.

Figure 1.1 below describes the fossil fuel consumption structure by fuel types in 2014. In general, during 2011-2014 the consumption structure has remained almost unchanged.

[1] *RA Government Programme 2017-2022*
[2] *WB, Country Program Snapshot, 2016*
[3] *International Labour Organization*
[4] *WB, Household Integrated Living Conditions Survey, 2014*
[5] *UNDP, Human Development Report, 2015*

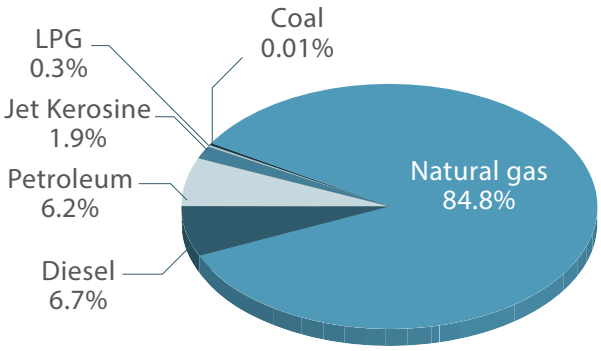


Figure 1.1 Fossil fuel consumption structure in 2014

Sector Regulation

The Ministry of Energy Infrastructures and Natural Resources of the RA is responsible for the development and implementation of polices in the energy sector.

The sector is regulated by the Public Services Regulatory Commission (PSRC) which is an independent regulatory body responsible inter alia for setting tariffs for gas and electricity generation and constituting electricity market rules.

Gazprom Armenia CJSC owned by Russia's Gazprom imports natural gas from Russia and Iran as well as owns and operates the gas transmission and distribution networks in the country.

Armenia is among the countries where fuel prices are taxed and not subsidized. Thus, there are no cross-subsidies from industrial to household consumers in Armenia, unlike several other countries of the EU Eastern Partnership (EaP) and Central Asia.

Total Primary Energy Supply

The economic downturn and energy crisis in 1991-1993 led to drastic reduction in the primary energy supply: in 1995 the primary energy supply accounted for 23 per cent (Table 1.4) and per capita supply for 26 per cent of the 1990 level, whereas the supply of oil products decreased by about 90 per cent, and the natural gas supply by about 70 per cent. Since 1995, there has been gradual increase in the primary energy supply.

In 2014 the primary energy supply reached 39.6 per cent and per capita supply - 46.3 per cent of the 1990 level.

The total primary energy supply structure in 1990-2014 is described in Table 1.4 and Figure 1.2.

Table 1.4 Total primary energy supply, ktoe

Resources	1990	1995	2000	2005	2010	2012	2013	2014
Natural gas	3608.2	1029.2	1122.4	1394.6	1459.0	1924. 5	1971.2	2008.0
	44.8%	55.5%	50.1%	50.4%	51.6%	63.1%	62.8%	62.9%
Oil products	3887.6	508.6	322.3	372.5	388.2	294.3	292.3	293.2
	48.2%	27.4%	14.4%	13.5%	13.7%	9.7%	9.3%	9.2%
Hydro power	160.0	169.5	107.5	152.8	245.9	198.8	186.9	171.3
	2.0%	9.1%	4.8%	5.5%	8.7%	6.5%	6.0%	5.4%
Nuclear power	0.0	52.5	518.2	702.0	649.5	602.3	614.8	642.2
	0.0%	2.8%	23.1%	25.4%	23.0%	19.8%	19.6%	20.1%
Coal	320.6	9.5	0.0	0.0	0.7	2.4	1.0	0.8
	4.0%	0.5%	0.0%	0.0%	0.0%	0.1%	0.01%	0.01%
Biomass	2.1	83.6	210.0	212.5	152.8	163.1	171.2	172.3
	0.0%	4.5%	9.4%	7.7%	5.4%	5.4%	5.5%	5.4%
Electricity imports/ exports	79.0	1.0	-40.0	-67.0	-68.0	-137.0	-100.2	-95.3
	1.0%	0.1%	-1.8%	-2.4%	-2.4%	-4.5%	-3.2%	-3.0%
Total	**8057.5**	**1853.9**	**2240.4**	**2767.4**	**2828.1**	**3048.4**	**3137.25**	**3192.65**

Source: Ministry of Energy (1990-2001), Gazprom Armenia CJSC (2002-2013), PSRC, Statistical Yearbook of Armenia (2011-2015)

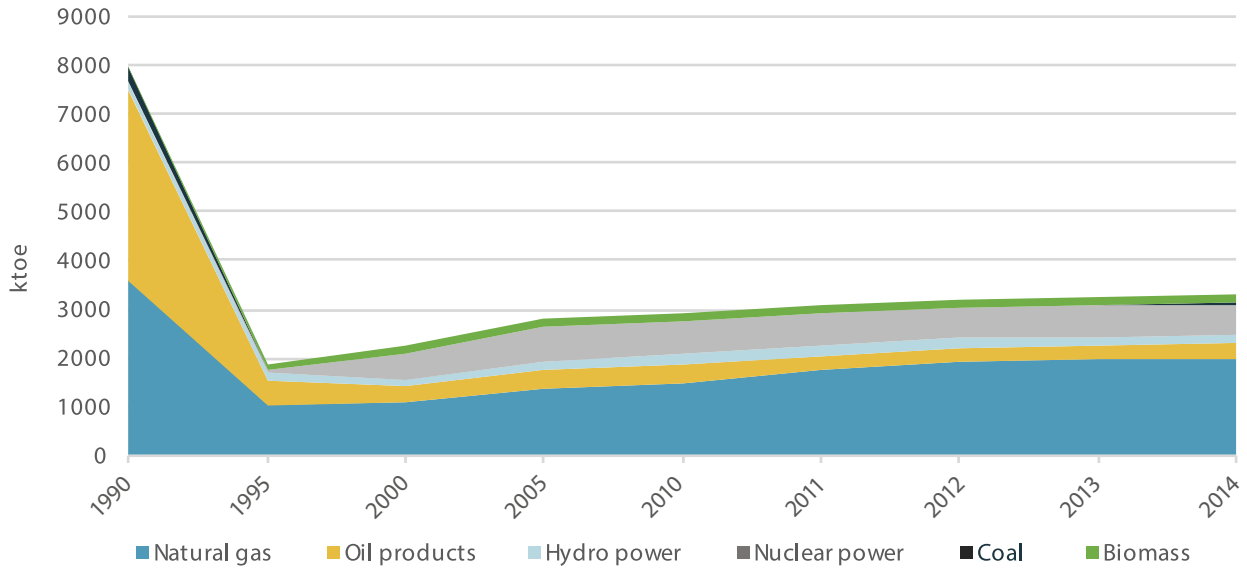


Figure 1.2 Total primary energy supply in 1990-2014

The increased share of natural gas, nuclear power and hydro power in the structure of the total primary energy supply in 2014, as compared with 1990, and the reduction in the share of oil products are an evidence of low-carbon development trends in Armenia.

Final Energy Consumption

The final energy consumption for 1990-2014 is described in Figure 1.3; Figure 1.4 shows the final energy consumption structure in 2014.

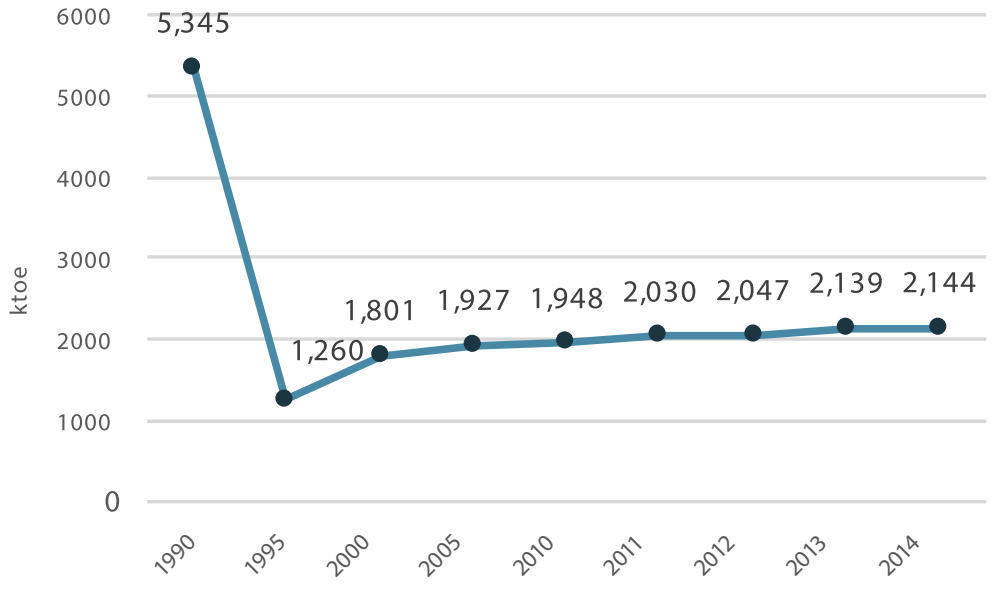


Figure 1.3 Final energy consumption, ktoe

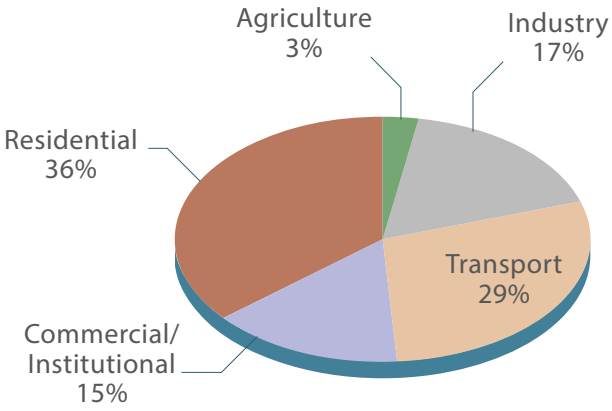


Figure 1.4 Final energy consumption structure

The final energy consumption has been on a rising trend since 1995, however, in 2014 the consumption accounted for about 40 per cent of the 1990 level. In 2014 the final energy consumption increased by 71.2 per cent as compared to the 1995 level, by 10.1 per cent as compared to the 2010 level and by 4.7 per cent as compared to the 2012 level.

The residential sector was the largest energy consumer, responsible for 36 per cent of the final energy consumption in 2014, followed by the transport sector (29 per cent), industry (17 per cent) and commercial/institutional sector (15 per cent).

In 2014 the energy intensity of GDP was 48 per cent lower than in 1995 because of the structural changes in the economy, i.e. decreased share of the energy intensive industries and increased share of the service sector as well as due to measures aimed at improving energy efficiency and energy savings.

Table 1.5 Energy consumption indicators for 1990-2014

Indicator	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014
Total primary energy supply (TPES)	ktoe	8,058	1,854	2,240	2,767	2,828	2,966	3,048	3,137	3,193
Final energy consumption	ktoe	5,345	1,260	1,801	1,927	1,948	2,030	2,047	2,139	2,144
Per capita primary energy consumption	toe/ person	2.29	0.57	0.7	0.86	0.93	0.98	1.01	1.04	1.06
GDP energy intensity	toe/ 1000 USD		0.55	0.52	0.36	0.31	0.306	0.293	0.292	0.287

Power Generation

The main power generation capacities in Armenia are the nuclear power plant, natural gas fired thermal power plants (including small cogeneration units), large hydropower plants as well as small renewables (small hydro, biogas plant, wind farm), which provided respectively 31.8 per cent, 42.4 per cent, 16.9 per cent, 8.9 per cent of the total electricity generation in 2014 (Table 1.6). As of 2014, renewable energy consisted mainly of hydropower (small to large HPPs).

Since 2010, Armenia has transitioned from being a net importer to a net exporter of power.

Table 1.6 Power generation by plant type (million kWh) and power generation structure

Plant type	2010	2011	2012	2013	2014	2015
Nuclear	2,490	2,548	2,311	2,359.7	2,464.8	2,787.7
	38.4%	34.3%	28.8%	30.6%	31.8%	35.7%
Thermal	1,443	2,395	3,398	3,173.1	3,288.6	2,801.3
	22.2%	32.2%	42.3%	41.2%	42.4%	35.9%
Hydro	2,143	2,033	1,814	1,433.1	1,307.8	1,369.3
	33.0%	27.3%	22.6%	18.6%	16.9%	17.6%
Small renewable	416	458	513	744.1	688.9	839.9
	6.4%	6.2%	6.4%	9.7%	8.9%	10.8%
Total	**6,492**	**7,434**	**8,036**	**7,710**	**7,750.1**	**7,798.2**

1.5 Industry

The breakdown of the former USSR and the common economic area coupled with the challenges of transition to a market-driven economy have been among the main causes for the Armenia's economic downturn: the volume of industrial production in 1993 accounted for 43 per cent of the 1990 level. The country managed to overcome the challenges and ensure a certain growth of industrial production since 1994. In the period of 2000-2005 the annual average growth of industrial production was 8 per cent, in 2006-2010 - 1.2 per cent and in 2011-2015 - 7.5 per cent.

Armenia has advocated an industry-oriented policy targeting at the development of sectors with certain export potential, introduction of advanced technologies and development of science-based sectors along with the sustainable development of the existing ones. Figure 1.5 below describes the volume of industrial output by sectors of economic activities for 2015.

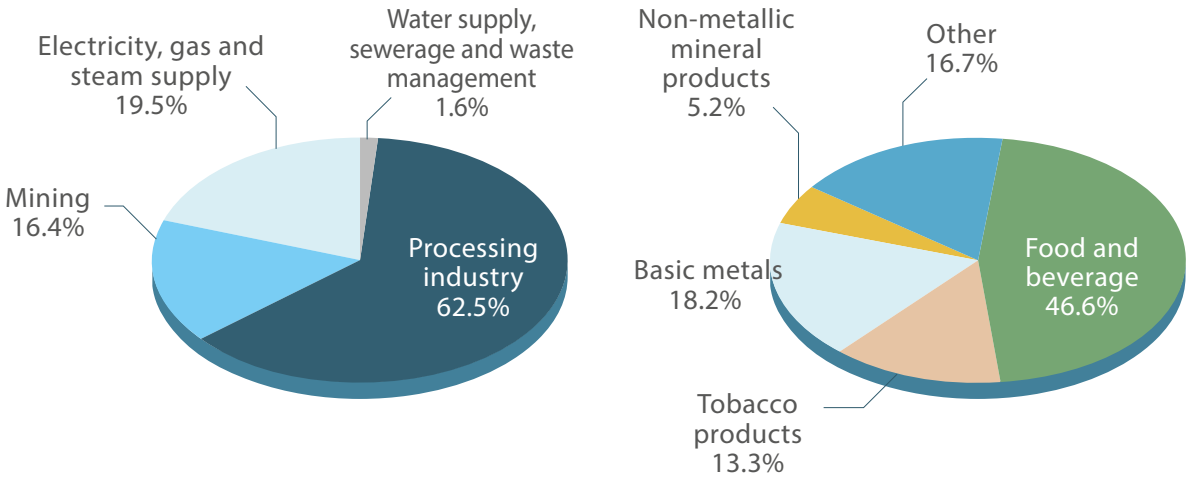


Figure 1.5 Industrial output by sectors of economic activities, %

Source: Statistical Yearbook of Armenia (year 2016).

The processing industry accounts for the largest share (over 60 per cent) in the industrial output, half of which comprises food and beverage production. This subsector has an excellent potential for export and attracting investment.

Armenia's mining plays a key role in the national economy. The country is rich in iron, copper, molybdenum, lead, zinc, gold, silver, antimony, aluminum, as well as in rare and scattered metals. Mountainous rocks formed as a result of volcanic processes in the territory of Armenia are of special value and significance, the most important of which are light rocks (tufa, perlite, pumice-stone, zeolite, scoria, etc.). There are significant resources of various types of basalts, granites, nephelite syenite, and marble in the country as well.

The mining industry is one of the largest contributors to tax revenues, exports and foreign direct investments.

1.6 Transport

The transport sector includes railways, road and air transportation. In 2014, road transport accounted for the majority of cargo and passenger transportation – 63 per cent and 89 per cent, respectively.

The road network is essential for the sustainable economic development of Armenia as a landlocked country with limited transport routes. It has a substantial impact on the economic competitiveness of the country and to a great extent contributes to the success of its export-oriented economy. The total length of the country's road network is 7,704 kilometers, excluding urban roads, less than half of which is in good or fair condition.[6]

Since 2000 there has been a rapid growth of the natural gas consumption in the road transport: in 2014 it accounted for 66.7 per cent.

1.7 Buildings

In 2015 the housing stock in Armenia comprised 19,053 multi-apartment residential buildings and 427,959 single–family houses. 64 per cent of the multi-apartment buildings and 93.7 per cent of the total living floor area are in urban communities, and 36 per cent of buildings and 6.3 per cent living floor area – in rural communities, whereas 37 per cent of single-family houses were in urban communities and 63 per cent – in rural communities. Capital city of Yerevan accounted for 25 per cent of multi-apartment buildings and 53.5 per cent of total living floor area.

The following types of fuel are consumed in the residential sector: natural gas, liquid petroleum gas (LPG), fuelwood, and manure (consumption of kerosene and coal is negligible). The natural gas predominates in the total fuel consumption – accounting for 70 per cent, followed by biomass – 29 per cent (manure and fuelwood) in 2014 (Figure 1.6).

[6] *WB, "Country Program Snapshot", 2016.*

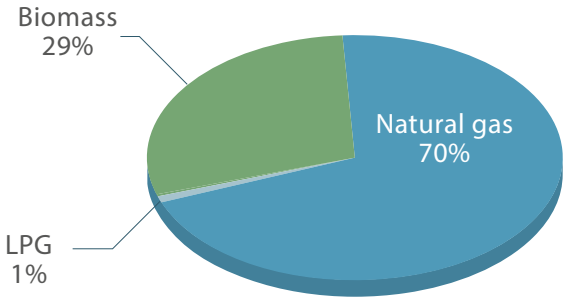


Figure 1.6 Fuel consumption in residential sector, 2014

Source: Housing stock and public utilities in Armenia; Statistical Bulletin, NSS of RA, 2015.

1.8 Agriculture and Forestry

Agriculture

The shift to a market-driven economy along with the privatization of the land and other means of agricultural industry, following the country's independence, has created preconditions for the successful development of the sector. Around 335,000 farms operate in the sector, with an average landholding of around 1.4 hectares per household. It is rather small for efficient agriculture and a diversified production system, both for crops and livestock.

Agriculture contributes substantially to the employment and rural incomes, as nearly 40 per cent of the total employment is involved in the sector. In recent years the crops constitute about 60 per cent and livestock – 40 per cent of the gross agricultural product.

Main agricultural crops in the country are: grain, vegetables, potatoes, fruits and berries, and grape. The agricultural products' processing industry is very diverse, export-oriented and includes almost all types of food processing industries.

Cattle breeding is the leading branch of animal husbandry and sheep breeding is one of the traditional animal husbandry branches in Armenia. There are more than 10 pedigree cattle raising farms in the country.

Forestry

In 2014, the forest stock in Armenia totaled to 456.9 thousand ha, including 349.2 thousand ha of the forest covered areas.

As a result of the energy crisis in 1992–1995, the illegal mass logging led to extremely negative consequences for the forest ecosystems: the estimated losses totaled to 6.0 million m^3. The illegal logging still continues, but on a smaller scale. Consequently, there is a need to improve the forest sector management and implement large-scale afforestation and reforestation measures.

In 2013 there was a reduction of the forest covered areas caused by "Teghut" mining operations and the work on cleaning the flooded shores of Lake Sevan.

1.9 Tourism

Throughout its long history (over 3,000 years), Armenia has been plagued with conflicts. However, in current more stable times, the country has had a substantial growth in tourism over the recent years. As the world's first Christian country, Armenia is rich in ancient monasteries and churches that date back thousands of years.

The Government of Armenia is striving to further increase the number of tourists by continuously improving the country's competitiveness, and turning the country into an attractive tourism destination.[7]

1.10 Greenhouse gas emissions and GDP energy intensity

The specific indicators of greenhouse gas emissions and the dynamics of GDP energy intensity is described in Table 1.7.

GHG emissions per unit of GDP in 2014 were 0.94 t $CO_{2eq.}$ that shows a relatively stable level since 2010. Per capita GHG emissions of 3.31 t $CO_{2eq.}$ were resulted from the reduction of population. GDP energy intensity in 2014 was equal to 0.138 toe reflecting the stable reduction trends in GDP energy intensity.

Table 1.7 GHG emissions and GDP energy intensity

Indicators	1990	2000	2010	2012	2014
GHG emissions per unit of GDP, t $CO_{2eq.}$/USD	-	1.46	0.91	0.96	0.94
GHG emission per unit of TPES, t $CO_{2eq.}$ /toe	2.82	1.92	2.06	2.27	2.2
Per capita GHG emissions, t $CO_{2eq.}$ /person	7.12	1.82	2.6	3.14	3.31
GDP (PPP) energy intensity, ktoe/million USD	-	0.25	0.15	0.141	0.138

1.11 Institutional arrangements for continuous development of national communications and biennial update reports

The Republic of Armenia has ratified the UNFCCC in 1993 and the Kyoto Protocol – in 2002.

The National Assembly of the Republic of Armenia has ratified the Paris Agreement (and Doha Amendment to the Kyoto Protocol) on February 8,

[7] *RA Government Program for 2017-2022*

2017 which came into force on April 22, 2017. The obligations of the Republic of Armenia under these international agreements are emanating from its non-Annex 1 developing country status under the UNFCCC. The countries position under the Convention and Paris Agreement was formulated in the "Intended Nationally Determined Contributions" (INDC) which was approved by the Government of Armenia on September 10, 2015 by Protocol Decree N 41-5, and submitted to the UNFCCC on September 22, 2015.

Biennial update reports and national communications along with the international consultation and analysis being the key tools of transparency arrangements under the Convention will serve as a basis for ensuring the enhanced transparency of action and support.

In light of the enhanced reporting requirements (both in terms of frequency and quality) there is a need to improve the corresponding institutional arrangements in Armenia, enabling development of the biennial update reports and national communications on a continuous basis for timely provision of information in a reliable, complete and transparent way. To this aim, certain steps have already been implemented.

Since the UNFCCC ratification, once every five years the Government of Armenia approves the list of measures for implementing the country's commitments under the international environmental conventions including the UNFCCC. The last one, approved by the RA Government Protocol Decision N 49-8 of December 8, 2016, includes inter alia the measures to be implemented within 2017-2021 in fulfillment of the obligations and provisions arising from the UNFCCC and Paris Agreement, and assigns the responsible agencies. In particular, the list includes the activity for "Preparation of the Second Biennial Update Report as well as upcoming biennial reports and their submission to the Convention".

Climate change is a challenge with many dimensions and hence a number of ministries are in charge of dealing with climate change related issues. Therefore in 2012 the Prime Minister of the Republic of Armenia adopted Decree N 955 "On the establishment of an Inter-agency Coordinating Council on the implementation of the requirements and provisions of the UNFCCC and the approval of the composition and rules of procedures of the Inter-agency Coordinating Council".

The Council is composed of representatives of 13 ministries, 3 state agencies adjunct to the Government and 2 independent bodies – the Armenian Public Services Regulatory Commission and Armenian National Statistical Service. The chairperson of the Council is the Minister of Nature Protection. The Council ensures high-level support and policy guidance thus giving sustainability to the preparation of the national communications and biennial update reports.

To support the operations of the Council on the fulfilment of the reporting requirements including the process of producing GHG inventories, a working group was also established comprised of the representatives of the ministries, state agencies as well as climate change experts and consultants. The institutional arrangements for the development of the national communications and biennial update reports is described in Figure 1.7 below.

Key agencies involved in BUR preparation

- Ministry of Nature Protection
- Ministry of Energy Infrastructures and Natural Resources
- Ministry of Agriculture
- Ministry of Transport, Communication and Information Technologies
- Ministry of Economic Development and Investments
- Ministry of Emergency Situations
- State Committee of Real Estate Cadaster
- Public Services Regulatory Commission
- National Statistical Service

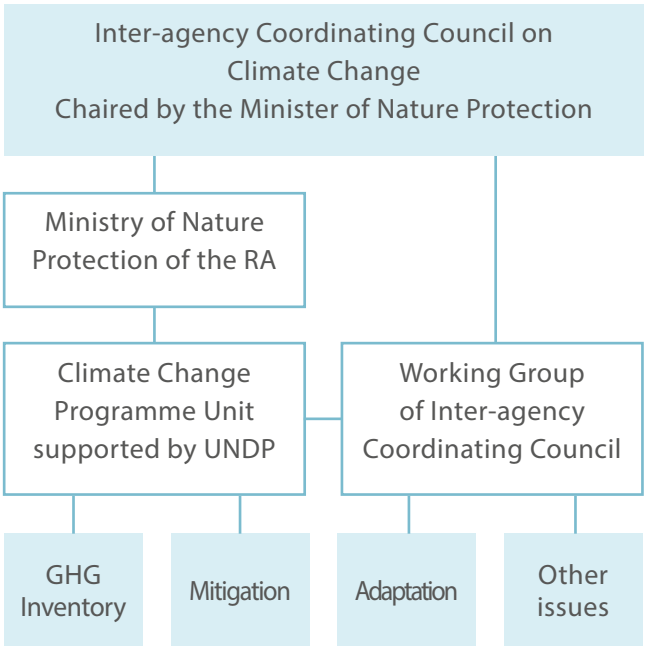


Figure 1.7 Institutional arrangements for development of national communications and biennial update reports

Ratification of the Paris Agreement requires further clarifications of the functions and assigned responsibilities of the bodies included in the Inter-agency Coordinating Council.

