REPUBLIC OF ARMENIA

FIRST BIENNIAL UPDATE REPORT

UNDER THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

REPUBLIC OF ARMENIA

MINISTRY OF NATURE PROTECTION

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ON CLIMATE CHANGE

Armenia's First 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 "Armenia's First Biennial Update Report to the UNFCCC" project.

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FOREWORD

I am pleased to present the First Biennial Update Report of the Republic of Armenia under the United Nations Framework Convention on Climate Change (UNFCCC).

Climate change has already its negative impact on natural ecosystems and millions of people all over the world. Therefore, efforts are being made to further boost national capacities to combat with climate change. The aim of the Paris agreement adopted in 2015 is to reach the legally binding global agreement aimed at keeping global temperature increases below 2°C and pursuing efforts to limit the temperature increase to 1.5 °C. This is only possible by the combined efforts when every country, in line with its national capacities, will bring its contribution for tackling climate change and moving towards a green economy.

Although the Republic of Armenia, as a developing country does not have quantitative obligations to limit the greenhouse gas emissions, as a part of an international efforts, has submitted its Intended National Determined Contributions to the UNFCCC. The document defines the country's official position to combat climate change in long term perspective.

Armenia has adopted sustainable economic development policy and continues to act towards mainstreaming environmental issues in development programs in the context of the country's international environmental commitments.

The present Report includes updated information: on climate change related national circumstances; greenhouse gas national inventory for 2012; completed, ongoing and envisaged measures for climate change mitigation; as well as on support received and required. The Report is presenting the projections of the climate change mitigation measures and their impact assessment up to 2030 taking into account the country's development priorities, objectives and capacities.

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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
E5P	Eastern Europe Energy Efficiency and Environmental Partnership
EBRD	European Bank for Reconstruction and Development
EE	Energy efficiency
EU	European Union
GDP	Gross domestic product
GEF	Global Environment Facility
GHG	Greenhouse gas
GPG	Good practice guidance
GSP	Global Support Programme
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
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
MoA	Ministry of Agriculture of the Republic of Armenia
MoENR	Ministry of Energy and Natural Resources of the Republic of Armenia
MoNP	Ministry of Nature Protection of the Republic of Armenia
MoUD	Ministry of Urban Development 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
NO	Not occurring
NPP	Nuclear power plant
NSS	National Statistical Service of Republic of Armenia
PPP	Purchasing power parity
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
SNC	Second National Communication
SNCO	State non-commercial organization
SPAN	Specially protected area of nature
SREP	Scaling up Renewable Energy Program
SW	Solid waste
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
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

Measurement Units

^{0}C	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)

Chemical Combinations

CO_2	Carbon dioxide
CH_4	Methane
N_2O	Nitrous oxide
HFCs	Hydrofluorocarbons
PFCs	Perfluorocarbons
SF_6	Sulfur hexafluoride
CO	Carbon monoxide
NOx	Nitrous oxides
SO_2	Sulfur dioxide
NMVOC	Non-methane volatile organic compounds

Energy units conversion

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

1 toe = 41. 868 GJ

EXECUTIVE SUMMARY

Armenia's First Biennial Update Report to the UNFCCC is developed according to the Decisions 1/16 and 2/17 adopted by UNFCCC Conference of Parties and provides the most up to date information on national circumstance, national GHG inventory, progress in GHG mitigation policies and actions, as well as on Measurement, Reporting and Verification system and on support received and needs for implementation of the UNFCCC commitments. The Report also provides for the climate change mitigation scenarios projections up to 2030 and its expected impact on GHG emissions taking into account the country's long-term development strategic papers and relevant on-going programmes/projects.