The Ministry of Nature Protection (MNP) is responsible for coordinating the activities related to the development of national communications and biennial update reports, including greenhouse gas inventory, through the Division on Climate Change and Atmospheric Air Protection under Environmental Protection Policy Department established in 2015. The division inter alia is responsible for coordinating the development of national communications and biennial update reports to ensure consistent, complete, and timely submission of information.

The legal/regulatory improvements will greatly facilitate resolving this issue. Hence, the RA Government Decree N 50-3 of 15 December, 2016 has approved the concept of the RA draft Law "On Atmospheric Air Protection". Among other changes, it is envisaged by the law to set up a unified system for the recording of hazardous substances and greenhouse gas emissions, which will contribute to compliance with the obligations of the Republic of Armenia by environmental conventions and the consistency of information provided under different conventions.

Currently the RA draft Law "On Government Structure and Activity" is under development. This Law stipulates that among other obligations the Ministry of Nature Protection shall be responsible for the development and implementation of the RA Government policies on prevention or reduction of the negative impact on climate change.

CHAPTER 2

National Greenhouse Gas Inventory

2.1 Basic information on greenhouse gas inventory

The inventory of greenhouse gases reported under the BUR2 covers the years 2013 and 2014.

The Armenia's greenhouse gas inventory is compiled according to the *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, including emissions and removals of four direct greenhouse gases - carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and hydrofluorocarbons (HFCs) in a series of time from 2000 to 2014.

The NIR includes also estimates of so-called indirect greenhouse gases - carbon monoxide (CO), nitrogen oxides (NOx), non-methane volatile organic compounds (NMVOCs) and sulphur dioxide (SO_2). According to the key provisions in Decision 1/CP.16 and pursuant to the guidelines in Annex III of Decision 2/CP17 on reporting information on national greenhouse gas inventories in the BUR for non-Annex I countries, Armenia's BUR2 includes:

- Summary report of national greenhouse gas inventory
- Inventory sectoral tables according to the 2006 IPCC Guidelines
- Key category analysis (KCA)
- Uncertainty analysis
- Consistent time series for years 2000-2014
- Summary information table of inventories for previous submission years from 1990 to 2014

According to the 2006 Guidelines the following sectors were considered:

- Energy
- Industrial Processes and Product Use (IPPU), including F-gases
- Agriculture, Forestry and Other Land Use (AFOLU)
- Waste

Within the frames of the BUR2 the following improvements were made to the greenhouse gas inventory:

- Introduction of higher Tier for 3 sub-categories (Tier 3 and Tier 2)
- Including data for 14 new sub-categories.

2.2 Overview of used methodology

Guidelines

The greenhouse gas national inventory was prepared according to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. The IPCC 2006 Inventory Software, developed for these Guidelines, was used for data entry, emission calculation, results analysis and conclusions.

"Good Practice Guidelines and Uncertainty Management in National Greenhouse Gas Inventories" (IPCC 2000), "Good Practice Guidelines for Land Use, Land Use Change and Forestry" (IPCC 2003) and "Air Pollutant Emission Inventory Guidebook" (EMEP/EEA, 2016), as well as upon necessity the "1996 IPCC Revised Guidelines for National Greenhouse Gas Inventories" were also used during the preparation of the NIR.

Global Warming Potentials

The estimated CH_4, N_2O, HFCs emissions were converted to CO_2 equivalent ($CO_{2eq.}$) using Global Warming Potentials (GWPs) values provided by the IPCC in its Second Assessment Report ("1995 IPCC GWP Values") based on the effects of greenhouse gases over a 100-year time horizon (Table 2.1).

Table 2.1 Global Warming Potential values

GHG	GWP
CO_2	1
CH_4	21
N_2O	310
HFC-32	650
HFC-125	2,800
HFC-134a	1,300
HFC-152a	140
HFC-143a	3,800
HFC-227ea	2,900

Methodologies

The greenhouse gas inventory was prepared according to the principles described below:

- Clear observation of the logic and structure of the 2006 IPCC Guidelines
- Priority given to the use of national data and indicators
- Utilization of all possible sources of information
- Maximum use of the capacities of national information sources

During the preparation of the greenhouse gas inventory the highest priority was given to the estimation of emission of gases with direct greenhouse effect - CO_2, CH_4 and N_2O from the key categories as well as for emission of hydrofluorocarbons (HFCs) compounds. Estimations were also made for emissions of gases with indirect greenhouse effect - CO, NOx, NMVOCs and SO_2.

The emission estimates were based on the sectoral approach, applying Tier 1, Tier 2 and Tier 3 methods. Country-specific approaches were used for key categories wherever possible to provide more accurate emissions estimates than Tier 1 approach.

The Tier 3 method was used for estimating emissions of CO_2 in:

- Energy Sector from electricity generation
- IPPU Sector from cement production, considering that both sub-categories were identified as key and disaggregated data were available.

The Tier 2 method was used for estimating emissions from the following key categories:

In Energy Sector:

- Emissions of CO_2 from stationary (with the exception of electricity generation) and mobile combustion of natural gas as well as for CH_4 emissions estimating from fugitive emissions of natural gas (The Tier 1 method was used for the emission estimates from liquid fuel combustion).

In IPPU Sector:

- The emissions of HFCs from refrigeration and air-conditioning were estimated applying the method 2A (estimation performed at a disaggregated level with country-specific data by sub-application and a default emission factor selected by sub-application from the 2006 IPCC Guidelines) considering that this sub-category was identified as key and data were available in each sublevel. The emissions of HFCs from the other applications were estimated by applying the method 1A (estimation performed at an aggregated level, with country-specific data by application and default emission factor by application from the 2006 IPCC Guidelines).

In AFOLU Sector:

- Emissions of CH_4 from cattle enteric fermentation
- Net CO_2 removals from Forest Land Remaining Forest

In Waste Sector:

- CH_4 emissions from solid waste disposal.

Other emissions were estimated with the Tier 1 method with default estimation parameters from the 2006 IPCC Guidelines and country-specific activity data.

In addition to the assessments based on Sectoral Approach, the emissions of CO_2 from fuel combustion were assessed by Reference Approach and the results were compared for checking purposes.

2.3 Total greenhouse gas emissions and trends

Armenia's greenhouse gas emissions in 2014 totaled 10,450.71 Gg CO_2 equivalent (Table 2.2). The emissions were some 4 per cent (434.5 $CO_{2eq.}$) higher than those in 2012.

The Table below provides the greenhouse gas emissions estimates in Armenia for 2014. Figure 2.1 presents the greenhouse gas emissions by sectors.

Table 2.2 Greenhouse gas emissions by sectors and by gases for 2014, Gg

Sectors	Net CO_2	CH_4	N_2O	HFCs $CO_{2eq.}$	Total $CO_{2eq.}$
Energy	5,370.26	76.88	0.09	NA	7,012.26
Industrial Processes[8]	250.79	NA	NA	NA	250.79
F gases[9]	NA	NA	NA	531.74	531.74
Agriculture	0.68	62.22	2.38	NA	2,044.73
Waste	4.36	25.69	0.22	NA	611.19
Total Emissions	**5,626.09**	**164.79**	**2.69**	**531.74**	**10,450.71**
Forestry and Other Land Use	-480.26	NA	0.01	NA	-477.14
Net Emissions	**5,145.82**	**156.82**	**2.70**	**531.74**	**9,973.57**

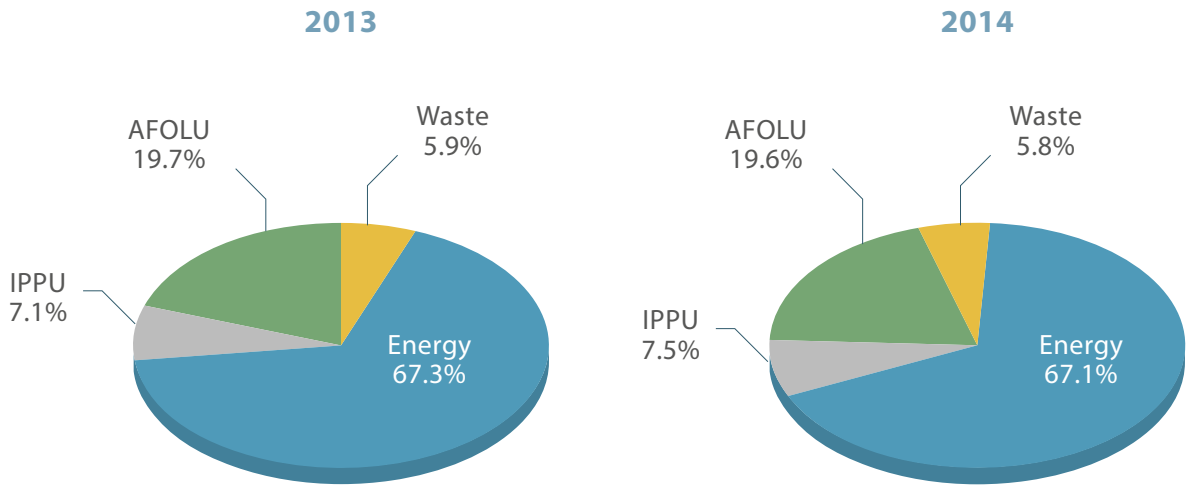


Figure 2.1 Greenhouse gas emissions by sectors without Forestry and Other Land Use, $CO_{2eq.}$

The Energy Sector is by far the largest producer of greenhouse gas emissions. In 2014, the Energy Sector accounted for 67.1 per cent of Armenia's total greenhouse gas emissions. The Energy Sector includes emissions from all use of fuels for generating energy including fuel used in transport, and the fugitive emissions related to the transmission, storage and distribution of natural gas. The second-largest source of emissions was the AFOLU Sector (without Forestry and Other Land Use) with an emission share of 19.6 per cent followed by the IPPU and Waste Sectors – 7.5 per cent and 5.8 per cent, respectively. Figure 2.2 provides the greenhouse gas emissions by gases.

[8] *Excluding F gases*
[9] *F gases refer to fluorinated greenhouse gases (HFC compounds)*

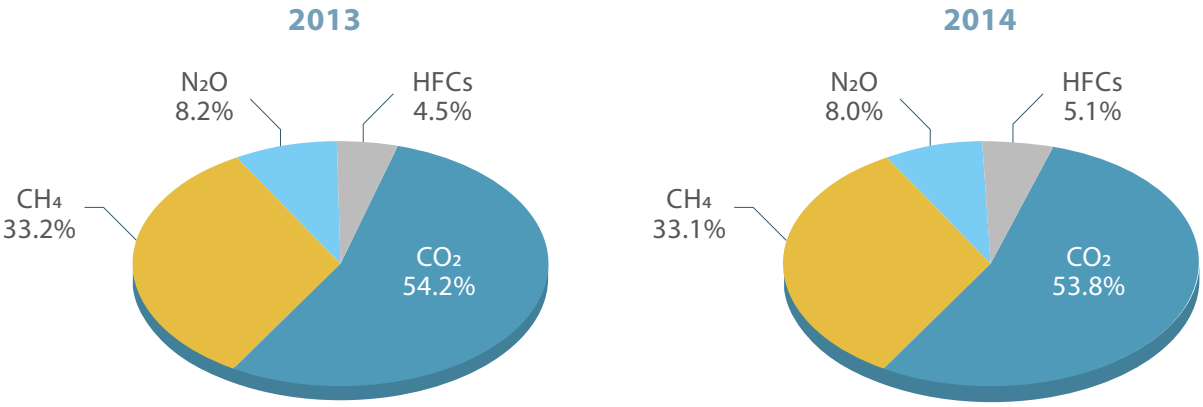


Figure 2.2 Greenhouse gas emissions by gases (without Forestry and Other Land Use)

The most significant greenhouse gas of Armenia's inventory is carbon dioxide (CO_2). Its share in the total emissions was: 54.2 per cent in 2013 and 53.8 per cent in 2014. Figure 2.3 provides greenhouse gas emissions by sectors and by gases for 2014.

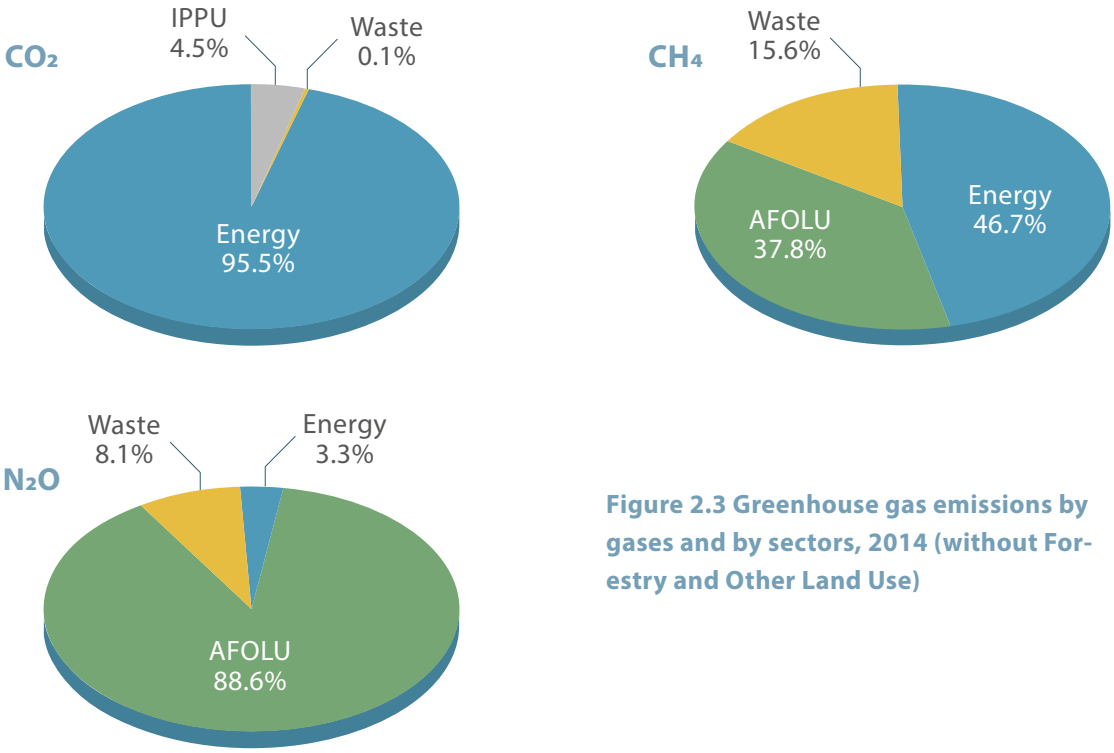


Figure 2.3 Greenhouse gas emissions by gases and by sectors, 2014 (without Forestry and Other Land Use)

The Energy Sector was mainly responsible for carbon dioxide emissions – it produced about 95.5 per cent of all carbon dioxide emissions in 2014 (Fig. 2.3) because of the high emissions volume from the thermal power plants, Residential and Road transportation subsectors.

CO_2 emissions from IPPU Sector were significantly less and accounted for 4.5 per cent of total carbon dioxide emissions; CO_2 emissions from the Waste Sector were negligible.

Methane emissions accounted for over 33 per cent of the total emissions in 2014. Methane emissions were also mostly from the Energy Sector (46.7 per cent) due to the fugitive emissions of the natural gas. The second one

with its share of methane emissions was the AFOLU Sector (37.8 per cent) - due to the emissions from enteric fermentation and the Waste Sector was the third (15.6 per cent).

Nitrous oxide emissions accounted for nearly 8 per cent of the total emissions. Most of nitrous oxide emissions (88.6 per cent) were from the AFOLU Sector mainly due to the direct and indirect N_2O emissions from managed soils. F-gases (HFCs) accounted for roughly 5 per cent of the total greenhouse gases emissions, but their share has been growing continuously.

Table 2.3 and Figure 2.4 provide greenhouse gas emissions by sectors from 1990 to 2014.

Table 2.3 Greenhouse gas emissions by sectors from 1990 to 2014, Gg $CO_{2eq.}$

Sector	1990	2000	2010	2012	2013	2014	2014 emissions change (%) compared to		
							1990 levels	2000 levels	2012 levels
Energy	22,712.16	4,298.27	5,827.53	6,914.72	6,895.22	7,012.26	-69.13	63.14	1.41
Industrial Processes and Product Use	630.33	142.72	555.00	675.81	729.94	782.53	24.15	448.30	15.79
Agriculture	1,989.21	1,326.67	1,462.26	1,827.11	2,015.43	2,044.73	2.79	54.12	11.91
Waste	438.99	532.94	582.61	598.55	603.49	611.19	39.23	14.68	2.11
Total Emissions	**25,770.69**	**6,300.60**	**8,427.40**	**10,016.19**	**10,244.08**	**10,450.71**	**-59.45**	**65.87**	**4.34**
Forestry and Other Land Use	-736.00	-454.33	-540.59	-512.68	-469.72	-477.14	-35.17	5.02	-6.93
Net Emissions	**25,034.69**	**5,846.28**	**7,886.80**	**9,503.51**	**9,774.36**	**9,973.57**	**-60.16**	**70.60**	**4.95**

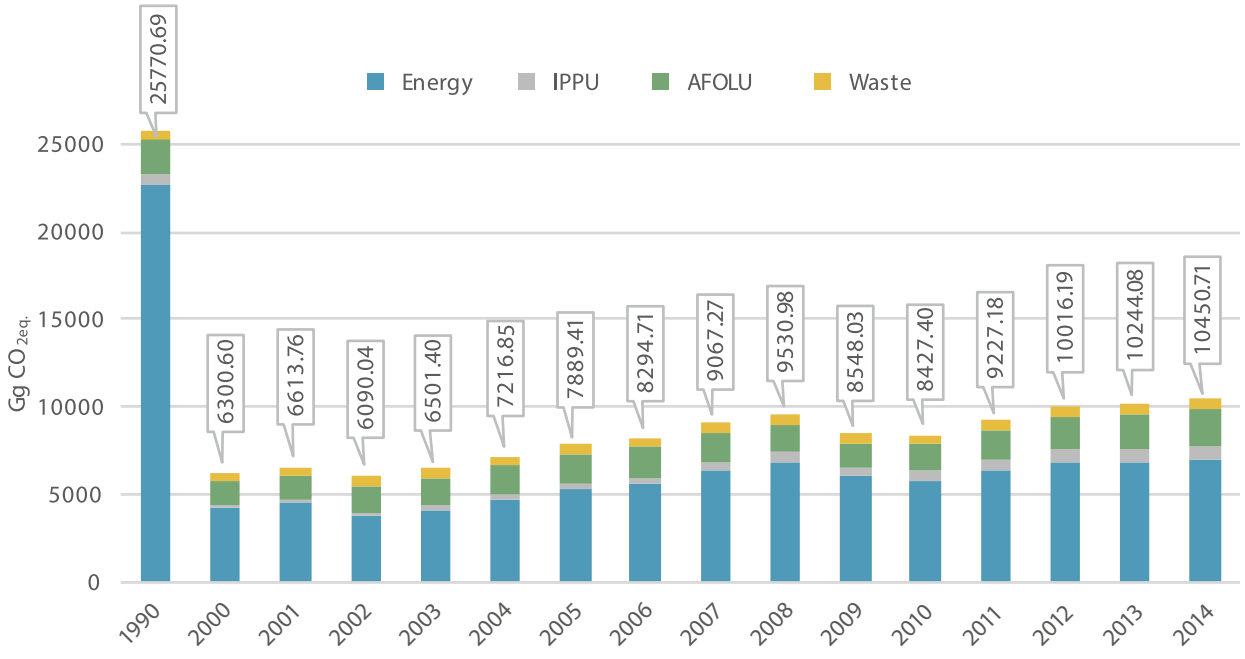


Figure 2.4 Greenhouse gas emissions trend by sectors for 1990 and 2000-2014, Gg $CO_{2eq.}$ (without Forestry and Other Land Use)

Figure 2.4 shows the contributions of the sectors to total greenhouse gas emissions and highlights the absolute predominance of energy-related emissions. As a whole, Armenia's total emissions in 2014 decreased by 59 per cent since 1990. This was largely due to the collapse of the Soviet Union followed by a severe energy crisis and structural changes in economy.

The Energy Sector emissions have decreased by 3.2 times as compared with the year 1990, while Total Primary Energy Supply (TPES) decreased by 2.5 times, which is an evidence of low-carbon development trends in Armenia. This is due to the structural changes in economy, i.e. decreased share of energy intensive industries and increased share of the service sector, wide use of eco-friendly fuel – natural gas - for energy production (which replaced mazut) and in transport, recommissioning of the Armenian Nuclear Power Plant and the strongest growth of the small hydropower plants which number has increased nearly eightfold since 2000.

In 2014, the Energy Sector emissions increased by over 63 per cent as compared to the 2000 level. This is due to the economic growth, leading to the growth in traffic volume and improved household living conditions resulted in the wide use of natural gas in transport and for space heating. It became possible because of the unprecedented level of natural gas deliverability (nearly 95 per cent) in the country since 2004. During 2000-2014 road transport emissions steadily grew - increase by 145 per cent, and emissions attributable to energy used by households increased over fourfold.

In 2009, the financial and economic crisis affected the energy consumption, however in 2010 emissions increased again as a result of economic recovery.

Emissions resulted from electricity production have varied considerably due to the changes in electricity exports and production of electricity by natural gas fired thermal power plants. Thus, the sharp increase of greenhouse gas emissions from the Energy Sector in 2012 in comparison with 2010 was caused by a high export growth met by thermal power plants (thermal power plants generation in 2012 has been increased by 135 per cent in comparison with 2010). This variation has been the principal feature of the trend of CO_2 emissions from Energy Sector in recent years.

In addition, the emissions are influenced each year by the economic situation in the country's energy intensive industries, the weather conditions and the volumes of energy produced with hydropower plants.

In industrial processes the most significant emission sources were CO_2 emissions generated in cement production. A small amount of CO_2 emissions was also generated in non-cement clinker production and glass production. Emissions caused by the industrial processes are mostly affected by the economic situation in the country. Thus, after the decline of greenhouse gas emissions from the IPPU Sector in 2009 because of the economic recession, which resulted in the decrease of construction volumes and, consequently cement production, in 2010 the construction volumes and cement production increased leading to the increase of greenhouse gas emissions.

Fluorinated gases, or F-gases, form a category of their own under industrial processes and accounted for over 5 per cent of total national greenhouse gas emissions and 68 per cent of the greenhouse gas emissions of industrial processes in 2014. In the period from 2010 to 2014, the biggest change occurred in F-gases emissions, which doubled. The increase in the IPPU Sector emissions since 2011 is due primarily to the increase of F-gases emissions from refrigeration and cooling devices and applications.

The increase in agricultural emissions since 2000, amounting to over 54 per cent, is due primarily to the increase in livestock populations and increase in emissions from managed soils and from fertilizer use.

The Waste Sector emissions account for 5.8 per cent of the country's total emissions in 2014. During 2000-2014 the Waste Sector emissions increased by 14.7 per cent due to the growth in methane emissions from solid waste disposal as a result of the increased population of the capital city Yerevan.

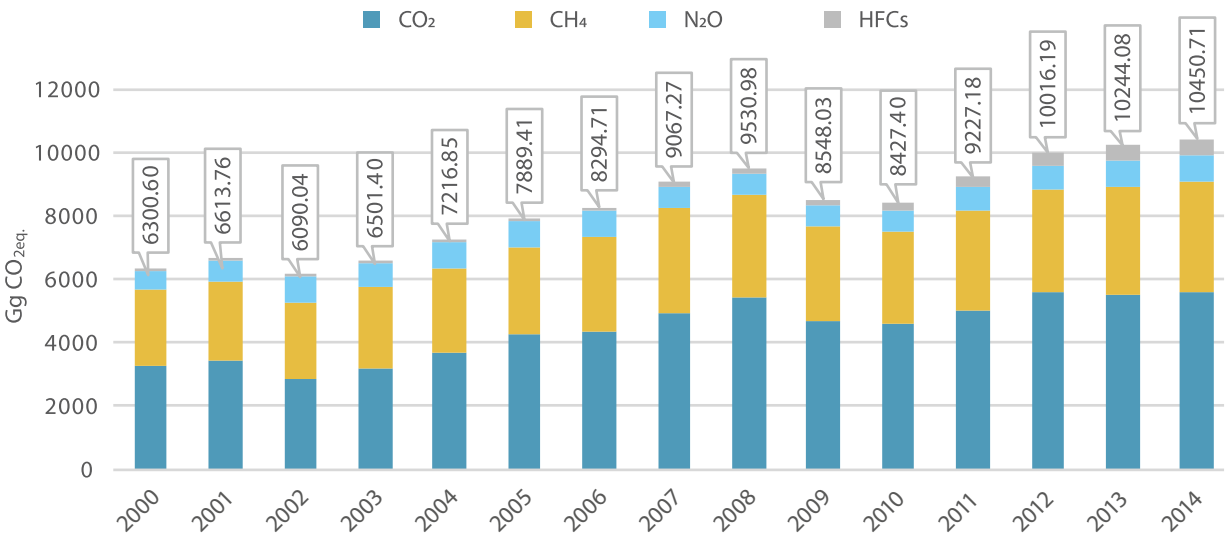


Figure 2.5 2000-2014 greenhouse gas emissions per gases, Gg $CO_{2eq.}$

Figure 2.5 shows the development of emissions of the various greenhouse gases since 2000. It must be noted that the emissions of each of these greenhouse gases are largely influenced by specific developments in a certain category.

Emissions of carbon dioxide – the great majority of which are caused by stationary and mobile combustion processes – predominate in the overall picture of greenhouse gas emissions, making nearly 53.8 per cent of the total emissions. All other greenhouse gases together account for less than half of greenhouse gas emissions. The Energy Sector produced roughly 95 per cent of all carbon dioxide emissions in 2014.

The increase of the overall emissions since 2000 amounts to over 66 per cent. Mainly, this resulted from an increase of CO_2 emissions.

In the period from 2005 to 2014, the biggest change occurred in F-gases emissions, which increased twelvefold. F-gases have been used to replace ozone depleting compounds in many refrigeration and cooling devices and applications, which is the main reason for the increase in F-gases.

The amount of CO_2 emissions is closely linked to trends in the Energy Sector. Increase of CO_2 emissions from the Energy Sector is mainly caused by changes in electricity exports and consequent increase of thermal power generation, traffic volume growth and wide use of natural gas for space heating.

Methane emissions are caused mainly by transmission, storage and distribution of natural gas, animal husbandry in agriculture and waste landfilling; emissions from wastewater treatment are much lower and energy-related emissions play an almost negligible role. Methane emissions have been increased by 43 per cent since 2000. This trend has been primarily the result of the increase of

the natural gas consumption and increase of the livestock populations.

The main emissions areas/sources of N_2O include agriculture – use of nitrogen-containing fertilizers and animal husbandry, smaller amounts of emissions are caused by wastewater treatment. Since 2000, N_2O emissions have increased by about 35 per cent. Agriculture has the greatest influence on emissions increase as a result of the increase in livestock populations and increased use of nitrogen-containing fertilizers.

F-gases emissions volume has been growing continuously which is conditioned by substituting the ozone layer depletion substances with HFCs and rapid development of this sector since 2008. There is a stable annual average growth for all applications, however the growth dynamics are different.

HFC emissions which are caused by refrigeration systems predominate in the overall picture of HFCs emissions, with the share of 94.5 per cent in 2014. The share of emissions from other applications is less than 6 per cent altogether.

2.4 Greenhouse gas emissions by sectors

2.4.1 Energy

Armenia's biggest source of greenhouse gas emissions is the Energy Sector. In 2014, its share of the total greenhouse gas emissions, including transport, was 67.1 per cent (7012.26 Gg $CO_{2eq.}$). The Energy Sector emissions in 2014 made 30.9 per cent of 1990 emissions level and were up 1.4 per on the 2012 level.

Energy Sector emissions can be divided into emissions resulting from fossil fuel combustion and fugitive emissions from natural gas. The majority of the sector's emission (78 per cent) results from fossil fuel combustion.

Fugitive emissions make up 22 per cent of the total emissions of the sector.

Armenia has no domestic resources of fossil fuel and imports all of its oil and gas. Total primary energy supply (TPES) of Armenia reached 3192.7 ktoe in 2014, nearly 69 per cent of which was imported considering that production of nuclear energy is regarded as an indigenous production.

Vast majority of natural gas come from Russia - nearly 84 per cent in 2014, Armenia also imports some natural gas from Iran in exchange for Armenia's supply of electricity to Iran. Oil is imported from a range of countries. Therefore it is the urgent need for Armenia to increase its indigenous energy production, improve energy efficiency, further develop transmission infrastructure and reduce its dependence upon external suppliers.

Armenia relies on electricity and gas to meet the majority of its energy consumption needs. Imported natural gas predominates in total primary energy supply in Armenia accounting for 63 per cent of Armenia's TPES, 84.8 per cent of the fossil fuel consumption and 80 per cent of CO_2 emissions originated from fuel combustion in 2014. This is due to a very high gas deliverability level in the country - 94.6 per cent; the widespread use of natural gas for heating purposes because it is almost two times less expensive than using electricity for heating and the widespread use of natural gas in transport as it is less expensive than petrol or diesel.

The main power generation capacities in Armenia are nuclear power plant, natural gas fired thermal power plants (including small cogeneration

units), large hydropower plants as well as small renewables (small hydro, biogas plant, wind farm), which provided 31.8, 42.4, 16.9 and 8.9 per cent, respectively, of the total electricity generation in 2014. At present, renewable energy consists mainly of hydropower (small to large HPPs).

Armenia has interconnections with the neighboring countries – Iran and Georgia, allowing for power exchange in both directions. Greenhouse gas emissions in the Energy Sector in 2014 are presented in Figure 2.6

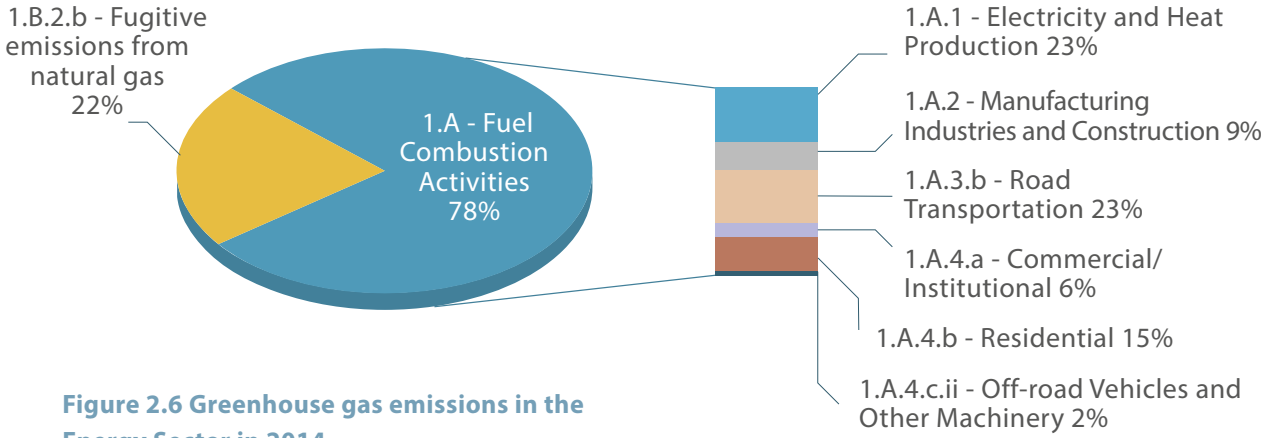


Figure 2.6 Greenhouse gas emissions in the Energy Sector in 2014

Energy Production and Road Transportation are the leading sources of greenhouse gas emissions within the sector, generating 23 per cent of the Energy Sector emissions in 2014 each. The other significant emission source in Energy Sector is Fugitive emissions of natural gas which share in 2014 was slightly less - 22 per cent. Emissions attributable to energy use by households accounted to 15 per cent, emissions from the fuels used by different industries made roughly 9 per cent, followed by the emissions from Commercial/Institutional category with the share of 6 per cent and emissions from Off-road Vehicles and Machinery in agriculture with the share of 2 per cent.

The Energy Sector is mainly responsible for carbon dioxide emissions, while it also contributes to methane emissions, nitrous oxide and other air pollutants such as CO, NOx, SO_2 and NMVOC. In 2014, 76.6 per cent of the emissions from the Energy Sector were CO_2, 23 per cent - CH_4 and 0.4 per cent - N_2O emissions. The contribution of each gas to the total of the sector is presented in Figure 2.7.

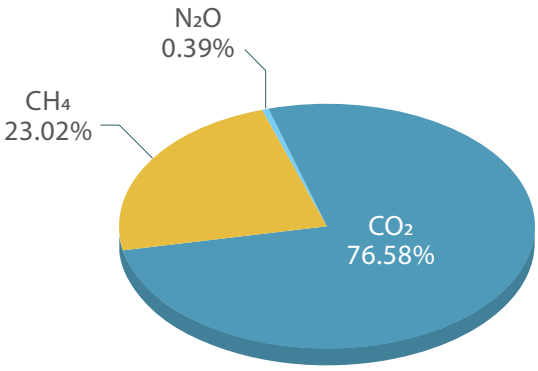


Figure 2.7 Greenhouse gas emissions by gases in Energy Sector in 2014 (Gg $CO_{2eq.}$)

Energy Sector emissions time series by sub-categories for 2000-2014 are provided below.

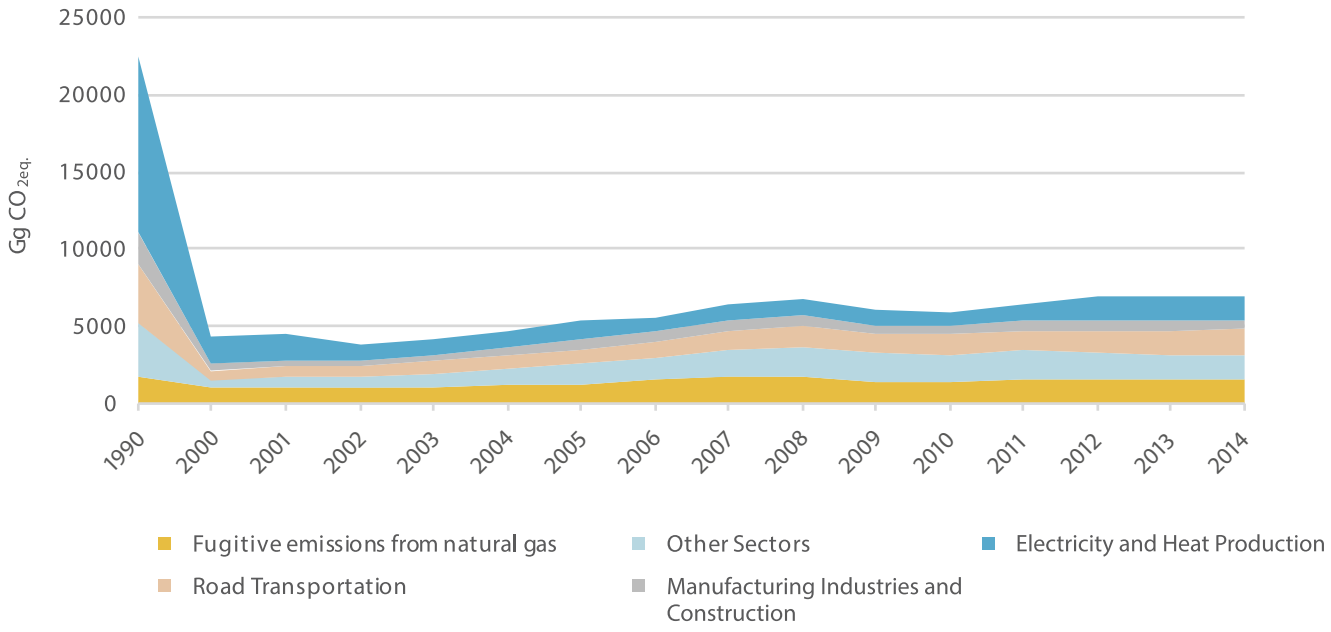


Figure 2.8 Energy Sector emissions time series by sub-categories for 2000-2014, Gg $CO_{2eq.}$

The sharp increase of 2007-2008 emissions from Other Sectors and Road Transportation sub-categories was recorded which was due to the unprecedented level of natural gas deliverability in the country leading to the widespread use of natural gas in road transport and by households for space heating.

Fugitive emissions have grown continuously since 2000 due to the gradual expansion of the natural gas distribution network and the biggest fugitive emissions were recorded in 2007-2008 when the level of gas deliverability reached 94.6 per cent. Gradual increase of methane emissions since 2010 was due to the growth of electricity export to Iran met by thermal power plants.

2.4.2 Industrial Processes and Product Use

Emissions from this sector include non-energy related CO_2 emissions from cement production, non-cement clinker and glass production, SO_2 emissions from metal production, NMVOC emissions from solvent use, asphalt production and Food and Beverage industry as well as emissions of F-gases from refrigeration, air conditioning and other product use.

Emissions from the production of electricity consumed by Armenian industry and from the electricity and heat produced by the industries themselves, as well as from the use of off-road machinery and industrial transport, are reported under the Energy Sector.

Emissions from the IPPU Sector amounted to 782.53 Gg $CO_{2eq.}$ in 2014 and were generated in Mineral Industry (cement and non-cement clinker production, glass production) - 250.79 Gg CO_2 and from F-gases - 531.74 Gg $CO_{2eq.}$. Emissions from the IPPU sector made up approximately 7.5 per cent of Armenia's total greenhouse gas emissions in 2014.

The prevailing part of the CO_2 emissions comes from the cement production, accounted for 28.5 per cent of the emissions from the sector and 2.1 per cent of Armenia's total emissions.

Emissions from non-cement clinker were 2.6 per cent of the total IPPU Sector emissions and from glass production were negligible.

Fluorinated greenhouse gases, or F-gases, form a category of their own under IPPU Sector. They accounted for over 5 per cent of the total national greenhouse gas emissions and nearly 68 per cent of the greenhouse gas emissions of the IPPU Sector in 2014. HFC emissions which are caused by refrigeration systems predominate in the overall picture of HFC emissions with the share of 94.5 per cent. The share of emissions from other applications is about 5.5 per cent altogether: 3.22 per cent from Foam Blowing Agents, 2.15 per cent from Aerosols, and minor emissions, only 0.1 per cent of total HFC emissions from Fire Protection application.

In Armenia, as well as globally, F gases are serving as alternatives to ozone depleting substances (ODS) which are being phased out under the Montreal Protocol. Armenia undertook commitments for ODS phase-out by ratifying the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer.

From F gases Armenia largely uses Hydrofluorocarbons (HFCs). Perfluorocarbons (PFCs) and SF_6 are not used in the country. Armenia has never had domestic production of HFCs. The country imports them as chemicals from the UAE, sometimes from Iran and Turkey, while they come contained in products or equipment (sub-application) from a large number of other countries.

In general, Armenia started importing products and equipment containing HCFCs and HFCs after 2005 when the country launched its first country program for CFCs phase-out. In particular: Armenia adopted the Law on Substances that Deplete the Ozone Layer and sub-legislative acts for ensuring enforcement of the Law. Later, Armenia limited CFCs import and completely banned it in 2010. In parallel, the country has launched HCFCs phase-out program. All these measures resulted in a sharp increase of HFCs import since 2010.

From all HFCs, HFC-134a has the widest application area which is due to its multifunctional character: it is widely used as both an individual chemical and a blend (R-404A, R-410A, R-407C) component in all sub-applications of RAC which is the country's HFCs key application area, and is also contained in aerosols as a propellant and in foam blowing as a foam blowing agent.

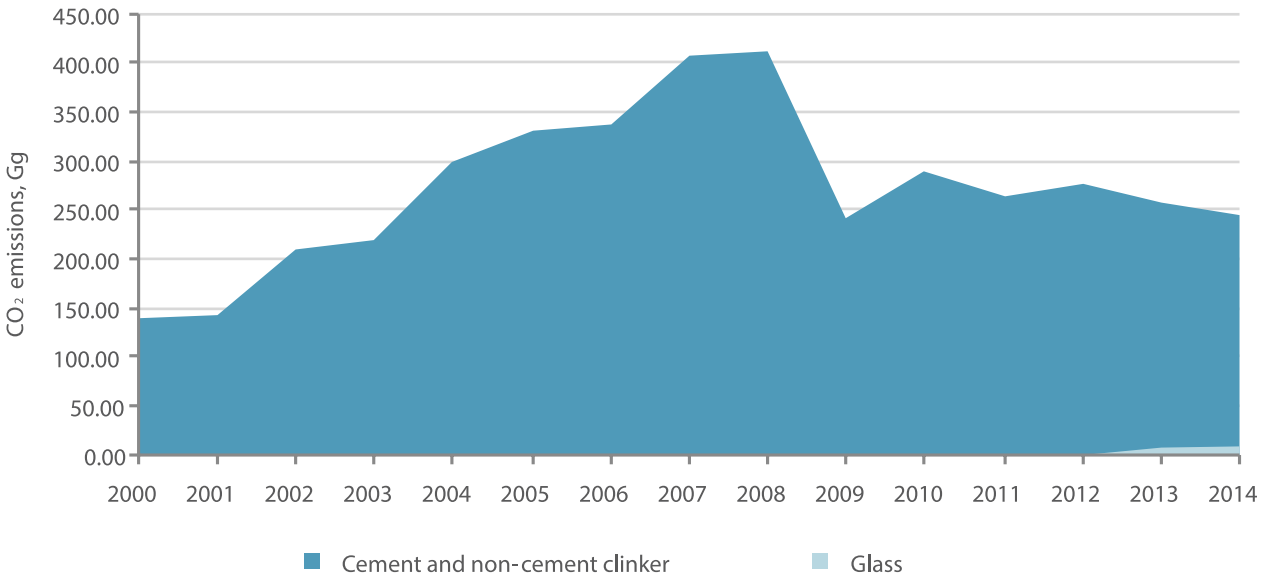


Figure 2.9 CO_2 emissions from Mineral Industry (cement and non-cement clinker production, glass production) for 2000-2014, Gg CO_2

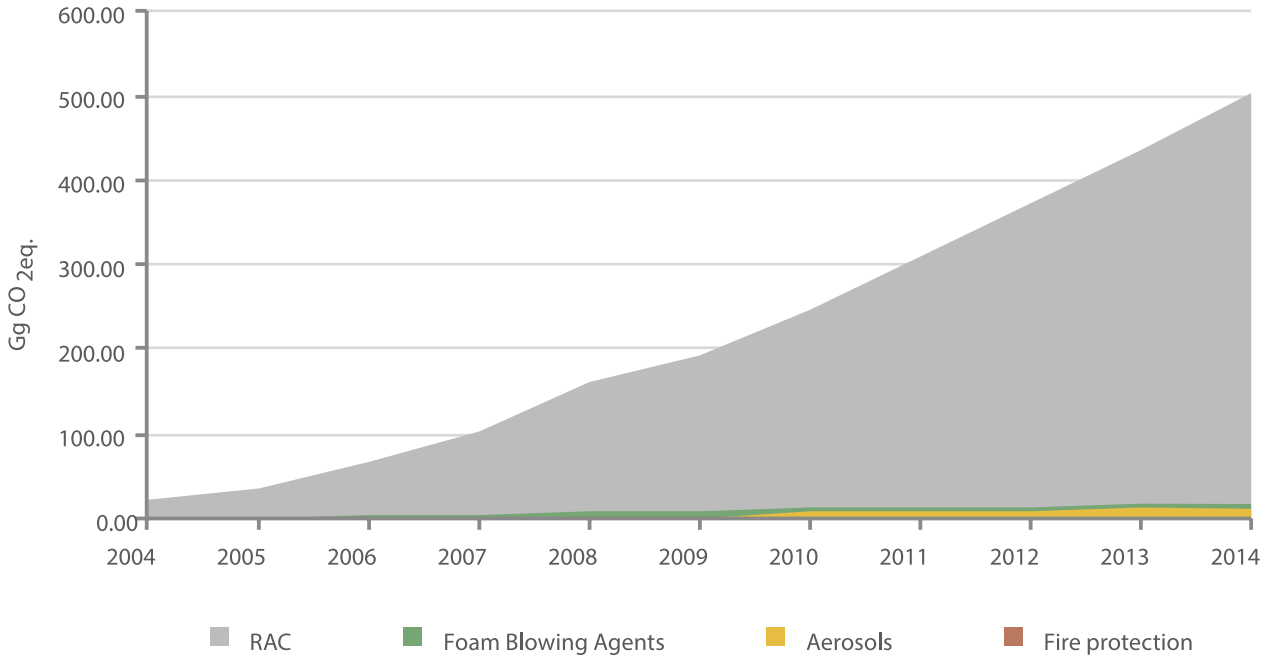


Figure 2.10 HFCs emissions for 2004-2014, Gg $CO_{2eq.}$

2.4.3 Agriculture, Forestry and other Land Use

2.4.3.1 Agriculture

Emissions from the Agriculture sub-sector were 2044.7 Gg $CO_{2eq.}$ in 2014. Agricultural emissions include methane (CH_4) emissions from the enteric fermentation of domestic livestock, manure management and biomass burning, CO_2 emissions from urea application as well as nitrous oxide (N_2O) emissions from manure management and direct and indirect emissions from managed soils following additions of urea-containing fertilizer and crop residue.

The Agriculture sub-sector accounted for 19.56 per cent of Armenia's total greenhouse gas emissions in 2014. The CH_4 emissions from enteric fermentation were 59.15 per cent, the CH_4 emissions from manure management were 4.74 per cent, the N_2O emissions from manure management were 7.54 per cent and the N_2O emissions from managed soils were 28.55 per cent of the total agricultural emissions. The share of emissions from the biomass burning and from urea application is negligible.

The prevailing part of the CH_4 emissions from enteric fermentation (90.3 per cent) is generated by cattle, but emissions generated by horses, pigs, sheep, goats, buffalos and asses are reported as well.

Most of the N_2O emissions (78.8 per cent) from the Agriculture sub-sector are direct and indirect N_2O emissions from managed soils.

Emissions in the Agriculture sub-sector decreased by 2.79 per cent during 1990–2014 while the increase in agricultural emissions since 2000 amounts to over 54 per cent. This was due primarily to increase in livestock populations and increase in emissions from managed soils and from fertilizer use. For example, the number of cattle was only 1.8 per cent less in 2014 as compared to the 1990 level and 41.6 per cent above the 2000 level. The increase in the number of livestock is visible in the higher CH_4 emissions from enteric fermentation and CH_4 and N_2O emissions from manure management (Figure 2.11).

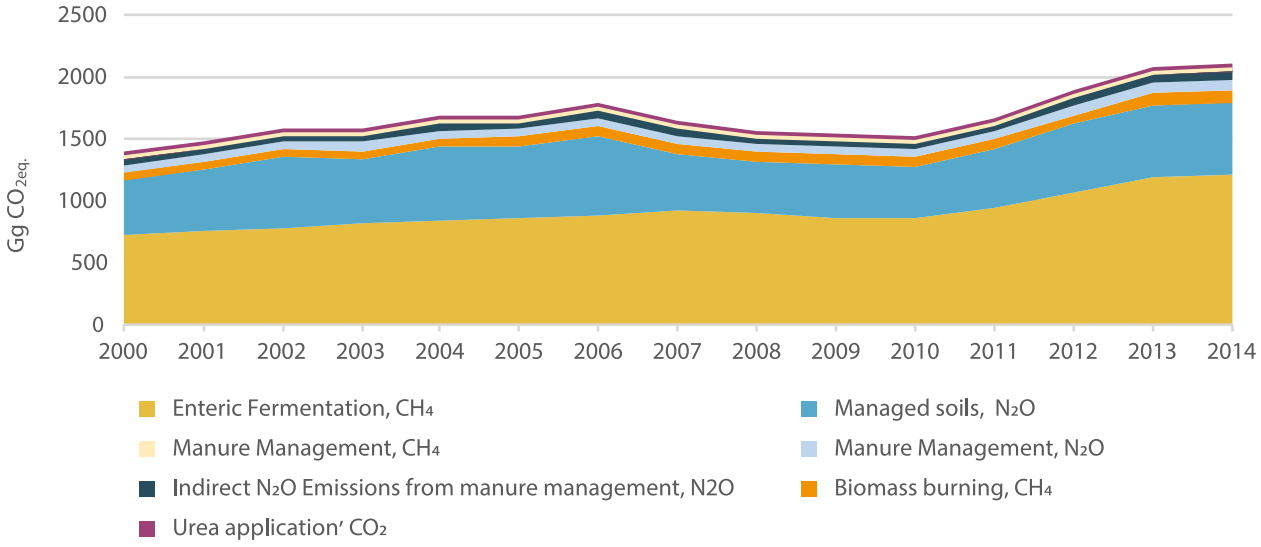


Figure 2.11 Greenhouse gas emissions from Agriculture, 2000–2014

2.4.3.2 Forestry and other land use

Armenia reports both greenhouse gas emissions and removals in the Forestry and Other Land Use Sector. Removals refer to the absorption of CO_2 from the atmosphere by carbon sinks, such as plant biomass. Changes in carbon stocks in six land-use categories covering the whole of Armenia are reported in this sector.

Due to the lack of complete data, the estimation of changes in carbon stock in the Forest Land Remaining Forest Land category were done in the above-ground and below-ground biomass only and in Land Converted to Forest Land category estimation of changes in carbon stock includes dead organic matter as well. For the remaining land-use categories, estimation of changes in carbon pools include dead organic matter and soils as well.

The Forestry and other land use sector in 2014 as a whole acted as a CO_2 sink for –477.14 Gg $CO_{2eq.}$ because the total emissions resulting from the sector were smaller than the total removals. The sink in 2014 was 4.57 per cent of the total national emissions excluding the Forestry and other land use sector. In forest land, the largest sink in 2014 was tree biomass: –534.28 Gg CO_2. The prevailing part of annual carbon loss is caused by harvested fuelwood. In general, carbon absorption by forests is relatively constant in recent years.

Even though the Forestry and Other Land Use Sector has clearly been a net carbon sink, the sector also produces some emissions. The largest emissions come from other lands and grasslands. Other emission sources in the Forestry and Other Land Use Sector include settlements and wetlands. Emissions from croplands are negligible.

Energy crisis of the 1990s resulted in a widespread harvesting of trees and economically undesirable change in the tree species i.e. high-value species (beech, oak, pine) have been replaced with those of low-productivity (mostly stump-sprig hornbeam, aspen, etc.). However, recently there is a trend that beech, pine and partially oak become dominate in tree species.

The trend in emissions and removals from the Forestry and Other Land Use Sector is presented in Figure 2.12

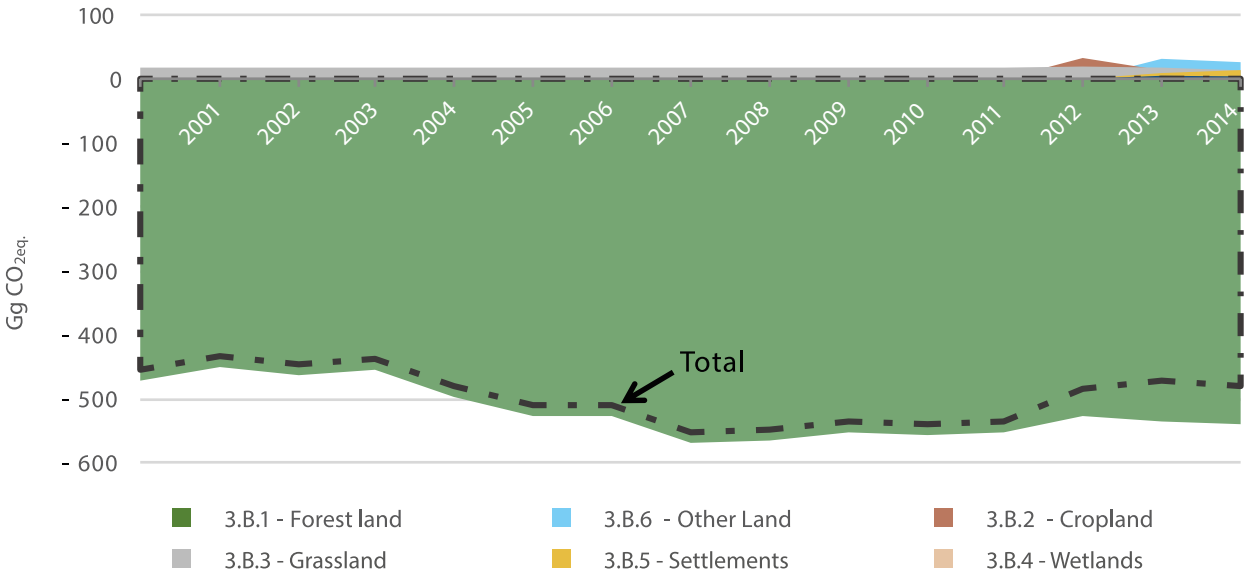


Figure 2.12 Greenhouse gas emissions from Forestry and Other Land Use Sector, 2000–2014

2.4.4 Waste

CH_4 emissions from landfills, CO_2, CH_4 and N_2O emissions from the combustion of waste and CH_4 and N_2O emissions from wastewater treatment and discharge are reported under the waste sector.

The Waste Sector emissions amounted to 611.19 Gg $CO_{2eq.}$ in 2014, which accounts for approximately 5.85 per cent of Armenia's total emissions. Landfill emissions accounted for 66.78 per cent of all Waste Sector emissions (3.9 per cent of the country's total emissions), while emissions from the combustion of waste are insignificant and accounted for 3.43 per cent. The emissions from waste water treatment accounted for 29.78 per cent of the Waste Sector emissions in 2014.

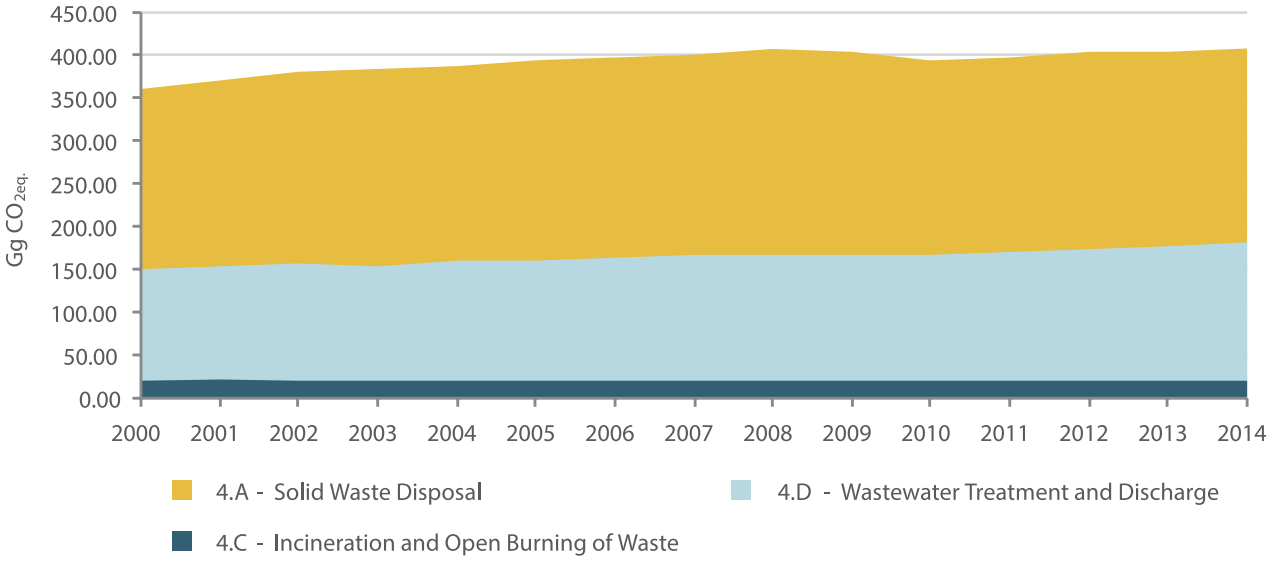


Figure 2.13 Greenhouse gas emissions from Waste Sector, 2000-2014

2.5 Key Category Analysis

The *2000 IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gases Inventories* recommends the use of the Key Category Analysis (KCA) to identify key categories in the national inventory. Key categories under the guidelines are those whose emissions when summed in descending order of magnitude add up to 95 per cent of total greenhouse gas emissions.

The Approach 1 - Level Assessment for 2014 is provided below (see Table 2.4). For 2014, the Approach 1 procedure identified 15 key categories. Energy Sector's 4 categories – Electricity and Heat Production, Fugitive emissions of Natural Gas, Road Transportation and Other Sectors (household heating appliances) generate more than half of all greenhouse gas emissions in the country.

Table 2.4 Approach 1 analysis – Level Assessment, 2014

A	B	C	D	E	F
IPCC category code	IPCC category	GHG	2012 emissions (Gg $CO_{2eq.}$)	Level assessment	Cumulative Total of the column E
1.A.1.a	**Electricity and Heat Production**	**CO_2**	**1,579.61**	**0.143**	**0.14**
1.B.2.b	**Fugitive Emissions of Natural Gas**	**CH_4**	**1,574.32**	**0.142**	**0.29**
1.A.3.b	**Road Transportation**	**CO_2**	**1,547.32**	**0.140**	**0.43**
1.A.4	**Other Sectors - Gaseous Fuels**	**CO_2**	**1,404.36**	**0.127**	**0.55**
3.A.1	**Enteric Fermentation**	**CH_4**	**1,209.54**	**0.109**	**0.66**
1.A.2	**Manufacturing Industries and Construction - Gaseous Fuels**	**CO_2**	**550.44**	**0.050**	**0.71**
3.B.1a	**Forest Land Remaining Forest Land**	**CO_2**	**-534.28**	**0.048**	**0.76**
2.F.1	**Refrigeration and Air Conditioning**	**HFCs**	**502.66**	**0.045**	**0.81**
3.C.4	**Direct N_2O Emissions from Managed Soils**	**N_2O**	**456.52**	**0.041**	**0.85**
4.A	**Solid Waste Disposal**	**CH_4**	**408.13**	**0.037**	**0.88**
2.A.1	**Cement Production**	**CO_2**	**223.40**	**0.020**	**0.90**
1.A.4	**Other Sectors - Liquid Fuels**	**CO_2**	**190.17**	**0.017**	**0.92**
3.C.5	**Indirect N_2O Emissions from Managed Soils**	**N_2O**	**126.95**	**0.011**	**0.93**
4.D	**Wastewater Treatment and Discharge**	**CH_4**	**118.15**	**0.011**	**0.94**
3.A.2	**Manure Management**	**CH_4**	**96.99**	**0.009**	**0.95**
3.A.2	Manure Management	N_2O	86.03	0.008	0.96
3.C.6	Indirect N_2O Emissions From Manure Management	N_2O	67.99	0.006	0.97
1.A.2	Manufacturing Industries and Construction	CO_2	64.17	0.006	0.97
4.D	Wastewater Treatment and Discharge	N_2O	63.84	0.006	0.98
1.A.3.b	Road Transportation	CH_4	36.11	0.003	0.98
1.A.3.eii	Off-Road	CO_2	29.96	0.003	0.98
3.B.6.bii	Cropland Converted to Other Land	CO_2	26.90	0.002	0.99
1.A.3.b	Road Transportation	N_2O	24.49	0.002	0.99
2.A.4.d	Non-Cement Clinker Production	CO_2	20.16	0.002	0.99
2.F.2	Foam Blowing Agents	HFCs	17.11	0.002	0.99

2.6 Uncertainty

Activity data are the primary source of uncertainty in the emission estimates because country-specific emission factors were applied for the majority of the key sources. A large proportion of the activity data are data on fuel combustion. Considering that in Armenia data on natural gas combustion at large sources are obtained from direct measurement and obligatory are reported, the uncertainty of activity data on natural gas combusted is within 3 per cent, while data on natural gas combusted in other categories including transport are within 5 per cent. The collection of natural gas combustion data through official statistics strengthened the confidence in the data and formed the basis for the low uncertainty in the greenhouse gas emissions caused by natural gas combustion.

The situation is quite different with liquid fuel due to the lack of official statistics on liquid fuel consumption by the subcategories.

Non-energy sector categories have high uncertainties for emission estimates even when a higher tier method was used as it is in the case with cement production category and RAC application in Armenia.

N_2O (direct and indirect) emissions from managed soils subcategories and the subcategory Forest Land Remaining Forest Land contribute most to the total uncertainty of the AFOLU Sector. Uncertainties in Forestry is mostly due to the lack of complete and accurate information on changes in forest covered areas as well as because of the lack of complete and accurate information on removals of fuelwood as a result of illegal felling.

2.7 Institutional Mechanisms and Processes for Inventory Development

The Ministry of Nature Protection of the Republic of Armenia (MNP) is responsible for coordinating the activities related to the development of national communications and biennial update reports including greenhouse gas inventory, through the division on Climate Change and Atmospheric Air Protection under the Environmental Protection Policy Department.

The Government of Armenia approves the list of measures in fulfillment of the obligations resulted from the international environmental conventions for successive five-year periods. The last one, approved by the GoA Protocol Decision N 49-8 on December 8, 2016, set up the measures for the implementation of the commitments and provisions of the UNFCCC and Paris Agreement for the period of 2017-2021 with the identification of the responsible bodies for their implementation. The list of measures includes development of the biennial update reports and greenhouse gas emissions inventories on a continuous basis every two year followed by their submission to the Secretariat, correspondingly.

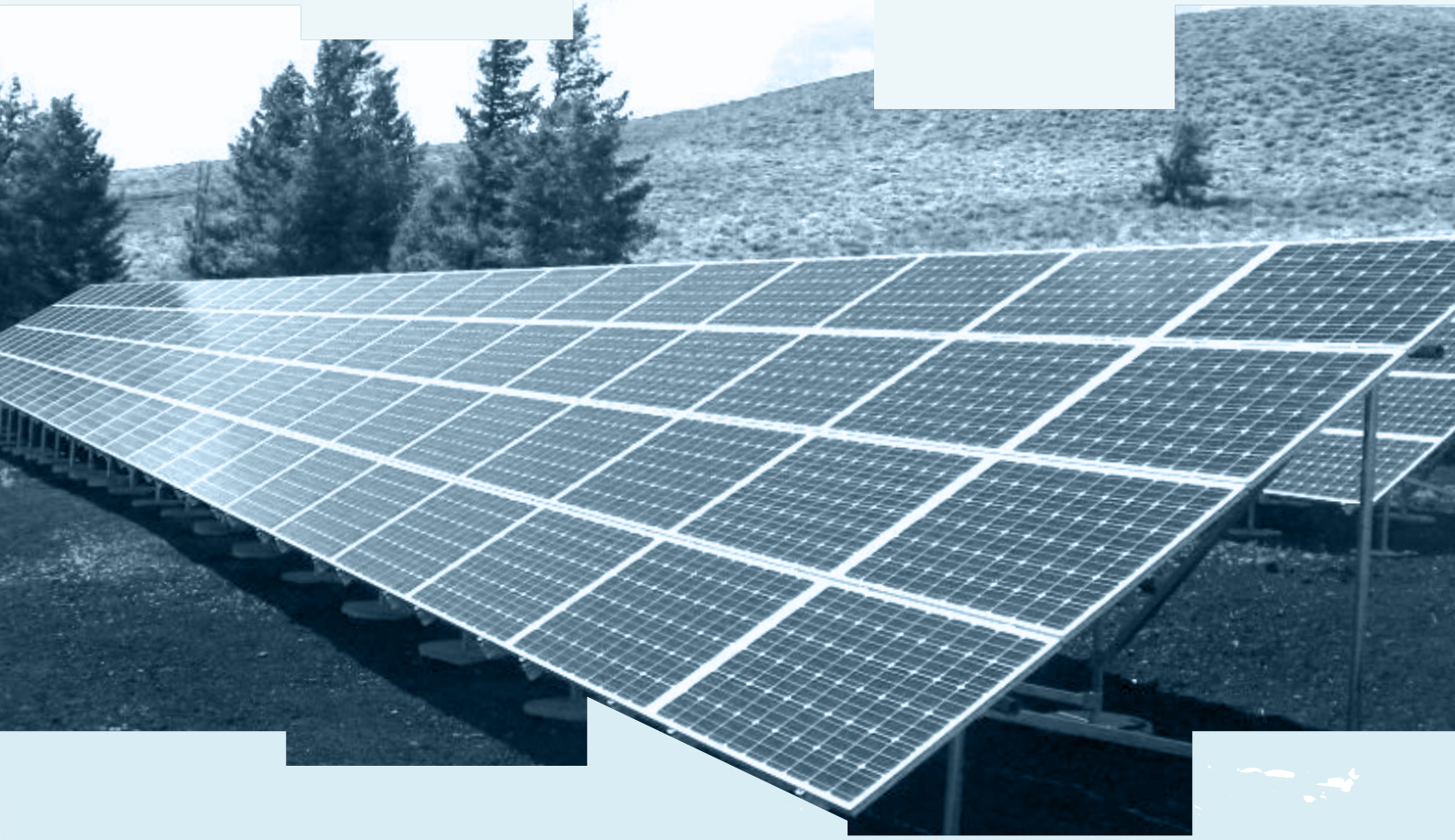
Climate change is a challenge with many dimensions and hence a number of ministries are in charge of dealing with climate change related issues. Therefore in 2012 the Prime Minister of the Republic of Armenia adopted Decree N 955 "On the establishment of an Inter-agency Coordinating Council on the implementation of requirements and provisions of the UNFCCC and the approval of the composition and rules of procedures of the Inter-agency Coordinating Council" to ensure the coordination on Armenia's approach to climate change.

To support the operations of the Council on the fulfillment of the reporting requirements including the process of producing greenhouse gas inventories, a working group was also established comprised from the representatives of the state agencies, ministries as well as climate change experts and consultants.

The UNDP Country Office through the UNDP Climate Change Program Unit supports the MNP in fulfillment of its obligations under the UNFCCC including development of national communications and biennial update reports. With this aim the greenhouse gas inventory expert group was formed with the involvement of experts engaged in preparation of the previous inventories and familiar with the 2006 IPCC Guidelines and software trying to keep "institutional memory" and ensure continuity and quality of the assessment process. The expert group worked in close cooperation with the Climate Change and Atmospheric Air Protection Division of the Environmental Protection Policy Department of the MNP.

Quality control was ensured through the internal review of the draft NIR by the RA Ministry of Nature Protection and the working group of the Inter-agency Coordinating Council followed by the handover to the stakeholder ministries and organizations for review. The draft NIR was uploaded on the web-site of the Climate Change Information Center: www.nature-ic.am.

At the next stage, the draft NIR was submitted to and verified by the Inter-agency Coordinating Council for ensuring QA procedure followed by the final step of handover to the UNFCCC and inclusion the summary in the BUR.



CHAPTER 3

Mitigation Actions and Their Effects

This chapter updates information presented in the first BUR in relation to the climate change mitigation actions and polices and their effects assessment in different sectors for the years 2013-2016.

Regarding the Energy Sector, as reported in the previous chapter, the majority of Armenia's emissions are from the Energy Sector with the share of over 67 per cent of the total emissions in 2014.

The Armenian Development Strategy and National Security Strategy highlight the key role of the energy sector in achieving economic growth, poverty reduction and national security. There are a number of strategies and action plans to develop the energy sector while improving energy security and achieving energy independence. This is expected to be achieved upon development and expansion of economically viable and technically available renewable energy sources, development of nuclear energy, promotion of energy efficiency/energy savings, diversification of fuel supply chains along with regional cooperation and integration.

This chapter presents the projections of Armenia's greenhouse gas emissions in the Energy Sector, considering that Energy is a strategic sector for the country and has the highest mitigation potential. Three scenarios - "without measures (WOM)", "with measures (WM)" and "with additional measures (WAM)"- are presented to align the strategy of this sector with the Armenia's environmental objectives and implementation of the country's contribution under the INDC.

3.1 Report on mitigation actions and their effects

The information on the mitigation actions has been obtained from the RA state agencies, private sector, international financial institutions and non-government organizations in response to the enquiry of the Ministry of Nature Protection.

Quality assurance and control procedures within the frame of reporting of the mitigation actions and their effects assessment have been ensured through the analysis of the data obtained from data providers and their cross-checking using the publically available data as well as by assessing the progress of those mitigation actions which have been included in the BUR1. These are followed by discussions with the data providers and corresponding clarifications as needed.

To ensure to the extent possible a transparent way on presentation of the information on mitigation actions and their effects, UNFCCC Handbook on Measurement, Reporting and Verification for Developing Country Parties as well as non-Annex I Parties reporting formats have been studied to develop the format which best reflects the national circumstances.

To assess the effect of policies and measures in the Energy Sector, the mitigation actions were split into two groups in terms of the feasibility of their implementation.

WM scenario includes those mitigation actions which have already been started or planned for the nearest future with secured financing or which are priority projects in the sectoral strategic and planning documents (Table 3.1).

WAM scenario includes mitigation actions which are assessed and recommended but have not secured financing yet (Table 3.2). These actions provide more ambitious development of renewable energy sources and enhanced implementation of energy efficiency measures. Hence, the actual mechanisms of implementing these measures are not defined yet, there is currently no progress in implementation of these measures, as well as no actual steps are taken or envisaged.

Table 3.1 Mitigation actions and their effects by Sectors

Description/ objectives	Quantitative goals	Progress indicators	Methodologies/ Assumptions	Progress of implementation/ steps taken or envisaged	Estimated outcomes/ GHG emissions reduction Gg $CO_{2eq.}$
Energy (generation side and distribution network)					
Coverage: CO_2 , CH_4 reduction through the increased share of renewables in power generation mix and implementation of the energy efficiency measures on generation side and in distribution networks					
Methodology: The impact assessment was carried out using the LEAP-Armenia software by calculating the reduction of greenhouse gas emission from natural gas combustion and associated reduction of natural gas fugitive emissions due to the reduced generation of thermal power plants					
Nature: Legislative, technology					
Name of the action: Commissioning of small Hydro Power Plants (SHPPs)					
Coordination/Support: EBRD, IFC (Sustainable Energy Finance Project), the WB and KfW Bank (through "German-Armenian Fund" RE Program) provided loans for lending through Armenian commercial banks					
Creating favourable conditions for SHPPs development: the Energy Law supports the development of SHPPs through the Power Purchasing Agreement for the 15 year period	According to the PSRC, as of July 1, 2017 the total capacity of the SHPPs was 339 MW while SHPPs with capacity 72 MW are under construction. Thus, the total capacity will reach 411 MW.	Capacity of newly installed SHPPs (MW) and their annual generation (GWh)	Assessment was carried out by inputting the actual installed capacities of the SHPPs and assuming that by 2020 the total capacity of SHPPs will reach 411MW	On-going: In 2013-2016, 51 SHPPs were commissioned with a total installed capacity 105.8 MW and annual generation 281.9 GWh. In 2016 the GoA approved the Hydro Energy Development Concept of the RA, which envisages commissioning of new SHPPs	Achieved annual emission reduction: 172 Gg $CO_{2eq.}$ Expected emission reduction in 2020: 278 Gg $CO_{2eq.}$

Table 3.1 Mitigation actions and their effects by Sectors (continued)

Description/ objectives	Quantitative goals	Progress indicators	Methodologies/ Assumptions	Progress of implementation/ steps taken or envisaged	Estimated outcomes/ GHG emissions reduction Gg $CO_{2eq.}$
Energy (generation side and distribution network)					
Name of the action: Commissioning of Solar PVs					
Coordination/Support: SREP resources will be used to develop roughly 40-50 MW of utility-scale solar PV, concessional loans Solar PVs with capacity of 150kW -1 MW can be financed from KfW Bank which provides loans for lending through Armenian commercial banks					
Promote solar PVs construction: 1. Solar PVs Construction Investment Program approved by the GoA Protocol Decision N 53 in 2016 considers commissioning of Solar PVs with total capacity of 118 MW in 2025 2. The PSRC Decision adopted on 16.11.2016 has set for the first time feed-in tariff for the sale of electricity from solar PVs (up to 1MW)	1. Solar PVs with installed capacity 118 MW based on the Solar PVs Construction Investment Program approved by the GoA Protocol Decision N 53, 2016 2. Construction of solar PVs with peak capacity up to 1 MW: there are no quantitative goals for this measure but licenses for the construction of solar PVs with a capacity of 10 MW are already issued	Capacity of newly installed solar PVs (MW) and their annual generation (GWh)	The impact assessment has been done assuming that by 2030 the total capacity of PVs will reach 148 MW	On-going: In 2016 the PSRC has set for the first time feed-in tariff for the sale of electricity from solar PVs (up to 1 MW) Licenses for the construction of solar PVs with capacity of 10 MW are already issued	Expected emission reduction in 2030: 127 Gg $CO_{2eq.}$
Name of the action: Promotion of Distributed Renewables (Solar PVs) for own needs					
Coordination/Support: Private investments; KfW Bank provides loans for lending through Armenian commercial banks					
Creating regulatory framework and incentives for promotion of solar generation for own needs through amendments to the RA Law on Energy and to the RA Law on Energy Saving and Renewable Energy, 2016: customers are enabled to generate electricity from solar energy for own needs with a peak capacity of up to 150 kW without licensing as well as to sell the excess generation to the grid according to the order/ regulation of mutual payments between the producers and Electric Networks of Armenia (ENA)	There are no quantitative goals for this measure but it is aimed at increasing distributed renewables generation	Capacity of newly installed solar PVs (MW) and their annual generation (GWh)	The assessment of the impact has been done assuming that by 2030 the total capacity of PVs will reach 13 MW	On-going: Amendments to the RA Law on Energy and to the RA Law on Energy Saving and Renewable Energy, 2016	Expected emission reduction in 2030: 11 Gg $CO_{2eq.}$

Name of the action: Construction of new nuclear power plant, installed capacity 600 MW					
Coordination/Support: NA					
The 2013 National Energy Security Concept identifies the commissioning of the new nuclear plant as essential for ensuring the energy security of the country	The commissioning of the new nuclear plant with the installed capacity 600 MW in 2027	The new nuclear plant being commissioned (GWh)	The assessment of the impact has been performed assuming that the new nuclear plant with the capacity of 600 MW will be commissioned in 2027	Planned The National Energy Security Concept and the RA Energy System Long-Term (up to 2036) Development Ways envisage the construction of new power plant with the capacity of up to 1000 MW	Expected emission reduction in 2030: 2359 Gg $CO_{2eq.}$
Name of the action: Construction of medium size Hydro Power Plants					
Coordination/Support: NA					
Increase the share of renewables in power generation mix through construction of medium-size HPPs in 2024	The commissioning of Schnogh and Loriberd hydro plants by 2024 with the installed capacity of 70 MW and 66 MW, respectively	Power generation by Schnogh and Loriberd power plants (GWh)	The assessment of the impact has been performed assuming that the both plants with the total capacity of 136 MW will be commissioned in 2024	Planned The construction of both plants have been envisaged in the Hydro Energy Development Concept of the RA approved by the GoA Protocol Decision N 53, 2016	Expected emission reduction in 2024: 340 Gg $CO_{2eq.}$
Name of the action: Construction of new wind farms					
Coordination/Support: NA					
Increase the share of renewables in power generation mix through construction of wind farm	The commissioning of a wind farm with the capacity of 50 MW in 2026	Capacity of wind farm (MW) and annual generation (GWh)	The assessment of the impact has been performed assuming that in 2026 the wind farm with the capacity of 50 MW will be commissioned	Planned The RA Energy System Long-Term (up to 2036) Development Ways envisages the construction of this plant	Expected emission reduction in 2026: 70 Gg $CO_{2eq.}$

Table 3.1 Mitigation actions and their effects by Sectors (continued)

Description/ objectives	Quantitative goals	Progress indicators	Methodologies/ Assumptions	Progress of implementation/ steps taken or envisaged	Estimated outcomes/ GHG emissions reduction Gg $CO_{2eq.}$
Energy (generation side and distribution network)					
Name of the action: Construction of geothermal plant					
Coordination/Support: The WB in the frames of SREP project provided a USD 8.55 M grant to confirm whether the geothermal resource at the Project Site is suitable for power generation					
Increase the share of renewables in power generation mix through construction of a geothermal plant	The commissioning of the geothermal plant with the capacity of 30 MW in 2025	Capacity of geothermal plant (MW) and annual generation (GWh)	The assessment of the impact has been performed assuming that in 2025 the geothermal plant with the capacity of 30 MW will be commissioned	Planned Exploratory drilling at the site was done to confirm whether the geothermal resource at the project site is suitable for power generation	Expected emission reduction in 2025: 92 Gg $CO_{2eq.}$
Name of the action: Upgrade of distribution networks implemented by Electric Networks of Armenia					
Coordination/Support: ENA will invest in further modernization of the grid over USD 200 M until 2020 EBRD's corporate loan of USD 80 M to ENA to finance a 5-year USD 200 M investment programme for the modernisation of the distribution network					
Reduction of the ENA losses through upgrading the distribution network. At the next stage the modernisation of the distribution network will also include introduction of smart metering across Armenia	Intermediate goal: reduction of distribution losses by 3% (reaching 9.7%) in 2016. Long-term goal: Reduction of distribution losses to 8.5% in 2020	Electricity losses in electricity distribution network (GWh)	The assessment of the impact has been performed assuming losses will reduce to 8.5% by 2020 (in 2012 the losses made 13.6% in distribution networks)	On-going: The upgrade of distribution networks was completed in 2016 which reduced the losses to 9.7%	Achieved emission reduction in 2016: 47 Gg $CO_{2eq.}$ Expected emission reduction in 2030: 248 Gg $CO_{2eq.}$
Name of the action: Vorotan Hydropower Cascade upgrade					
Coordination/Support: IFC has arranged USD 140 M financing package for the Vorotan Hydropower Cascade to bolster the supply of clean energy in Armenia					
The Vorotan Hydropower Cascade upgrade to increase power generation	Achieving the annual electricity generation by Vorotan Cascade up to 1,150 GWh	Vorotan Cascade annual generation (GWh)	The assessment of the impact has been performed assuming that in 2019 the Vorotan Cascade will be able to generate up to 1150 GWh of electricity annually	Planned The financing agreement is envisaged to be achieved In 2018-2019	Expected annual emission reduction in 2019: 103 Gg $CO_{2eq.}$

Energy (demand side)					
Coverage: CO_2 and CH_4 emissions reduction through the implementation of energy efficiency/energy saving measures and introduction of the new renewable energy sources					
Methodology: The impact assessment was carried out using the LEAP-Armenia software by calculating the reduction of greenhouse gas emissions, including the associated reduction of fugitive emissions, resulted from the natural gas and electricity savings through implementation of mitigation actions					
Name of the action: Energy Efficiency Project, WB–GEF					
Nature: Technology improvement, capacity building					
Coordination/Support: MoENR, WB, R2E2 USD 1.82 M GEF grant, GoA resources and on-lending through revolving fund of R2E2					
Reduction of energy consumption in social and other public facilities through pilot projects' implementation, their replication, capacity building activities and policy development support	The project was estimated to generate annual energy savings of 450 GWh	Energy savings (GWh) in the retrofitted social and other public facilities and from street lighting modernization	GHG emission reduction assessment is based on the estimates and information provided by the WB–GEF Project. Assessment of emissions reduction was done considering estimated electricity and natural gas savings compared to the baseline in each retrofitted building and street lighting project	Completed Project started in 2012 and completed in 2016. 64 public facilities (167 buildings) have been reconstructed by 2016, with actual energy savings of 27-80% from baseline	Achieved annual energy savings in 2017: 450 GWh (both electricity and natural gas). Increased energy savings compared to those reported in the BUR1 are due to the increased number of retrofitted buildings and street lighting projects. Achieved emission reduction in 2017: 163.3 Gg $CO_{2eq.}$
Name of the action: Improving Energy Efficiency in Buildings, UNDP-GEF Project					
Nature: Combination of technology improvement, regulations, incentives and education					
Coordination/Support: MNP, MoUD, UNDP, UNDP-GEF Project USD 1.045 M GEF and USD 150 thousand UNDP grant, USD 2.0 M RA Government co-financing					
Reverse the existing trends and reduce energy consumption of new and restored, primarily residential buildings through design, enforcement of new mandatory EE building codes, outreach, training and educational campaign on integrated building design, piloting integrated building design	Reduced energy consumption in pilot buildings from 185 kWh/m^2 to 111 kWh/m^2	Energy savings (GWh) in the restored residential buildings	Emissions reduction assessment was done considering energy savings of both natural gas and electricity in comparison to the baseline, provided in the Project Final Report	Completed Project started in 2010 and completed in 2016. Energy consumption in pilot buildings was reduced from 185 kWh/m^2 to 111 kWh/m^2	Achieved annual energy savings in 2017: 68.4 GWh (both electricity and natural gas) Achieved emission reduction in 2017: 29.7 Gg $CO_{2eq.}$

Table 3.1 Mitigation actions and their effects by Sectors (continued)

Description/ objectives	Quantitative goals	Progress indicators	Methodologies/ Assumptions	Progress of implementation/ steps taken or envisaged	Estimated outcomes/ GHG emissions reduction Gg $CO_{2eq.}$
Energy (demand side)					
Name of the action: Irrigation System Enhancement Project, WB					
Nature: Technology improvement, capacity building					
Coordination/Support: WB, MoA and State Committee of Water Economy USD 30 M WB/IBRD loan					
Reduce energy consumption and improve irrigation conveyance efficiency in targeted irrigation schemes	The annual energy savings of about 36.4 GWh (equivalent to about 30 per cent of the total needs of the irrigation system)	Energy savings (GWh) in the targeted irrigation schemes	Emissions reduction assessment was done considering electricity savings resulted from improved efficiency of irrigation schemes, provided in 2016 WB Report	Completed Project started in 2013 and completed in 2017. Improved irrigation and drainage services on more than 12,000 hectares resulted in reduced amount of energy used and reduction of water losses	Achieved annual energy savings: 36.4 GWh Achieved emission reduction: 21.3 Gg $CO_{2eq.}$
Name of the action: Clean Energy and Water Program, USAID					
Nature: Combination of technology improvement, capacity building and education					
Coordination/Support: USAID USD 577 thousand (including community and partner contributions)					
Increasing energy efficiency in rural areas through introducing EE and RE solutions aimed at improving water supply, outdoor lighting and heating		Energy savings (GWh)	Emissions reduction assessment was done considering energy savings provided in USAID project Final Report	Completed Project started in 2013 and completed in 2015. 18 RE and EE pilot projects were implemented	Achieved annual energy savings in 2015: 1.4 GWh Achieved emission reduction in 2015: 1.1 Gg $CO_{2eq.}$

Name of the action: The IFC Armenia Sustainable Energy Finance Project (ArmSEFF)					
Nature: Promotion, financial, technology					
Coordination/Support: Armenia Sustainable Energy Finance Project USD 30 M IFC loan and technical assistance grant from the Armenia Sustainable Energy Finance Project					
Establish a sustainable market for EE and RE finance products in Armenia, increasing the application of advanced technologies through the lending provided from Armenian commercial banks		Energy savings (GWh) and new renewable power generation capacities	To avoid duplication, emissions reduction resulted from new Renewables are not considered here but have been considered on generation side. Only emission reductions resulted from the implementation of EE measures were considered based on the technical estimates provided by the ArmSEFF project	Completed Project started in 2009 and completed in 2015. New renewable power generation capacities of 35 MW have been commissioned. 35 GWh annual energy savings in Industry - both electricity and natural gas provided by ArmSEFF project consultant	Achieved annual energy savings in 2015: 35 GWh Achieved emission reduction in 2015: 20.3 Gg $CO_{2eq.}$
Name of the action: Small Grants Programme, UNDP-GEF					
Nature: Combination of technology, promotion, capacity building, incentives					
Coordination/Support: UNDP-GEF, Small Grants Programme, GEF Grant					
Promote the demonstration, development, transfer and widespread use of renewable energy technologies at the community level		Energy savings (GWh)	Emissions reduction was assessed considering electricity and natural gas savings on demand side, provided by the SGP experts	Completed Project started in 2014, completion - in 2016. Installed solar collectors with total area of 106m^2, 3 grid-connected PVs with total capacity of 24 kW, EE measures in 9 public facilities	Annual energy savings in 2016: 0.546 GWh Achieved emission reduction in 2016: 0.2 Gg $CO_{2eq.}$

Table 3.1 Mitigation actions and their effects by Sectors (continued)

Description/ objectives	Quantitative goals	Progress indicators	Methodologies/ Assumptions	Progress of implementation/ steps taken or envisaged	Estimated outcomes/ GHG emissions reduction Gg $CO_{2eq.}$
Energy (demand side)					
Name of the action: Green Urban lighting, UNDP-GEF Project					
Nature: Combination of technology, education, capacity building, financial mechanism, legislation					
Coordination/Support: MNP, local authorities,UNDP, UNDP-GEF Project USD 1.6 M GEF and USD 120 thousand UNDP grant, USD 200 thousand co-financing from municipalities					
Promote energy efficiency in municipal lighting through demonstration projects implementation, establishment of financial and institutional mechanisms for scaling up municipal EE lighting programs and policy instruments, educational and capacity building activities	Direct annual energy savings of 1.2 GWh from demonstration projects. Indirect annual energy savings of 20 GWh from replication of demonstration projects via municipal programs in Armenia. Indirect annual energy savings of 125 GWh from implementation of EE measures in lighting sector	Energy savings (GWh)	Emissions reduction assessment was done considering both direct annual electricity savings and indirect annual electricity savings from implementation of national green lighting policy (50% decrease from baseline) provided in the UNDP-GEF project report	On-going Project started in 2013 and will be completed in 2018. Installation of 2374 LED street luminaires. In 14 communities demonstration projects are completed ensuring 1.73 GWh annual energy savings. Indirect energy savings from replication of demonstration projects are 0.99 GWh. The street and park lighting system efficiency is improved in average by 68%. Indirect energy saving from implementation of national lighting policy is expected to be achieved by the end of the project	Expected annual energy savings in 2030: 146.2 GWh, including direct, indirect energy savings from demonstration projects and national green lighting policy. Expected emission reduction in 2030: 102 Gg $CO_{2eq.}$
Name of the action: Green for Growth Fund (GGF)					
Nature: Promotion, technology, financial mechanism					
Coordination/Support: USD 22.354 M loan facilities have been provided from the Green for Growth Fund to Araratbank, Inecobank, ACBA leasing and ACBA. Recently GGF added US$ 2 M loan facilities through ACBA Leasing commercial bank to further strengthen EE lease financing portfolio					
Support the development of EE lending product within the commercial banks, enabling households and business customers to take loans for EE improvements		Energy savings (GWh)	Emissions reduction assessment was done based on the expected annual energy savings in 2020 provided by GGF	On-going Project started in 2012 and will be completed in 2020 As of 2017, overall 4,230 borrowers have benefited	Expected annual energy savings in 2020: 82.83 GWh Expected emission reduction in 2020: 37.6 Gg $CO_{2eq.}$

Name of the action: Caucasus Sustainable Energy Finance Facility, branded as Energocredit					
Nature: Combination of promotion, technology, financial mechanism, incentives					
Coordination/Support: Project financing was extended to US$ 21.5 M financed through PFI loans, and US$ 1.5 M of incentives provided through EU NIF and the EBRD Special Shareholder Fund					
The EBRD is operating a credit line to provide financing for EE projects and/or small renewable energy projects implemented by private entities and individuals		Energy savings (GWh)	Emissions reduction assessment was done based on the expected annual energy savings in 2020 provided by Caucasus Sustainable Energy Finance Facility	On-going Project started in 2013 and will be completed in 2020 As of 2017, 10,800 households and 22 SMEs have received EE financing	Expected annual energy savings in 2020: 180 GWh Expected emission reduction in 2020: 81.7 Gg $CO_{2eq.}$
Name of the action: Continuous replacement of mini buses by larger passenger buses in Yerevan					
Nature: Infrastructure development					
Coordination/Support: Yerevan Municipality					
Optimization of public road transport route grid and reduction of annual running distance; replacement of minibuses by larger passenger buses	In the 2015-2020 period the replacement of mini buses by 468 larger passenger buses	Energy savings (GWh)	Emissions reduction assessment was done based on the energy savings assessment provided in the Second NEEAP	On-going Project started in 2012 and will be completed in 2020. In 2012-2017, 434 new buses replaced mini buses, resulting in removal of corresponding routes of mini buses. During 2017-2020, another 4 routes of minibuses are expected to be removed and 5 routes of larger buses to be added	Expected emission reductions in 2020: 158.7 Gg $CO_{2eq.}$

Table 3.1 Mitigation actions and their effects by Sectors (continued)

Description/ objectives	Quantitative goals	Progress indicators	Methodologies/ Assumptions	Progress of implementation/ steps taken or envisaged	Estimated outcomes/ GHG emissions reduction Gg $CO_{2eq.}$
Energy (demand side)					
Name of the action: Habitat for Humanity					
Nature: Technology, incentives					
Coordination/Support: Habitat for Humanity, "Renewable Energy Financing" (REF) Project, "Residential Energy Efficiency for Low-income Households" (REELIH) Project"Access to Renewable and Efficient Energy in Municipalities Vayk and Spitak" (AREEM) Project					
Promote the use of solar energy in multi-apartment buildings for low and middle income families in the frames of "REF" and "REELIH" projects. Develop and test models through implementing EE measures and using renewable energy sources in the frame of "AREEM"		Energy savings (GWh)	Emissions reduction assessment was done based on the expected annual energy savings in 2018 considering the allocated loans and actual annual energy savings in 2017 provided by Habitat for Humanity as well as the remaining loan amount to be provided to beneficiaries	On-going Projects started in 2013 and will be completed in 2018. As of 2016, the number of served families & buildings - 434 families and 9 buildings, respectively	Expected annual energy savings in 2018: 3 GWh Expected emission reduction in 2018: 1.5 Gg $CO_{2eq.}$
Name of the action: Household Energy Efficiency Mortgage Loans					
Nature: Promotion, technology, financial mechanism					
Coordination/Support: Central Bank, National Mortgage Company (NMC) The Program is complemented by EUR 3 M loan from the French Development Agency to the existing EUR 10 M loan, technical assistance funding from the EU Neighbourhood Investment Facility (NIF) to Partner Financial Institutions (PFI) and non-refundable grant funding from the EU NIF to borrowers. Recently KfW bank financed the 4th phase of the program in the amount of EUR 20 M					
To provide loans for on-lending to private households outside Yerevan City Center and in the regions of Armenia to finance energy efficiency investments in housing for low and middle-income families	Approximate number of beneficiaries (households) is 3,000	Energy savings (in GWh)	Emission reductions were assessed based on technical estimates and information provided by NMC, considering natural gas savings resulted from EE investment in housing which leads to an average of 44% energy savings on demand side	On-going Project started in 2014 and will be completed in 2020. 791 households received EE loans in the frame of the French Development Agency financing and 73 loans have been provided from KfW financing	Expected annual energy savings in 2025: 20.51 GWh Expected emission reduction in 2025: 6 Gg $CO_{2eq.}$

Name of the action: GAF Energy Efficiency Programme for MSMEs					
Nature: Promotion, technology, financial mechanism					
Coordination/Support: KfW Financed from a concessional loan of EUR 20 M under the umbrella of the German-Armenian Financial Cooperation					
Investments in modern energy efficient equipment and machinery, building infrastructure and projects that use renewable sources of energy		Energy savings (in GWh)	Emissions reduction assessment was done based on the expected annual energy savings in 2019 considering: the allocated loans and actual annual energy savings in 2017 provided by GAF as well as the remaining loan amount to be provided to the customers	On-going Project started in 2016 and will be completed in 2019. As of 2017, 96 GWh annual energy savings have been achieved	Expected annual energy savings in 2019: 320 GWh Expected emission reduction in 2019: 145.2 Gg $CO_{2eq.}$
Name of the action: Bright Border					
Nature: Energy efficient technology transfer and introduction of renewable energy sources					
Coordination/Support: Public initiative					
Promotion of energy efficient technologies, reduction of energy costs and market development		Energy savings (in GWh)	Emissions reduction assessment was done based on the achieved energy savings in 2017	On-going Project started in 2016. Installation of 18500 LED street luminaires in 17 bordering communities	Achieved energy savings: 1.4 GWh Achieved emission reduction: 0.6 Gg $CO_{2eq.}$
Name of the action: De-risking and Scaling-up Investment in Energy Efficient Building Retrofits					
Nature: Combination of technology improvement, regulations, incentives and education					
Coordination/Support: UNDP, MNP, USD 20 M grant from the Green Climate Fund					
Improve energy efficiency through building retrofits, address high levels of energy poverty and high use of imported fossil fuels	Per the Project Document, 6000 single-family individual buildings, 290 multi-apartment buildings and 173 public buildings are expected to be benefited	Energy savings (in GWh)	Emissions reduction assessment was done considering energy savings in 2023 of both natural gas and electricity provided in the Project Document	Ongoing Project started in 2017	Expected annual energy savings in 2023: 264.3 GWh Expected emission reduction in 2023: 98.4 Gg $CO_{2eq.}$

Table 3.1 Mitigation actions and their effects by Sectors (continued)

Description/ objectives	Quantitative goals	Progress indicators	Methodologies/ Assumptions	Progress of implementation/ steps taken or envisaged	Estimated outcomes/ GHG emissions reduction Gg $CO_{2eq.}$
Energy (demand side)					
Name of the action: GoA Decision "On implementation of energy saving and energy efficiency improvement measures in facilities constructed by state funding", 2014					
Nature: Combination of regulatory and technology improvement					
Coordination/Support: Urban Development Committee under the GoA					
Implementation of energy saving and energy efficiency improvement measures in facilities being constructed (reconstructed, renovated) under the state funding	Reduction of specific energy consumption in buildings from 160 kWh/m^2 to 96 kWh/m^2	Energy savings (in GWh)	Emissions reduction assessment was done based on the energy savings resulted from the reconstruction of the public facilities assessed by the project's experts considering the results of the energy audits of the standardized buildings as well as the amount of the state funding envisaged for EE improvement measures	On-going As of 2016, 20 public facilities have been reconstructed	Expected annual energy savings in 2021: 21 GWh Expected emission reduction in 2021: 8.7 Gg $CO_{2eq.}$
Name of the action: Technology upgrading in cement factory					
Nature: Technology					
Coordination/Support: "Hrazdan Cement" CJSC					
Technology upgrading through combination of different measures	The technology upgrading is implemented to achieve annual energy savings of: 4.142 GWh of electricity and 10.925 GWh of natural gas	Energy savings (in GWh)	Emissions reduction assessment was done based on the electricity and natural gas savings resulted from technology upgrading assessed and provided by the experts of the cement factory	Planned "Hrazdan Cement" CJSC and commercial banks are negotiating financing (loan) for technology upgrading	Expected annual energy savings in 2019: 15.1 GWh Expected emission reduction in 2019: 6.1 Gg $CO_{2eq.}$

Name of the action: Yerevan Street Lighting Project					
Nature: Technology improvement					
Coordination/Support: EBRD, MNP, Yerevan Municipality The EBRD's USD 2 M sovereign loan, USD 2 M E5P grant					
Reduce energy consumption and modernize Yerevan street lighting system by introducing new EE LED lighting and 80 km of underground cabling in primary and secondary streets	Refurbishment of the street lighting network of 28 streets in Yerevan	Energy savings (in GWh)	Emissions reduction assessment was done considering the difference between the existing electricity consumption of Yerevan street lighting system and expected electricity consumption resulted from Yerevan street lighting system modernization provided by the EBRD	Planned EBRD has secured funds for the project implementation	Expected annual energy savings in 2026: 43.2 GWh Expected emission reduction in 2026: 30.1 Gg $CO_{2eq.}$
Name of the action: Geothermal Heat Pump and Solar Thermal Project (SREP)					
Nature: Technology, incentives, capacity building					
Coordination/Support: USD 3 M of SREP funding					
Increase the deployment of geothermal heat pumps and solar water heaters to help reduce gas imports through reduction of demand for gas-based electricity and gas used for heating/hot water	Generation capacities and production targets for 2025 indicated in SREP: Geothermal heat pumps: installed capacity– 25 MW generation–33 GWh. Solar thermal: installed capacity– 20 MW generation–25 GWh	Renewable energy generation (in GWh)	Emission reduction assessment was done based on the projected reduction of demand for natural gas-based electricity and natural gas used for heating/hot water in 2025 indicated in SREP	Planned Secured funds in SREP	Expected annual renewable energy generation in 2025: 58 GWh Expected emission reduction in 2025: 27 Gg $CO_{2eq.}$

Table 3.1 Mitigation actions and their effects by Sectors (continued)

Description/ objectives	Quantitative goals	Progress indicators	Methodologies/ Assumptions	Progress of implementation/ steps taken or envisaged	Estimated outcomes/ GHG emissions reduction Gg $CO_{2eq.}$
Industrial Processes and Product Use					
Name of the action: Technology upgrading in cement factories					
Coverage: CO_2 emissions reduction through technology upgrading in cement factories					
Nature: Technology improvement					
Coordination/Support: "Hrazdan Cement" CJSC					
Improving dust collectors' efficiency which allows to capture more amount of dust and recycle to the kiln	Increased annual dust capture up to 309 tonne	Annual dust capture	Emission reduction assessment was done based on the projected reduction of cement dust provided by the "Hrazdan Cement" CJSC experts. CO_2 emission reduction was assessed applying Tier 3 method provided in 2006 IPCC Guideline	Planned "Hrazdan Cement" CJSC and commercial banks are negotiating financing (loan) for technology upgrading	The annual expected emission reduction in 2019: 0.1422 Gg $CO_{2eq.}$
Name of the action: Implementing Kigali Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer					
Coverage: HFCs emissions reduction in Product Use sub-sector					
Nature: Regulatory					
Coordination/Support: MNP					
The measure covers the steps for implementing the Kigali agreement such as development of HFCs phase out plan, establishing the HFCs consumption phase-down commitments by a law, adopting national quotas, regulating control over quotas and similar activities	Phase down HFCs consumption reducing it by 80-85 % in 2040	HFCs annual emissions	Emission reduction assessment was done based on the projected growth of emissions based on simple extrapolation of recent trends and with assumptions that these emission will stabilize by 2024 and in 2029 reduce by 10% from 2024 levels	Planned Armenia has already ratified Kigali amendment. Steps envisaged include developing a national action plan for phasing down HFCs consumption which will include legislation, licensing system, limitation of HFCs import into the country, targeted trainings and awareness raising	The annual expected emission reduction in 2030: 531 Gg $CO_{2eq.}$

Agriculture					
Name of the action: Production of organic fertilizer through public-private partnership					
Coverage: N_2O emissions reduction through production of organic fertilizers					
Nature: Technology					
Coordination/Support: Agriculture Development Fund of the RA Ministry of Agriculture					
Decrease the amount of the imported non-organic fertilizer to reduce N_2O emissions (direct and indirect) from managed soils	Production of organic fertilizer starting from the volumes for fertilizing of 20,000 ha in 2018 with further annual increased volumes of production of 5% in average	Production volumes	Emission reduction assessment was done based on the projected production volumes and the amount of nitrogen fertilizer to be replaced applying 2006 IPCC software	Planned Agriculture Development Fund negotiates with private sector	Expected annual emission reduction is about 22 Gg $CO_{2eq.}$ in 2018 and 160 Gg $CO_{2eq.}$ in 2030
Forestry					
Coverage: The increase of CO_2 removals through the forestation and afforestation measures					
Name of the action: Strengthening of Forest Ecosystems on Climate Change through Transformation of Forests in South Caucasus Countries					
Nature: Capacity building, technology improvement					
Coordination/Support: WWF, EUR 491,207 grant from EU					
Create the necessary conditions to develop and implement strategies for transformation of homogeneous forests		Transformation of forest land (ha) and tree planting (number)	CO_2 removals assessment was done based on the size of transformed lands (ha), applying 2006 IPCC software	Completed Project started in 2011 and completed in 2015. In 2013-2014, transformation of about 128 ha of forest land and 250,000 planted trees	Annual CO_2 removals in 2015: 0.374 Gg

Table 3.1 Mitigation actions and their effects by Sectors (continued)

Description/ objectives	Quantitative goals	Progress indicators	Methodologies/ Assumptions	Progress of implementation/ steps taken or envisaged	Estimated outcomes/ GHG emissions reduction Gg $CO_{2eq.}$
Forestry					
Name of the action: Sustainable Biodiversity Management Program					
Nature: Capacity building, technology improvement					
Coordination/Support: GIZ EUR 494,000 grant from Ministry of Foreign Affairs of Norway					
Improve the forestry growth and development through grass cuttings and improve the resistance of forest ecosystems to climate change impacts		Transformation of forest land (ha) and tree planting (number)	CO_2 removals assessment was done based on the size of transformed lands (ha), applying 2006 IPCC software	Completed Project started in 2013 and completed in 2015. In 2013-2014, transformation of about 184 ha lands and 130,000 planted trees	Annual CO_2 removals in 2015: 0.26 Gg
Name of the action: Forest Fund for Reconstruction and Development, Teghut Project					
Nature: Support					
Coordination/Support: "Hayantar" SNCO, "Forest's Recovery and Development Fund"					
Implement afforestation and reforestation		Land subjected to afforestation and reforestation (ha)	CO_2 removals assessment was done based on the size of land subjected to afforestation and reforestation (ha), applying 2006 IPCC software	Completed Project started in 2013 and completed in 2014. In 2013-2014, afforestation and reforestation were implemented in 157 ha of land	Annual CO_2 removals in 2020: 0.282 Gg
Name of the action: Forest pest control					
Nature: Technology					
Coordination/Support: "Hayantar" SNCO State funding					
Implement pest control in the forests through spraying		Land subjected to the implemented measures (ha)	CO_2 removals assessment was done based on the size of land subjected to the implemented measures (ha), applying 2006 IPCC software	Completed Project started in 2013 and completed in 2014. In 2013-2014, the measures were implemented in 157 ha of land	To avoid the reduction of CO_2 emission removals in the amount of 30.7 Gg

Waste					
Coverage: CH_4 emission reduction through the improvement of the solid waste collection and management					
Name of the action: Nubarashen Landfill Gas Capture and Power Generation CDM Project					
Nature: Infrastructure development					
Coordination/Support: Yerevan Municipality, Shimizu Corporation (Japan)					
CH_4 emission reduction through the capture and combustion of landfill gas	135 Gg $CO_{2eq.}$ emission reduction annually	Landfill gas captured	The estimate of the certified emissions for the period of 01.10.2014 to 30.12.2016 is provided by the project's experts -Shimizu Corporation. CDM methodologies– "Renewable electricity generation for a grid" (AMS-I.D. v 5) and "Consolidated methodology for landfill gas project activities" (ACM0001) - were applied for CH_4 emission reduction estimate	On-going Project started in 2007 The gas capture and combustion system was constructed in the Nubarashen landfill	The estimate of the certified emissions for the period of 01.10.2014 to 30.12.2016 is 25 Gg of $CO_{2eq.}$
Name of the action: Kotayk and Gegharkunik Solid Waste Management Project					
Nature: Infrastructure and waste management development					
Coordination/Support: EBRD, Ministry of Territorial Administration and Development, Municipalities EUR 5.5 M loan from EBRD, EUR 3.5 M grant from EU Neighbourhood Investment Facility, EUR 2 M grant from E5P					
Improvement of the solid waste collection and management services in Kotayk and Gegharkunik regions of Armenia, including the construction of a new landfill in Hrazdan	4 Gg of $CO_{2eq.}$ annual emissions reduction in 2021. Environmental and social benefits for local residents	Emission reduction	The estimate of emissions reduction was provided by the EBRD and done based on the projected recovery of landfill gas from existing dumpsite(s) and from the new landfill	Planned EBRD has secured funds for the project implementation. The preparation of the design of the first EU compliant regional landfill and relevant infrastructure in Hrazdan town	The annual emission reduction expected: 4 Gg of $CO_{2eq.}$ in 2021

Table 3.1 Mitigation actions and their effects by Sectors (continued)

Description/ objectives	Quantitative goals	Progress indicators	Methodologies/ Assumptions	Progress of implementation/ steps taken or envisaged	Estimated outcomes/ GHG emissions reduction Gg $CO_{2eq.}$
Waste					
Name of the action: Solid Waste Management in Yerevan					
Nature: Infrastructure and waste management development					
Coordination/Support: EBRD, Yerevan Municipality EUR 8 M loan from EBRD, EUR 8 M loan from Environment Investment Bank (EIB), EUR 8 M grant from EU Neighbourhood Investment Facility, EUR 2 M grant from E5P					
The new sanitary landfill will reduce adverse environmental and health impact from the current landfill, which will be rehabilitated when the new site becomes operational	140 Gg of $CO_{2eq.}$ annual emission reduction in 2021. Reduce adverse environmental and health impacts	Emission reduction	The estimate of emissions reduction was provided by the EBRD and done based on the projected recovery of landfill gas from existing dumpsite(s) and from the new landfill	Planned EBRD has secured funds for the project implementation	Expected annual emission reduction: 140 Gg of $CO_{2eq.}$ in 2021
Name of the action: Integrated Solid Waste Management System in Vanadzor					
Nature: Infrastructure and waste management development					
Coordination/Support: Ministry of Territorial Administration and Development, Vanadzor Municipality, KfW loan					
Development of waste management to achieve a significant step-change in waste management practices, including waste collection and disposal infrastructure	10.148 Gg of $CO_{2eq.}$ annual emissions reduction in 2025	Emission reduction	The estimate of emissions reduction is provided in the Feasibility Study implemented by KfW and was done considering landfill gas capture and flaring of 50% of developed methane compared to baseline	Planned GoA and KfW are negotiating financing for the project implementation	Expected annual emission reduction: 10.15 Gg of $CO_{2eq.}$ in 2025

Table 3.2 Additional mitigation actions and their effects in Energy Sector

Name of the action	Description/ objectives	Methodologies/ Assumptions	Estimated outcomes/ GHG emission reduction, Gg $CO_{2eq.}$
Generation side			
Commissioning of additional renewable plants	Additional Renewables in 2030 with the total installed capacities: Solar PVs – 85 MW Wind farms – 150 MW	The construction of these Renewables is based on different studies and assumes more ambitious development of distributed Solar PVs. The impact assessment was carried out using the LEAP-Armenia software by calculating the reduction of greenhouse gas emission from natural gas combustion and associated reduction of natural gas fugitive emissions due to the reduced generation of thermal power plants	Expected emission reduction in 2030: Solar PVs – 75 Gg $CO_{2eq.}$ Wind – 212 Gg $CO_{2eq.}$, including reduction of fugitive emissions
Demand side			
Supporting participation of the Eastern Partnership and Central Asian Cities in the Covenant of Mayors. As of 2017, 8 Sustainable Energy Action Plans have been developed, from which seven is approved, including one for Yerevan city, one is pending. Most of energy savings will come from Yerevan city	Implementation of energy saving, energy efficiency actions and development of renewable energy sources aimed at achieving the 20% GHG emission reduction goal by the year 2020	To avoid double counting, emissions reduction assessment was done considering difference between expected energy savings estimated under the Covenant of Mayors (Sustainable Energy Action Plans) and energy savings resulted from specific projects included in SEAPs but already reported as mitigation actions	The annual emission reductions are expected to be 13.1 Gg $CO_{2eq.}$ in 2020
Energy Efficient Public Buildings and Housing in Armenia - NAMA registered in the UNFCCC NAMA Registry for seeking investments	EE improvements in public buildings and housing	GHG reduction assessment was done based on the energy savings assessment provided in the Second NEEAP considering energy savings of both natural gas and electricity	The annual emission reductions are expected to be 91.1 Gg of $CO_{2eq.}$ in 2025
Energy Efficient Rehabilitation of Schools	Modernization of 15-25 schools by increasing EE and reducing energy consumption	The assessment of emissions reduction was done considering natural gas savings in comparison with baseline consumption	The annual emission reductions are expected to be 2.4 Gg of $CO_{2eq.}$ in 2021

Table 3.2 Additional mitigation actions and their effects in Energy Sector (continued)

Name of the action	Description/ objectives	Methodologies/ Assumptions	Estimated outcomes/ GHG emission reduction, Gg $CO_{2eq.}$
Demand side			
Increasing energy efficiency in public transport system	A part of measure for transport considered under the Second NEEAP is considered as additional measures as there is no secured financing for the part of the program yet	Emissions reduction assessment was done considering corresponding reduction of energy consumption in public transport provided in the Second NEEAP	The annual emission reductions are expected to be 222.4 Gg of $CO_{2eq.}$ in 2020
Increasing energy efficiency in industrial sector	Promote EE through introduction of mandatory energy audits and introduction of Best Available Technologies (BAT)	To avoid double counting, emissions reduction assessment was done based on energy savings of both natural gas and electricity provided in the Second NEEAP, reduced by energy savings resulted from the other already reported EE actions in industrial sector	The annual emission reductions are expected to be 102.5 Gg of $CO_{2eq.}$ in 2030
Energy efficiency retrofit in buildings	Reduce energy consumption of existing residential buildings through design and enforcement of new mandatory EE building codes	Emissions reduction assessment was done based on the energy savings assessment provided in the Second NEEAP	The annual emission reductions are expected to be 18.9 Gg of $CO_{2eq.}$ in 2018
Energy efficiency in residential appliances	Reduce energy consumption through the introduction of EE refrigerators and air conditioners	Emissions reduction assessment was done based on the projected energy savings from the increased share of EE household appliances provided in "Accelerate the process of development and adoption of common minimum energy performance standards and labelling requirements for energy related products in the republic of Armenia", U4E Country Assessment, reduced by the amount of energy savings expected from the other already reported projects aimed at introducing modern energy efficient equipment	The annual emission reductions are expected to be 115.1 Gg of $CO_{2eq.}$ in 2030

Natural gas tariff structure revision study for SMEs	Development of the revised tariff structure for SMEs to encourage energy savings as needed	Emissions reduction assessment was done based on the energy savings assessment provided in the Second NEEAP	The annual emission reductions are expected to be 17.3 Gg of $CO_{2eq.}$
Renewing the agricultural machinery park	Replacement of the agricultural machinery with new efficient equipment to achieve 20% fuel savings		The annual emission reductions are expected to be 0.2 Gg of $CO_{2eq.}$
Grading agricultural products based on quality	Creating mechanisms for grading agricultural products based on quality for the processing industry to improve irrigation management and reduce water usage		The annual emission reductions are expected to be 6 Gg of $CO_{2eq.}$
Install gravity irrigation	Apply modern irrigation methods such as drip irrigation and support private sector to introduce this technology for irrigation		The annual emission reductions are expected to be 12 Gg of $CO_{2eq.}$

3.2 Assessment of mitigation potential in Energy sector

As it is stated above, the greenhouse gas reduction potential has been assessed for the Energy sector up to 2030 for different development scenarios, considering its strategic role for Armenia's economic and environmental goals and that the most of the emissions come from the Energy sector.

The assessment has been done based on the corresponding energy strategies, policies and programs adopted during 2013-2017 which fully reflect energy efficiency and renewable energy potential of the sector.

Strategies and polices

The currently upgraded legal/regulatory framework covers the wide range of regulations - from laws, strategies to programs and action plans. The most important ones are listed below:

Energy Security Concept of the RA, 2013
The concept defines the main ways for ensuring energy security for providing affordable and reliable energy supply, considering the lack of domestic fossil fuel resources of industrial significance. The concept identifies the development of nuclear energy, the promotion, development and investment in renewable energy and energy efficiency as critical to achieving energy security.

Scaling up Renewable Energy Programme (SREP), 2014
The Programme identifies renewable energy technologies and projects that can best contribute to Armenia's energy, economic and environmental development goals and outlines the activities that must be carried out for the realization of the projects. The investment priorities have been identified according to the economically viable projects in following order: geothermal power, utility-scale solar PV, geothermal heat pumps and solar-thermal. As of 2014, the share of renewables (without large HPPs) in the power generation mix was 8.91 per cent[10]. The Government's target for such generation indicated in the SREP is to represent 21 per cent of total generation by 2020, and 26 per cent by 2025[11].

Energy Security Action Plan for 2014-2020, 2014
The action plan identifies specific actions to be implemented for achieving goals set forth in RA Energy Security Concept and Scaling-up Renewable Energy Programme (SREP) Investment Plan for Armenia.

Long-term Development Strategy Program of the RA for 2014-2025, 2014
The program is aimed at ensuring a coordinated post-crises strategic framework for the development of state policies, given the current conditions and global development challenges. The implementation of the priorities will be mainstreaming with the environmental issues consideration and the sustainable management of natural resources.

Amendment to the RA Energy Law, 2014
The Amendment aims at the creating the favorable conditions for renewable energy sources by extending the power purchasing agreement from RE sources (with the exception of the small HPPs) from 15 to 20 years.

RA Energy System Long-Term (up to 2036) Development Ways, 2015
This program of strategic development of the energy system of Armenia defines the development strategy to meet the criteria of energy security at the lowest cost based

[10] *"Settlement Center" CJSC of the RA MENR, 2014*

[11] *Scaling up Renewable Energy Programme, 2014*

upon nuclear energy and modern gas fired generation plants, development and expansion of economically viable and technically available renewable energy sources and diversification of fuel supply chains.

Currently, the energy development strategy of the country is being revised considering more ambitious development of renewable energy sources, diversification of fuel supply chains and regional cooperation and integration programs.

Amendment to the RA Energy Law, 2016
The Amendment aims at promoting the solar energy generation for own needs with peak capacity of up to 150 kW (inclusive) by stipulating that such power plants generation can be carried out without the activity licenses issued by the PSRC as well as enabling to sell the excess generation to the grid according to the order/regulation of mutual payments between the producers and Electric Networks of Armenia.

Amendment to the RA Energy Saving and Renewable Energy Law, 2016

- Net metering for solar energy for autonomous producers has been adopted stipulating a sales price for net metering for autonomous producers
- Stipulates for mandatory compliance with the EE requirements in state investment projects and residential construction

Establishment of feed-in tariff, 2016
The PSRC for the first time has set a feed-in tariff for the sale of electricity from solar PVs (up to 1MW)

Solar PVs construction Investment Program, 2016
Provides for construction of solar PVs with total capacity of about 110 MW.
Approved by the GoA Protocol Decision N 53, 2016.

Hydro Energy Development Concept of the RA, 2016
Aims at promoting the hydro power generation considering the need to use the public-private partnership options as well as certain legislative guarantees to make the investment environment more attractive.
Approved by the GoA Protocol Decision N 53 in 2016.

Second National Energy Efficiency Action Plan, 2017
The second NEEAP defined a set of policy and programme measures for energy efficiency improvements in all relevant economic sectors. The next step assumes translation of the NEEAP into sector-specific programmes.

Program of the Government of RA for 2017-2022, 2017
The Program aims at provision of around 5 per cent GDP growth in average.
The Program indicates that the Energy Policy of the RA Government is aimed at ensuring energy independence and enhancing the energy security of Armenia, ensuring regional integration and sustainable development of the energy sector based on further development of nuclear energy, diversification of the supply of energy sources and full and efficient use of local (renewable) energy resources, as well as implementation of modern energy-efficient tools and introduction of new technologies.

International agreements
Iran-Armenia Electricity-for-Gas Swap Agreement - targets at increasing average annual amount of gas received from Iran to 2,300 million m^3 and exchanged with 6,900 GWh electricity. Currently only 360 million m^3 gas is received annually in exchange for 1,200 GWh electricity. Full contractual quantities can be achieved after commissioning of the 400 kV Armenia-Iran power transmission line.

Intergovernmental agreement between the RA and the Russian Federation - on lending for the Armenian Nuclear Power Plant life-extension (up to 2026) related work, 2015. Work on extension of the operation period of the second unit of the Armenian NPP is underway and due to be completed by 2020.

Eastern Europe Energy Efficiency and Environment Partnership Programme (E5P) - envisages EUR 20 million grant financing to enable implementing the most important EE projects.

Supporting participation of Eastern Partnership and Central Asian Cities in the Covenant of Mayors – aimed at achieving the 20 per cent GHG emission reduction goal by the year 2020 as compared to the baseline emissions.

Studies

- "Wind Energy in Armenia - Study on Potential and Development Opportunities", USAID, 2010.
- "Renewable Energy Roadmap", R2E2 Fund, 2011.
- "Armenia Least Cost Energy Development Plan", USAID, 2015.
- "Armenia -Low Carbon Economic Growth Opportunities in Developing Countries", WB, 2015
- "Accelerate the process of development and adoption of common minimum energy performance standards and labelling requirements for energy related products in the Republic of Armenia", EU4 Energy, 2017
- In-Depth Review of the Energy Efficiency Policy of Armenia, International Energy Charter, 2017
- "Support to national and regional energy planning and capacity building at the Scientific Research Institute of Energy", USAID, 2017

The impact of mitigation actions is assessed for the following Scenarios considered for Energy sector:

Scenario 1 (without measures - WOM) was considered to assess the GHG emissions growth risks in case of a delay of the new nuclear plant construction. Construction of new renewables is also not provided. All the growing demand including fulfilment of the contractual obligations under the Iran-Armenia Electricity-for-Gas Swap Agreement will be met by the construction of new thermal power plants. Demand side mitigation measures were also not provided.

Scenario 2 (with measures - WM) provides for both generation and demand side mitigation measures and includes those mitigation actions which are highly likely to be implemented, as financing has been secured for them or they constitute a priority in the sectoral strategic papers (Table 3.1).

Scenario 3 (with additional measures - WAM) includes those actions both on generation and demand side for which the implementation entails a relatively high degree of uncertainty (Table 3.1 and Table 3.2).

During the preparation of the Armenia's First Biennial update Report the model LEAP-Armenia was developed that was used to generate projections of greenhouse gas emissions under WOM, WM and WAM scenarios. The projections were based on 2012 GHG inventory as a base year and power plant operation data, the assumed socio-economic growth (GDP and population growth rates) and the estimated impacts of different mitigation measures (in case of WM and WAM scenarios).

For the BUR2 the same model was used to track emissions for the monitored years (2013-2014) and re-evaluate emission projections for the same scenarios using the updated data on GDP and population growth rates, plant operation and mitigation measures.

To estimate ex-post emissions for WOM Scenario the projections for 2013-2014 years were corrected to account for:

- Recalculation of 2012 GHG emission inventory
- Observed GDP and population growth
- Observed hydrological and wind regimes of the renewable plants

- Observed efficiencies of the thermal power plants
- Electricity import-export values.

As for WM and WAM scenarios, the 2013-2014 years were calibrated to real inventory data from Armenia's 2013 and 2014 GHG emission inventory. The observed difference between WOM and real observed inventory values shows the real measured emission reductions achieved in the period of 2013-2014.

The projections after 2014 were reevaluated with updated data on GDP and population growth rates and impacts of different mitigation actions. The real observed values were used for all exogenous factors (such as GDP and population growth rates as well as electricity exports) for years 2015 and 2016 and the projections of them were used afterwards. Mitigation assessment was done using LEAP v. 2017.0.11.0 (Long Range Energy Alternatives Planning System) software. The LEAP was used to assess individual measures, which then were combined in different combinations into alternative integrated With Measures (WM) and With Additional Measures (WAM) scenarios. This approach allows assessing the marginal impact of an individual measure as well as the effect that occurs when multiple policies and measures are combined.

Updates also include remodeling of electricity generation system, where plant dispatching is based on national system's load curve and merit order of the plants.

Figure 3.1 shows the updated ex-post estimations of scenarios for 2013-2014 and projections for 2013-2020.

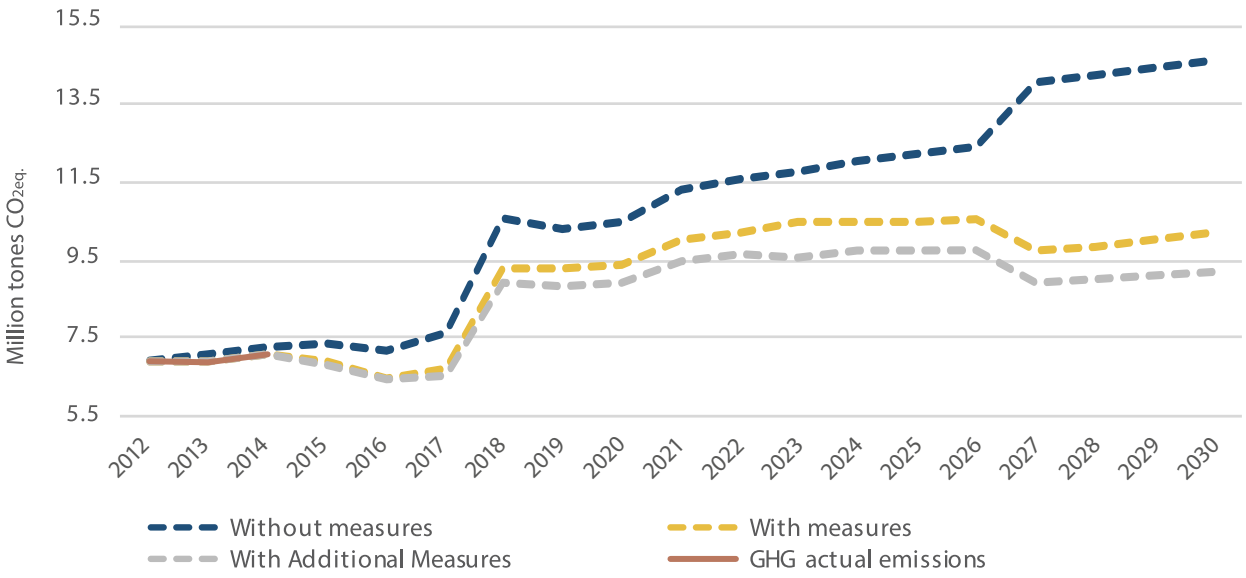


Figure 3.1 Emission projections under WOM, WM and WAM scenarios

As already indicated, the difference between the ex-post evaluation of WOM scenario and the real observed emissions in 2014 shows actual emission reductions achieved in 2014.

It is equal to 239 Gg $CO_{2eq.}$, which mainly come from the new small hydro plants that have been added to Armenia's power system in 2013 and 2014, as well as from demand side mitigation measures. Measures that mostly contribute to the demand side reductions include Green for Growth Fund, the IFC Armenia sustainable energy finance project, Caucasus sustainable energy finance facility (Energocredit) as well as the measures in transport sector.

Figure 3.1 shows the projected decrease of emissions in 2016, which in WOM case is due to

the real electricity export values that are used for export estimation in 2014 and which are strongly decreased compared to earlier years. Additional decrease in WM and WAM scenarios is based on projected effects of mitigation measures. In all scenarios there is a sharp increase of GHG emissions in 2018 due to the increase of generation in thermal power plants pursuant to the contractual obligations under Iran-Armenia Electricity-for-Gas Swap Agreement. The 2019 decrease of emissions is caused by the retirement of the Hrazdan TPP and its substitution with more efficient new block. The sharp reduction of GHG emissions in 2027 in the WM and WAM scenarios is due to decommissioning of 400 MW nuclear power unit and commissioning of new 600 MW nuclear power plant, while in WOM scenario the old 400 MW nuclear power plant is replaced by new thermal power plants.

Table 3.3 shows the projections of emissions in different scenarios by categories and Table 3.5 shows projections of greenhouse gas emissions by gases.

Table 3.3 GHG emissions projection in Energy sector by scenarios, Gg $CO_{2eq.}$

Scenarios/Categories	2012	2015	2020	2025	2030
WOM					
Electricity Generation	1618	1586	3459	4118	5544
Industry/Construction	688	732	833	953	1041
Transport	1467	1702	2144	2557	2879
Households	1138	1165	1228	1321	1382
Commercial	297	392	441	504	551
Agriculture	202	170	180	192	201
Fugitive emissions from Natural Gas Transmission, Storage and Distribution	1506	1633	2248	2578	3037
Total	6916	7379	10532	12223	14636
WM					
Electricity Generation	1618	1378	2958	3192	2481
Industry/Construction	688	631	667	771	847
Transport	1467	1697	2109	2512	2825
Households	1138	1093	1106	1167	1225
Commercial	297	368	364	429	477
Agriculture	202	169	180	193	202
Fugitive emissions from Natural Gas Transmission, Storage and Distribution	1506	1534	2008	2227	2187
Total	6916	6870	9392	10491	10243
WAM					
Electricity Generation	1618	1363	2813	2878	1958
Industry/Construction	688	631	644	739	807
Transport	1467	1697	1950	2353	2665
Households	1138	1093	1064	1107	1165
Commercial	297	368	363	427	475
Agriculture	202	169	180	192	201
Fugitive emissions from Natural Gas Transmission, Storage and Distribution	1506	1530	1884	2052	1959
Total	6916	6852	8897	9749	9230

Under WM scenario the total GHG emissions decrease by 30 per cent in 2030 compared to WOM scenario and in WAM scenario they decrease by 36.9 per cent. Largest share in this reduction is related to the new nuclear plant. Table 3.4 shows the changes in electricity generation, consumption and export in various scenarios. The implementation of demand side mitigation measures considered under WM and WAM scenarios will result in reduction of domestic consumption and in decrease in power generation.

Table 3.4 Projection of power generation, domestic consumption and export, GWh.

Scenarios	Description	2012	2015	2020	2025	2030
WOM	**Net Generation**[12]	**7640.1**	**7545.3**	**12853.4**	**14488.0**	**15007.1**
	Domestic Consumption	5120.6	5338.3	5807.4	6430.4	6870.6
	Export	1699.7	1423.7	6005.0	6905.0	6905.0
	Losses	819.7	783.3	1041.0	1152.6	1231.5
WM	**Net Generation**	**7640.1**	**7414.0**	**12109.4**	**13629.6**	**14041.8**
	Domestic Consumption	5120.6	5356.4	5481.8	6038.7	6408.8
	Export	1699.7	1423.7	6005.0	6905.0	6905.0
	Losses	819.7	633.9	622.6	685.9	728.0
WAM	**Net Generation**	**7640.1**	**7386.0**	**11830.2**	**13162.2**	**13375.8**
	Domestic Consumption	5120.6	5332.1	5231.0	5619.0	5810.8
	Export	1699.7	1423.7	6005.0	6905.0	6905.0
	Losses	819.7	630.2	594.2	638.2	660.0

Table 3.5 Projection of GHG emissions in Energy sector by gases, Gg $CO_{2eq.}$

Scenarios		2012	2015	2020	2025	2030
WOM						
	Carbon Dioxide	5296	5623	8139	9481	11419
	Methane	1586	1718	2346	2688	3156
	Nitrous Oxide	34	38	47	55	61
	Total	6916	7379	10532	12223	14636
WM						
	Carbon Dioxide	5296	5213	7241	8103	7881
	Methane	1586	1619	2105	2336	2304
	Nitrous Oxide	34	38	46	53	58
	Total	6916	6870	9392	10491	10243
WAM						
	Carbon Dioxide	5296	5199	6879	7543	7105
	Methane	1586	1616	1975	2156	2071
	Nitrous Oxide	34	38	43	50	55
	Total	6916	6852	8897	9749	9230

[12] *Net Generation is defined as gross generation minus own consumption of the plants.*

The split of the greenhouse gas reductions by measures is given in 3.6.

Table 3.6 Emission reductions in Energy sector, Gg $CO_{2eq.}$

Scenarios/Categories	2015	2020	2025	2030
WM				
Reductions from generation side measures	172	335	755	3287
New NPP	0	0	0	2359
new medium and small HPPs	172	278	551	617
wind farms	0	0	0	70
geothermal PPs	0	0	92	103
solar PVs	0	57	112	138
Reductions from demand side measures	337	806	977	1106
Total	**509**	**1140**	**1732**	**4393**
WAM				
Reductions from generation side measures	172	377	902	3607
New NPP	0	0	0	2383
new medium and small HPPs	172	305	590	624
wind farms	0	0	67	282
geothermal PPs	0	0	98	104
solar PVs	0	72	147	213
Reductions from demand side measures	356	1258	1572	1799
Total	**527**	**1635**	**2475**	**5406**

The GHG emission reduction potential in 2030 in "Energy" sector is provided in Table 3.7.

Table 3.7 Greenhouse gas emissions reduction potential for 2030

Mitigation measures	GHG emission reduction, Gg $CO_{2eq.}$	Share, %
New nuclear power plant	2383	44.1
New renewable energy sources	928	17.2
Demand side mitigation measures	1106	20.5
Additional renewable energy sources	295	5.5
Additional demand side mitigation measures	693	12.8
Total	**5406**	**100.0**

Table 3.8 provides projection of energy consumption indicators from the implementation of the mitigation measures.

Table 3.8 Projections of energy consumption indicators in 2012-2030 for WM scenario

Indicators	2012	2015	2020	2025	2030
GDP, million USD	10394	11457	13954	17470	20253
Population, million people	3.027	2.999	2.939	2.934	2.907
Primary energy supply (TPES), thousand toe	3048	3126	3782	4148	4550
GDP energy intensity, toe/thousand USD	0.29	0.27	0.27	0.24	0.22
Per capita primary energy consumption, toe/person	1.01	1.04	1.29	1.41	1.57
GHG emissions, thousand t $CO_{2eq.}$	6916	6870	9392	10491	10243
GHG emission per unit of TPES, t $CO_{2eq.}$ /toe	2.27	2.20	2.48	2.53	2.25

Implementation of mitigation actions will contribute to reduction of GDP energy intensity by 24 per cent – from 0.29 toe/thousand USD in 2012 to 0.22 toe/thousand USD in 2030, while in case of projected 49 per cent increase in TPES, GHG emission per unit of TPES will not grow.

As it comes from the above, the Energy sector, being the largest source of GHG emissions while having the largest mitigation potential, will substantially contribute to meeting the country's objectives under the INDC.

CHAPTER 4

Support Received and Needs

4.1 Support received

Support received from external sources including technology transfer, capacity building and climate finance from multilateral and bilateral sources has a substantial contribution in addressing climate change mitigation and adaptation needs of the country. It supports the country progress towards a low-emission development path through the implementation of the sectoral policies and programs and promotion of environmentally friendly business solutions.

Complete information on these flows and analysis of the results achieved will contribute to optimizing the use of resources and improvement of future climate policy-making. For this purpose, biennial update reports play an important role as a source of information.

In collecting the data on the support received, the mitigation-related finance information from the statistics of Organisation for Economic Co-operation and Development (OECD), project-level data gained from publicly available sources (project documents, reports, country program snapshot), and information received from implementing/financing entities in response to the MNP inquiry have been used.

As a result of the analysis of the information provided in the OECD database and by donors, it has been noticed that the OECD database includes some projects that have a climatic component and have been identified as having mitigation objective. The total amount of these projects is attributed to mitigation-related finance. However, according to the donors' official information, those projects have a small climate component and the projects have other objectives. For example, the objectives of the WB financed Electricity Transmission Network Improvement Project are to improve the reliability of the power transmission network and system management and support the Borrower's efforts in ensuring an adequate electricity supply - energy savings are not envisaged.[13] The climate component is limited by the preparation of a feasibility study and an environmental and social impact assessment for a new combined cycle gas turbine (CCGT) project. However, according to the OECD database, the project in the amount of USD 52 million is attributed to mitigation-related finance.

Different financial instruments including grants, concessional and non-concessional loans have been used to deliver mitigation-related development support to Armenia while loans from multilateral and bilateral sources have been most widely used. Energy sector has received the greatest amount of mitigation-related finance.

During the data collection, it became clear that the information from multilateral sources is more accessible, complete and transparent than the information available from bilateral ones, especially in cases when the government has not direct engagement.

Table 4.1 provides information on the support received for mitigation actions implementation in the years of 2013-2017. Despite the difficulties faced in data collection, Table 4.1 presents the information to the most possible extent.

[13] *WB, Country Program Snapshot, 2016*

Table 4.1 Support received

Year	Project	Donor/ Implementing agency	Type of support				Project objective
			Financial resources	Capacity building	Technical support	Technology transfer	
2010-2014	Construction of Small HPPs	EBRD, IFC (Sustainable Energy Finance Project), WB and KfW (through German-Armenian Renewable Energy Fund Project)	Loan On-lending through Armenian commercial banks				Promotion of renewable energy development through the involvement of private sector
2009-2015	Armenia Sustainable Energy Finance Project	IFC supported with funds from the Ministry of Finance of Austria	Loan USD 30M	X	X	X	Establishment of sustainable market for investments directed to the development of energy efficiency and renewable energy
2013-2020	Caucasus Sustainable Energy Finance Facility (branded as "Energocredit")	EBRD, EU Neighbourhood Investment Facility (NIF), EBRD Special Shareholder Fund (SSF), Ministry of Finance of Austria	Loan USD 21.5M from EBRD, Grant USD 1.5M from EU NIF and EBRD SSF	X	X		Provision of financing to local financial institutions in lending for the investment of energy efficiency and renewable energy in the private sector
2011-2015	Third National Communication to the UNFCCC	GEF-UNDP	Grant USD 500,000	X	X		The development and submission of the Third National Communication of the Republic of Armenia to the UNFCCC
2013-2016	Small Grants Programme	GEF-UNDP	Grant USD 133,714 from GEF USD 125,119 co-financing from local and international donors	X	X	X	Demonstration, development and transfer of low carbon technologies at the community level

Table 4.1 Support received (continued)

Year	Project	Donor/ Implementing agency	Type of support				Project objective
			Financial resources	Capacity building	Technical support	Technology transfer	
2012-2015	Clean Energy and Water Program	USAID	Grant USD 577,000	X	X		Introduction of energy efficiency and renewable energy solutions in rural areas
2012-2016	Energy Efficiency Project	GEF-WB	Grant USD 1.82M	X		X	Reduce greenhouse gas emissions through the removal of barriers towards implementation of energy efficiency investments in the public sector
2012-2020	Support the Development of Energy Efficiency-based Lending Product	GGF	Loan USD 22.354M (on-lending through Armenian commercial banks)			X	Create energy efficiency credit lines for households and private enterprises
2013-2017	Residential Energy Efficiency for Low-Income Households (REELIH) Project	USAID-Habitat for Humanity	Grant USD 230,000		X	X	Improve the energy efficiency in buildings for low-income households
2013-2018	Green Urban Lighting	GEF-UNDP	Grant USD 1.72M and 0.504M co-financing from local municipalities	X	X	X	Increase the energy efficiency of municipal lighting via implementation of pilot projects and elaboration of financial and institutional mechanisms
2013-2017	Irrigation System Enhancement Project	WB	Loan USD 30M		X	X	Reduce energy consumption and improve irrigation conveyance efficiency in the targeted irrigation schemes

2013	Black Sea Buildings Energy Efficiency Plan (BSBEEP)	European Neighbourhood and Partnership Instrument (ENPI)	Grant USD 123,000	X			Support the cross border partnership and create administrative capacity for the design and implementation of local development polices
2013-2016	Support to Climate Change Mitigation and Adaptation in Russia and European Neighbourhood Policy (ENP) in East Countries (regional project)	EU-Clima East	Grant EUR 17.71M (the budget is not separated for each participating country)	X			The project consists of two components: the first component is directed to foster the development climate change policies, strategies and market mechanisms, and the second component is implemented by UNDP (the description is provided below)
2013-2017	Sustainable Management of Pastures and Forest in Armenia to Demonstrate Climate Change Mitigation and Adaptation Benefits and Dividends for Local Communities	UNDP, EU-Clima East	Grant USD 1.489M	X	X	X	Increase ecosystems capacity for carbon sequestration under climate change conditions as well as retain biodiversity and economic values
2013	Feasibility Study on Improving and Deve-loping Water Supply and Sanitation Systems in Rural Communities	KfW	Grant USD 486,850		X		Assistance for sustainable development of infrastructures in Armenian small municipalities
2014-2018	Access to Renewable and Energy Efficiency in Municipalities of Vayk and of Spitak (AREEM)	EU-Habitat for Humanity	Grant EUR 1.7M			X	Support Spitak and Vayk municipalities by developing and testing a replicable and efficient models on energy saving in multi-apartment and public buildings in accordance with the municipalities' Sustainable Energy Action Plans under the Covenant of Mayors

Table 4.1 Support received (continued)

Year	Project	Donor/ Implementing agency	Type of support				Project objective
			Financial resources	Capacity building	Technical support	Technology transfer	
2014	NAMA - Energy Efficient Public Buildings and Housing in Armenia	UNDP	Grant USD 25,000		X		Improve the energy efficiency in buildings capital renovated and funded by the state
2014- ongoing	Investment Plan for the Scaling-up Renewable Energy Program (SREP)	Strategic Climate Fund (SCF) within the framework of the Climate Investment Funds (CIF)	Grant USD 14M Soft loan USD 26M		X	X	Identify and support renewable energy technologies and projects that can best contribute to Armenia's energy, economic and environmental development goals
2014-2016	Armenia's First Biennial Update Report to the UNFCCC	GEF-UNDP	Grant USD 352,000	X	X		Assist the Republic of Armenia in the preparation and submission of its First Biennial Update Report to the UNFCCC
2014-2020	Social and Energy Efficient Housing Finance Program	French Development Agency, KfW, NMC	Credit line EUR 31.5M Grant EUR 1.5M from EU NIF	X	X		Provide loans for on-lending to private households to finance energy efficiency investments in housing for low and middle income families
2014-2017	Technology Needs Assessment	GEF-UNEP	Grant USD 134,800	X	X		Assistance in country-driven technology assessment to identify environmentally sound technologies with a substantial contribution in addressing climate change mitigation and adaptation needs of the country
2014-2015	Akhurian River Water Resources Integrated Management Program	KfW	Feasibility Study		X	X	Construction of Kaps reservoir and gravity system.

2014	Feasibility Study of Vedi Reservoir construction	French Development Agency	Loan EUR 1.52M		X		Feasibility study of gravity irrigation for land in Ararat Valley resulted from construction of Vedi reservoir
2014	Irrigation System Modernization Project	WB-EDB	Grant USD 720,000		X		Improve the services of irrigation services provision companies as well as energy efficiency
2013-2017	Development of Sustainable Energy Action Plans in the frame of the Covenant of Mayors	EU	Grant EUR 12.5M (the budget is not separated for each participating country)	X	X		Help local authorities to reduce GHG emissions by enhancing resilience to the impacts of climate change and improving access to the secure, sustainable and affordable energy
2016-2019	GAF Energy Efficiency Program for MSMEs	KfW	Loan EUR 20M		X	X	Promote environmentally friendly businesses through provision of energy efficiency and renewable energy loans to MSMEs
2016	De-risking and Scaling-up Investment in Energy Efficient Building Retrofits	GCF-UNDP	Grant USD 20.420M	X	X	X	Reduce investment risks in the energy efficiency retrofits in public and residential building
2014	Integrated Solid Waste Management System in Vanadzor	KfW	Feasibility Study		X		Development of integrated waste management system to prevent negative impact on the environment
2014-2016	Preparatory Technical Assistance for Improvement of the Solid Waste Management Project	ADB	Loan USD 800,000		X		Assist the development of the SWM strategy for Shirak region to tackle acceleration of the MSW generation
2015	Kotayk and Gegharkunik Solid Waste Management Project	EBRD, EU	Loan EUR 5.5M from EBRD, Grant EUR 5.5M from EU NIF and E5P		X	X	Provide environmental and social benefits for the local residents via enhancement of the solid waste collection and management services

Table 4.1 Support received (continued)

Year	Project	Donor/ Implementing agency	Type of support				Project objective
			Financial resources	Capacity building	Technical support	Technology transfer	
2015	Solid Waste Management in Yerevan	EBRD, EIB, EU	Loan EUR 16M from EBRD and EIB, Grant 10M from EU NIF and E5P		X	X	Address adverse environmental, health and climate impact from the current landfill through the construction of the new sanitary landfill
2015-2017	Solid Waste Management solutions for small and remote communities of Armenia	ADB, Japan Fund for Poverty Reduction	Loan USD 550,000		X	X	Support critical infrastructure investments that will help improve living conditions and health of people through pilot projects
2015	Akhurian River Water Resources Integrated Management Program, 2nd phase	KfW	Loan and grant (in the frame of a number of projects financed by KfW)		X	X	Construction of Kaps reservoir and gravity system.
2016-2020	Fourth National Communication to the UNFCCC and Second Biennial Update Report	GEF-UNDP	Grant USD 852,000	X	X		Assist the Republic of Armenia in the preparation of its Fourth National Communication to the UNFCCC and Second Biennial Update Report
2016-2020	Renewable Energy Financing Project	Habitat for Humanity	Grant USD 136,000		X	X	Promote the use of solar energy by low and middle-income families to save on energy bills
2017	Yerevan Green City Action Plan	EBRD	Grant EUR 500,000 from the Czech Government's Official Development Assistance	X	X		Identifies Yerevan's key environmental challenges, outlines its long-term strategic objectives as well as propose mid-term targets and short-term priority actions

2017-2018	Solar Development Projects	Sustainable Energy Development Fund, Philip Morris International	Grant USD 150,000 from Philip Morris International		X	X	Reduce energy costs by promoting hot water and electricity use from solar energy
2014-2020	Mainstreaming Sustainable Land and Forest Management in Mountain Landscapes of North-Eastern Armenia	GEF-UNDP	Grant USD 4.78M (including USD 91,000 for project preparation)		X		Secure the continued flow of multiple eco-system services and ensure conservation of wildlife habitats through land and forest sustainable management in the north-east Armenia (Lori and Tavush provinces)
2014-2015	Mitigation Policy Support	UNDP, GIZ	Grant USD 100,000	X	X		Support the Government of Armenia to elaborate and communicate its Intended Nationally Determined Contributions to UNFCCC
2013-2016	Mitigation of Climate Change Risks of Rural Communities Through Improved Local Development Planning	UNDP - Bureau for Crisis Prevention and Recovery	Grant USD 500,000 from Swedish Government	X	X	X	Mitigate climate change risks of rural communities by mainstreaming the climate risk management into agricultural sector and strengthening the adaptive capacities of vulnerable communities
2014-2018	Climate Policy as an Impetus for Modernization in East and Southeast Europe	Heinrich Böll Foundation	Grant	X	X		Assist Eastern European countries in overcoming the challenges faced in the way of improving energy, environmental, climate change and sustainable development policies
2014-2017	Resource Efficiency and Cleaner Production Demonstration Project	EU EaP Green-UNIDO	Grant EUR 96,000	X	X	X	Reduction of energy consumption in the production of food, beverage, construction and chemical materials

Table 4.1 Support received (continued)

Year	Project	Donor/ Implementing agency	Type of support				Project objective
			Financial resources	Capacity building	Technical support	Technology transfer	
2016-2018	Generate Global Environmental Benefits through Environmental Education and Raising Awareness of Stakeholders	GEF - UNDP	Grant USD 840,000	X	X	X	Strengthen the capacity of using environmental education and awareness raising as tools to address natural resource management issues
2015-2018	Energy Assistance and Regional Integration	USAID	Grant USD 1.2M	X	X	X	Support energy reforms and regional integration with Georgia
2016-2017	Construction of Passive Solar Greenhouses	Government of Romania - UNDP	Grant USD 74,000	X	X	X	Reduce vulnerability to climate change in highland poor communities

4.2 Needs

Armenia submitted its First Biennial Update Report to the UNFCCC in April 2016 and went through the International Consultation and Analysis (ICA) process. The one-week technical analysis of the Armenia's First BUR took place in September 2016, followed by the facilitative sharing of views (FSV) held in November 2017 in Bonn, Germany.

Capacity-building needs

In comparison to the Armenia's First BUR, the Second BUR has been improved in terms of presenting information in a more accurate and disaggregated way, in particular considering new subcategories and applying higher Tier approaches for the GHG Inventory as well as transparent reporting on applied methodologies for non-energy mitigation actions.

However, based on the experience gained while developing the BUR1, following the technical analysis of the BUR1 as well as taking into account the difficulties encountered in the preparation of the BUR2, the following capacity-building needs still exist:

- Further strengthening the technical capacity of institutions and experts at the domestic level for the preparation of national GHG inventories on a continuous basis, including:
  - Developing additional country-specific emission factors and applying higher-tier methodologies
  - Improving greenhouse gas emissions/ removals estimates for the AFOLU Sector
  - Further enhancing the uncertainty assessment of emissions and removals
  - Conducting key category analysis – trend assessment
- Developing formal and institutional arrangements to collect and validate activity data and set up database enabling development of inventories on a sustainable and continuous basis
- Conducting a GHG mitigation analysis for the non-energy sectoral development plans and programmes
- Establishing the domestic MRV system

Financial needs

The needs presented in this section refer to both the preparation of BURs and the implementation of climate change mitigation actions.

- Armenia requires further support for the development of national communications and BURs since the available national capacities are not sufficient to fulfil the reporting obligations arising from the decisions of the Conference of the Parties
- To improve reporting on greenhouse gas removals from forest lands, there is a need on reliable data on the current extent and conditions of the national forest resources. Already for 25 years there has been no nation-wide forest inventory to provide reliable statistics on country's forest resources.
- Identification of the mitigation actions in non-energy sectors and development of feasibility studies thereof
- To support the application of energy efficient advanced technologies including application and scaling up of biogas technology to medium and large agricultural farms for high-efficiency combined generation of electricity and heat

Technology transfer needs

To ensure the mechanism of development and transfer of sustainable technologies in Armenia, it is required to further develop and strengthen the "Armenian Climate Technology Center and Network" (ArmCTCN), initiated under the GEF / UNEP / DTU project "Technology Needs Assessment" (TNA). The implementation of certain pilot projects for technology transfer, such as the manufacturing of plastic solar water heaters, in parallel with

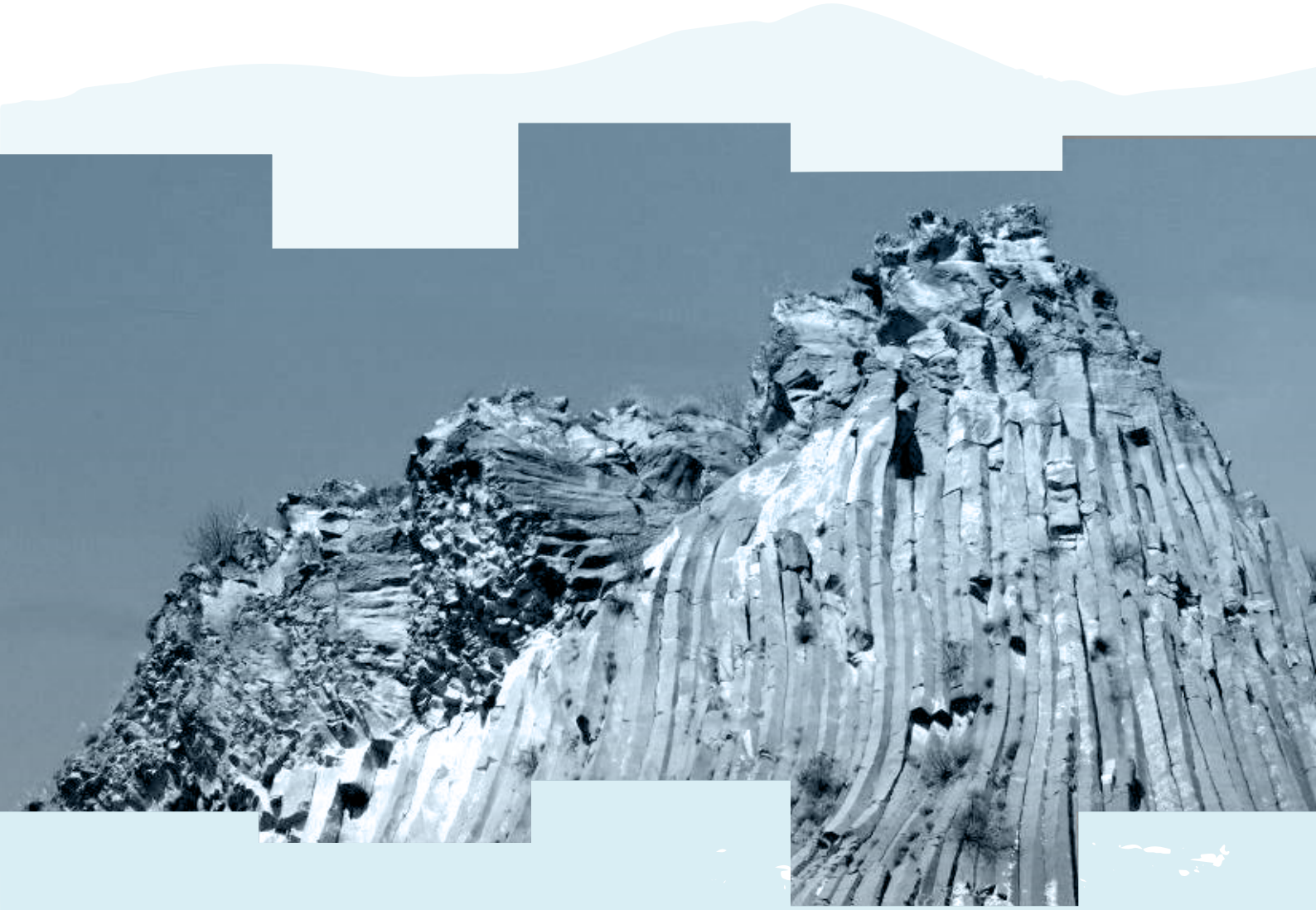
the ongoing program, implemented by UNIDO Armenia and aimed at strengthening the ArmCTCN will contribute to this aim as well.

For the creation of domestic sustainable financial mechanisms, the civil revolving investment fund should be established to support the implementation of climate change mitigation and adaptation pilot projects. The Program of the RA Government for 2017-2022 envisages the establishment of innovative financial mechanisms including the environmental civil revolving investment funds during 2019-2022. Such funds will substantially support the implementation of mitigation and adaptation pilot projects.

Constraints and gaps

While developing the BUR2, Armenia identified the following constraints and gaps that still exist to report in the required standards and frequency to the UNFCCC:

- Lack of institutional/formal arrangements for inventory data collection
- Inconsistency of activity data obtained from different sources
- Lack of official statistics on liquid fuel annual consumption per type of fuel and per categories
- Difficulties in data collection from the industrial sector
- Lack of complete and reliable data on HFCs consumption in the country. It becomes even more important considering that Armenia has already ratified the Kigali amendment and a range of certain actions shall be done for phasing down HFCs consumption including legislation, licensing system, limitation of HFCs import into the country, targeted trainings and awareness raising.
- Absence of nation-wide forest inventory for the recent 25 years
- Lack of reliable data on wood removals and in particular on fuelwood removals
- Lack of formal arrangements/assigned responsibilities for data collection/ provision on current/planned mitigation actions
- Lack of common approach for mitigation actions effect assessment for different projects implemented in the Energy Sector
- Difficulties in collecting information on financial and technical support for climate change mitigation activities
- Absence of MRV comprehensive framework as a whole.



CHAPTER 5

Measurement, Reporting and Verification

Measurement, reporting and verification system (MRV) is an essential tool to track progress made in implementing and achieving the nationally determined contributions and in achieving the sustainable development goals. The MRV is considered an important tool which enables to plan and manage mitigation and adaptation actions, track progress made on implementing these actions and analyse their effects.

The MRV is structured into the three key directions: MRV of greenhouse gas emissions; MRV of mitigation and adaptation actions; and MRV of support (financial, technology transfer and capacity building).

The Paris Agreement adopted in 2015 calls to enhance the transparency framework for action and support, indicating that all Parties should work on common modalities, procedures and guidelines, building on experience from the arrangements related to transparency under the Convention including national communications, biennial update reports and international consultation and analysis process for developing countries. In so doing, the support shall be provided to developing country Parties to build transparency framework.

The Comprehensive and Enhanced Partnership Agreement between the European Union and Armenia signed in November 2017 emphasizes the importance of strengthening the multilateral, rules-based regime under the UNFCCC and to cooperating on the further development and implementation of the international climate-change framework under the UNFCCC and agreements and decisions related thereto, including the Paris Agreement.

According to the RA Government Protocol Decision N 49-8 of December 8, 2016 "On approval of the list of measures to be implemented in the fulfillment of the Republic of Armenia's Obligations Emanated from a number of International Environmental Conventions", the MRV system should be established in 2019 and the Ministry of Nature Protection of the RA is responsible for coordination of that process.
The proposed arrangement for MRV should be implemented gradually, proceeding from national circumstances and existing local capacities and taking into account the best practices of other countries. It envisages institutional reforms aimed at coordinating all activities related to preparation of national communications and biennial update reports, including: establishment of legal/formal arrangements for data collection, identification of common approaches for assessing mitigation actions, as well as procedures for verification and archiving of information.

Legal/institutional reforms

Development of greenhouse gas inventories:
Currently the development of greenhouse gas inventories is implemented within the frame of the five-year plans in fulfillment of the obligations arising from the international environmental conventions including the UNFCCC, approved by the GoA protocol decisions. The Ministry of Nature Protection is responsible for the coordination of the development of greenhouse gas inventories for once two year. However, there are no clear responsibilities assigned to the bodies involved in greenhouse gas inventory preparation with respect to data provision.

The legal reforms currently in progress in the country will facilitate development of greenhouse gas inventories on a continuous basis. Thus, the RA Government Decree N 50-3 of 15 December, 2016 has approved the concept of the RA draft Law "On Atmospheric Air Protection". Among other changes, it is envisaged by the Law to set up a unified system for the recording of hazardous substances and greenhouse gas emissions, which will contribute to compliance with the obligations of the Republic of Armenia under environmental conventions, as well as to the consistency of information provided under different conventions.

Under the European Neighbourhood Instrument (ENI) Shared Environmental Information System (SEIS) II EAST project, it is planned to identify the scope of cooperation between the NSS and the MNP aimed at setting up the complete database of the statistical data required for developing greenhouse gas inventory. It is envisaged that the NSS will provide respective methodological assistance to the MNP in organizing data collection required for development of the greenhouse gas inventories.

In this respect, certain steps have been already done for streamlining the data collection process - data collection templates/formats by the IPCC sectors and data holders are developed.

The current MRV scheme for greenhouse gas inventory preparation is described in Figure 5.1.

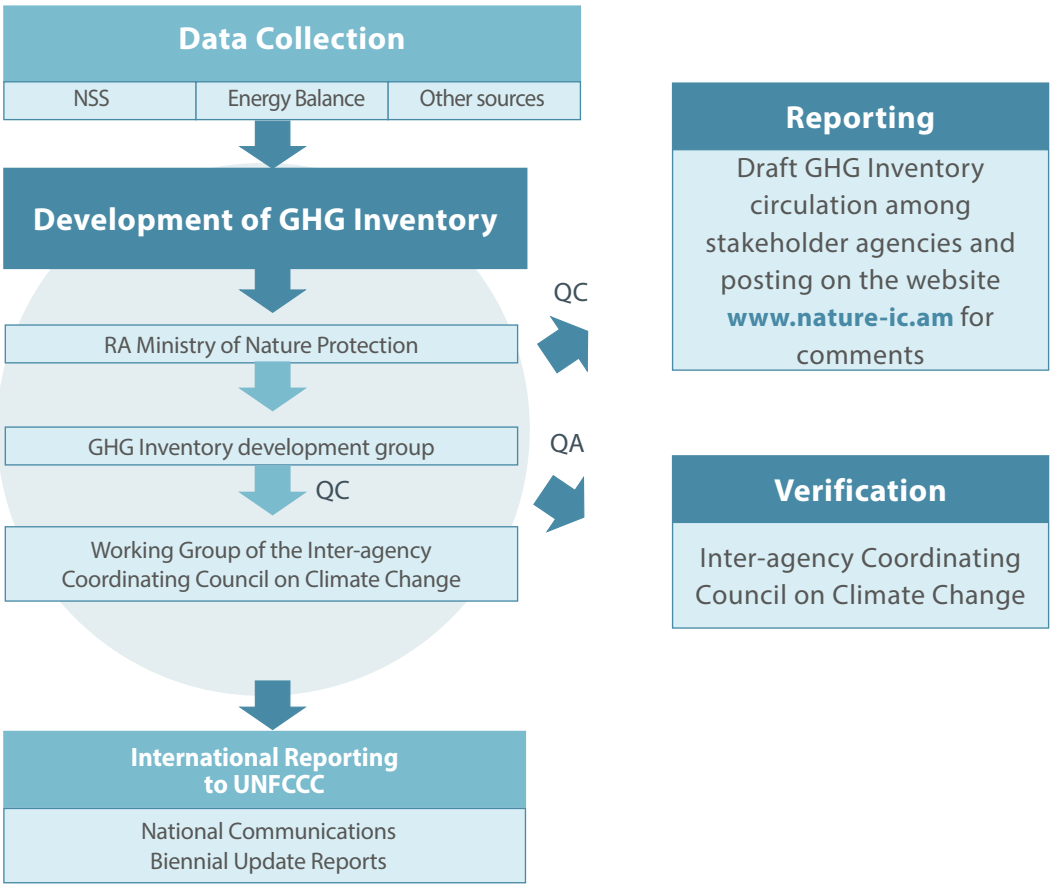


Figure 5.1 MRV scheme for greenhouse gas inventory preparation

Mitigation policies, actions/projects: MRV system for mitigation actions is envisaged to be established through the following sequence of steps as described in Figure 5.2 below.

Figure 5.2 Recommended steps for establishing mitigation actions for MRV system

Step1. Establish the institutional arrangements and processes: The institutional responsibilities for policy making, data collection, data analysis, reporting, quality control and quality assurance will be defined to ensure monitoring and reporting of mitigation policies and actions.

To this aim, certain steps are under progress: currently the RA draft Law "On Government Structure and Activity" is under development. The Law will stipulate inter alia the responsibility of the Ministry of Nature Protection for the development and implementation of policies aimed at preventing or reducing the negative impact on climate change as well. This provision of the Law will become a precondition for the creation of the MRV system by setting up the rights of the Ministry of Nature Protection to require monitoring of and reporting on policies and actions.

Step 2. Define methodologies for assessing effects of GHG mitigation actions: At this phase it is foreseen to discuss and develop the common approaches for mitigation actions impact assessment followed by the development of standardized formats on reporting differentiated by the nature of the action. This approach will ensure the compliance, consistency and comparability of data to track progress in the implementation of mitigation actions and to analyse their effects. Some steps have already been implemented in this respect.

The MNP, with the UNDP support, has developed the Electricity Grid Emission Factor of the RA as a standardized baseline, which was approved by the CDM Executive Board. The first standardized baseline was valid for the period of January 2015 to January 2018, and the second (developed using the 5.0 version of the Tool) is valid for three years, since February 2018 (available on the UNFCCC website). This factor allows assessing the impact of renewable energy and energy saving projects on greenhouse gas emissions, ensuring comparability and credibility of the mitigation projects impact assessment.

Project-level data gained from publicly available sources (project documents, reports, country program snapshots) and information received from implementing/financing entities in response to the MNP's inquiry have been used in the course of collecting the data on the mitigation actions. Information obtained from data providers has been reported per the required format in compliance with the UNFCCC "Handbook on Measurement, Reporting and Verification for Developing Country Parties".

Step 3. Identify mitigation actions data providers: A number of bodies are directly involved in the implementation of the mitigation policies. The state agencies mainstream climate change issues into the strategies and sectoral programmes while the local governments, private and non-governmental organizations also implement mitigation actions. At this stage, the roles of the multiple agencies and ministries who are simultaneously responsible for a particular mitigation policy or project will be clarified to avoid double counting of greenhouse gas emissions reduction.

Step 4. Define reporting obligations: At this stage, the reporting obligations will be assigned to the bodies identified at the previous stage. The information on progress made on implementing mitigation actions and their effects shall be reported by them according to the required format and frequency.

Step 5. Verification and assurance of compliance: At this stage the information provided will be verified to ensure whether it is complete and accurate and the methodologies/assumptions used are appropriate. The MNP will be responsible for verifying the mitigation actions impact assessment and providing feedback to stakeholders. This process should be carried out by cooperating with the stakeholders on a continuous basis and will contribute to the improvement of estimations.

Methodological issues

Greenhouse gas inventory: The Energy sector predominates in the country's total emissions. Thus, the energy balance is the most important source of activity data and it supports the breakdowns in accordance with fuels and categories. Hence, the development of the Energy Balance on a continuous basis along with measures aimed at its improvement is essential to ensure the enhancement of the emissions inventory in terms of completeness, transparency, accuracy and comparability.

Amendments to the RA Energy Saving and Renewable Energy Law were adopted in 2016, setting out the mandatory requirement for the development and publication of the RA energy balance to be performed on annual basis by the NSS and the Ministry of Energy Infrastructures and Natural Resources which is responsible for the development and implementation of the state policy on energy saving and renewable energy.

In 2017, the NSS published the Energy Balance of Armenia for 2015.

The expert team involved in the preparation of greenhouse gas inventory collaborates with the team in charge of the energy balance preparation to ensure accuracy and comparability of data.

Mitigation actions: Given the importance of common approaches to assessing the impact of mitigation actions to ensure consistency and comparability of results, the certain methodological approaches have been developed/applied, differentiated by the nature of the action:

- To assess the impact of renewable energy and energy saving projects on reduction of greenhouse emissions, ensuring comparability and credibility of the mitigation projects impact assessment, the Grid Emission Factor of the RA as a standardized baseline was developed within the frames of the BUR2 and approved by the CDM Executive Board. It has become effective since February 19th, 2018, and is valid for 3 years.
- Currently "De-risking and Scaling-up Investment in Energy Efficient Retrofits" Green Climate Fund (GGF) funded Project is launched in Armenia. It is designed to facilitate the sustainable reduction of energy consumption and greenhouse gases emissions from the existing buildings in Armenia. The Project will support in setting up the MRV system for buildings including development of the guidelines and monitoring methodologies.
- The on-going UNDP-GEF "Mainstreaming Sustainable Land and Forest Management in Mountain Landscapes of North-Eastern Armenia" Project supports carbon stock assessment and development of country-specific coefficients for the main types of forests as part of a long-term strategy for the establishment of a carbon stock monitoring system in the country.
- In the frames of the on-going Nubarashen Landfill Gas Capture and Power Generation CDM Project the estimate of the certified emissions has been done applying CDM methodologies– "Renewable electricity generation for a grid" and "Consolidated methodology for landfill gas project activities".

ANNEX

Summary report for national greenhouse gas inventory for 2014

Category	Emissions (Gg)			Emissions $CO_{2eq.}$ (Gg)			Emissions (Gg)			
	Net CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	NOx	CO	NMVOCs	SO_2
Total Emissions and Removals	**5,145.824**	**164.786**	**2.695**	**531.743**	**NA, NO**	**NA, NO**	**12.4**	**22.322**	**10.155**	**39.010**
1 - Energy	**5,370.256**	**76.880**	**0.089**				**12.4**	**22.322**	**2.299**	**0.054**
1.A – Fuel Combustion activities	**5,369.093**	**1.912**	**0.089**				**12.4**	**22.322**	**2.299**	**0.054**
1.A.1 – Energy Industries	1,579.611	0.028	0.003				2.474	1.084	0.072	NE
1.A.2 – Manufacturing Industries and Construction	617.020	0.013	0.002				1.163	0.361	0.246	NE
1.A.3 – Transport	1,577.284	1.721	0.081				7.371	20.054	1.929	0.053
1.A.4 – Other Sectors	1,595.179	0.150	0.004				1.392	0.823	0.052	0.001
1.A.5 – Non-Specified	NO	NO	NO				NO	NO	NO	NO
1.B – Fugitive emissions from Fuels	**1.163**	**74.968**	**NA**				**NA**	**NA**	**NA**	**NA**
1.B.1 – Solid Fuels	NO	NO	NO				NO	NO	NO	NO
1.B.2 – Oil and Natural Gas	1.163	74.968	NA				NA	NA	NA	NA
1.B.3 – Other Emissions from Energy Production	NO	NO	NO				NO	NO	NO	NO
2 – Industrial Processes and Product Use	**250.792**	**NA, NO**	**NA, NO**	**531.743**	**NA, NO**	**NA, NO**	**NA,NO, NE**	**NA,NO, NE**	**10.155**	**39.010**
2.A – Mineral Industry	**250.792**	**NO**					**NO**	**NO**	**NO**	**NE, NA NO**
2.A.1 – Cement Production	223.402						NA	NA	NA	NA
2.A.2 – Lime Production	NO						NO	NO	NO	NO
2.A.3 – Glass Production	7.231						NE	NE	NE	NE
2.A.4d –Non-Cement Clinker Production	20.160						NA	NA	NA	NA
2.A.5 – Other	NO	NO					NO	NO	NO	NO
2.B - Chemical Industry	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
2.C – Metal Industry	**NA, NO**	**NA, NO**	**NA, NO**	**NA, NO**	**NA, NO**	**NA, NO**	**NA, NO**	**NA, NO**	**NA, NO**	**39.010**
2.C.1 – Iron and Steel Production	NO	NO	NO				NO	NO	NO	NO
2.C.2 – Ferroalloys Production	NA	NA	NA				NA	NA	NA	7.610
2.C.3 – Aluminum Production	NO	NO	NO		NO		NO	NO	NO	NO
2.C.4 – Magnesium Production	NO			NO	NO	NO	NO	NO	NO	NO
2.C.5 – Lead Production	NO						NO	NO	NO	NO
2.C.6 – Zinc Production	NO						NO	NO	NO	NO

2.C.7 – Other – Primary Copper Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	31.400
2.D – Non-Energy Products from Fuels and Solvent Use	**NA, NE, NO**	**NA**	**NA**				**NO, NA,NE**	**NO, NA,NE**	**9.268**	**NO,NA,NE**
2.D.1 – Lubricant Use	NE						NE	NE	NE	NE
2.D.2 – Paraffin Wax Use	NO	NO	NO				NO	NO	NO	NO
2.D.3 – Solvent Use							NA	NA	7.418	NA
2.D.4 – Bitumen Use	NA	NA	NA				NA	NA	1.850	NA
2.E - Electronics Industry	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
2.F – Product Uses as Substitutes for Ozone Depleting Substances	**NA, NO**	**NO**	**NO**	**531.743**	**NA, NO**		**NA**	**NA**	**NA**	**NA**
2.F.1 – Refrigeration and Air Conditioning	NA			502.660	NA		NA	NA	NA	NA
2.F.2 – Foam Blowing Agents	NA			17.109	NA		NA	NA	NA	NA
2.F.3 – Fire Protection	NA			0.531	NA		NA	NA	NA	NA
2.F.4 – Aerosols				11.444	NA		NA	NA	NA	NA
2.F.5 – Solvents				NO	NO		NO	NO	NO	NO
2.F.6 – Other Applications	NO	NO	NO	NO	NO		NO	NO	NO	NO
2.G – Other Product Manufacture and Use	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
2.H – Other	**NA, NO**	**NA, NO**	**NO**				**NA, NO**	**NA, NO**	**0.887**	**NA, NO**
2.H.1 – Pulp and Paper Industry	NO	NO					NO	NO	NO	NO
2.H.2 – Food and Beverages Industry	NA	NA					NA	NA	0.887	NA
2.H.3 – Other	NO	NO	NO				NO	NO	NO	NO
3 – Agriculture, Forestry and Other Land Use	**-479.589**	**62.217**	**2.389**				**NA**	**NA**	**NA**	**NA**
3.A – Livestock		**62.216**	**0.278**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
3.A.1 – Enteric Fermentation		57.597					NA	NA	NA	NA
3.A.2 – Manure Management		4.619	0.278				NA	NA	NA	NA
3.B – Land	**-480.265**	**NA**	**0.01**				**NA**	**NA**	**NA**	**NA**
3.B.1 – Forest Land	-539.780	NA	NA				NA	NA	NA	NA
3.B.2 – Cropland	0.779	NA	NA				NA	NA	NA	NA
3.B.3 – Grassland	14.525	NA	NA				NA	NA	NA	NA
3.B.4 – Wetlands	3.752	NA	0.01				NA	NA	NA	NA
3.B.5 – Settlements	13.564	NA	NA				NA	NA	NA	NA

Summary report for national greenhouse gas inventory for 2014 (continued)

Category	Emissions (Gg)			Emissions $CO_{2eq.}$ (Gg)			Emissions (Gg)			
	Net CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	NOx	CO	NMVOCs	SO_2
3.B.6 – Other Land	26.895	NA	NA				NA	NA	NA	NA
3.C – Aggregate Sources and non-CO2 emissions sources on land	**0.675**	**0.002**	**2.101**				**NA, NO**	**NA, NO**	**NA, NO**	**NA, NO**
3.C.1 – GHG emissions from biomass burning	NA	0.002	NA				NA	NA	NA	NA
3.C.2 – Liming	NO						NO	NO	NO	NO
3.C.3 – Urea Application	0.675						NA	NA	NA	NA
3.C.4 – Direct N_2O Emissions from Managed Soils			1.473				NA	NA	NA	NA
3.C.5 – Indirect N_2O Emissions from Managed Soils			0.410				NA	NA	NA	NA
3.C.6 – Indirect N_2O Emissions from Manure Management			0.219				NA	NA	NA	NA
3.C.7 – Rice Cultivation		NO	NO				NO	NO	NO	NO
3.C.8 – Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3.D – Other	**NA, NO**	**NO**	**NO**				**NO**	**NO**	**NO**	**NO**
3.D.1 – Harvested Wood Products	NA						NO	NO	NO	NO
3.D.2 – Other	NO	NO	NO				NO	NO	NO	NO
4 – Waste	**4.365**	**25.689**	**0.217**				**NA**	**NA**	**NA**	**NA**
4.A – Solid Waste Disposal		19.435	NA				NA	NA	NA	NA
4.B – Biological Treatment of Solid Waste		NO	NO				NO	NO	NO	NO
4.C – Incineration and Open Burning of Waste	4.365	0.629	0.011				NO	NO	NO	NO
4.D – Wastewater Treatment and Discharge	NA	5.626	0.206				NA	NA	NA	NA
4.E – Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5 – Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items										
International Bunkers	**127.571**	**0.001**	**0.004**				**0.162**	**0.049**	**0.077**	**0.040**
1.A.3.a.i – International Aviation (International Bunkers)	127.571	0.001	0.004				0.162	0.049	0.077	0.040
1.A.3.d.i – International Water-Borne Navigation (International Bunkers)	NO	NO	NO				NO	NO	NO	NO
1.A.5.c – Multilateral Operations	NO	NO	NO				NO	NO	NO	NO

Emissions from product uses as substitute for ozone depleting substances for 2014, $CO_{2eq.}$

Category	HFC-32	HFC-125	HFC-134a	HFC-152a	HFC-143a	HFC-227ea	Total HFCs
2.F - Product Uses as Substitutes for Ozone Depleting Substances	**18.085**	**172.876**	**189.479**	**1.215**	**149.557**	**0.531**	**531.743**
2.F.1 - Refrigeration and Air Conditioning	18.085	172.876	162.142	0	149.557	0	502.660
2.F.1.a - Refrigeration and Stationary Air Conditioning	18.085	172.876	85.213	0	149.557	0	425.731
2.F.1.b - Mobile Air Conditioning	0	0	76.929	0	0	0	76.929
2.F.2 - Foam Blowing Agents			16.398	0.711		0	17.109
2.F.3 - Fire Protection		0	0			0.531	0.531
2.F.4 -– Aerosols			10.940	0.505		0	11.444

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