S-1. National Circumstances

Country snapshot

Country	Republic of Armenia
State structure	Republic of Armenia (RA) was established on September 21, 1991. A democratic state with semi-presidential governance based on the principle of the separation and balance of the legislative, executive and judicial powers. The administrative units are: city of Yerevan and 10 marzes (provinces) with 931 communities, including 60 urban and 871 rural communities.
Location	Armenia is a mountainous landlocked country covering 29743 km^2. Armenia is located in the Southern Caucasus bordering Georgia to the north, Azerbaijan to the east, Iran to the south and Turkey to the southwest.
Population	The population is 3027 thousand (2012). 63.4% is urban population.
Economy	GDP is 4,266.5 billion AMD (USD 10,619.4 million) or USD 22,035 million GDP (PPP), GDP per capita is USD 3,511.6 , GDP (PPP) per capita amounted to USD 7,398.5 (2012). GDP structure: industry - 17. 9%, agriculture - 16.1%, construction - 11.7%, services - 43.6%, net taxes - 10.7%.
Climate	Almost all types of climatic patterns can be observed in Armenia – the country's climate ranges from arid subtropical to cold, high mountainous. . Average ambient air temperature varies from -8^{0}C in high mountainous regions (2500m above sea level and higher) to 12-14^{0}C in low valleys. The climate is rather dry. Annual average precipitations is 592mm. There is a significant temperature increase recorded in recent decades. The annual average temperature in the periods of 1935-1996, 1935-2007, and 1935-2014 has increased by 0.4^{0}C, 0.85^{0}C, and 1.1^{0}C respectively.
GHG emissions	GHG emissions in 2012 totalled to 9,829 thousand tonne $CO_{2eq.}$. Emissions by sectors: "Energy" - 70.3%, AFOLU - 16.5% , IPPU - 6.7%, "Waste" - 6.4%.

Population

The population of the Republic of Armenia is 3027 thousand people (2012), urban population is 1918 thousand people (63.4%), rural population is 1109 thousand people (36.6%). In terms of population Armenia is the 136th in the world.

The number of employed people was 1,173 thousand people (2012).

After 1990 there was a sustainable trend of reduction in population of Armenia which is due to reduced natural population growth and emigration. Compared to 1990, the population in 2012 decreased by 494 thousand people (14 %) while the natural growth fell 3 times.

Economy

After the collapse of the USSR followed by the sharp economic downturn (53%) of 1991-1993, Armenia managed to overcome the difficulties of the transition period and to ensure economic growth. During 1995-2000, Armenia's GDP increased annually by 5.4% and between 2001-2006 the average annual GDP growth amounted to 12.4%. This annual growth slowed to 2.2%, on average, during 2007-2010 due to the worldwide financial crisis. The average annual growth for 2010-2013 was 4.4%.

Energy

Armenia has no domestic fossil fuel resources and strongly depends on imported fuel resources to meet its energy demand. Domestic primary energy resources (hydro, nuclear, wind, biomass) provide 35% of the country's energy demand.

In 2012, the total primary energy supply (TPES) amounted to 3,185.4 thousand toe, of which: natural gas share - 60.4%, nuclear energy - 18.9%, oil products - 9%, hydro energy - 6.2% and biomass - 5.1%. Primary energy consumption per capita was 1.052 toe, the energy intensity of GDP was 0.320 toe/thousand USD.

Electricity is generated by thermal, nuclear and hydro power plants. In 2012, power generation was 8,036 GWh, of which: 42% generated by TPPs, 29% - by NPP and 29% - by HPPs.

At present, the residential sector heating and hot water needs is mainly covered by natural gas and electricity consumed household appliances. Heat supply of public/commercial sector is mainly met by natural gas fired local boiler houses .

Industry

Industrial production in Armenian by types of economic activities as of 2012 had the following structure: processing industries – 62.3%; mining industries – 17.2%; electricity, gas, and steam supply – 18.9%; water supply, sewerage and waste management – 1.6%.

In 2012, the processing industries included the following sectors: food (54%), metallurgy (23.5%), construction materials (6.9%), chemical (4.1%), machine building (4.4%), jewellery (1.5%), light industry (1.1%) and other (4.5%).

The average annual growth of industrial production in 2000-2005 and 2006-2012 was 8% and 3% respectively.

Transport

In 2012, the share of railway transport, road transportation, and air transport accounted for 35.6%, 66.3%, and 0.1% respectively in the total goods turnover. In 2012 the share of road transportation accounted for 90.1%, railway transport–0.3%, air transport- 0.8%, metro-6.5% and other types of transport–2.3% of the total passenger turnover. The transport sector accounted for 26% of the total energy consumption.

Buildings

As of 2012, the RA housing stock included 19,019 multi-apartment buildings (436,631 apartments), including 12,029 multi-apartment buildings (63%) in urban communities, 6,990 multi-apartment buildings (37%) in rural areas, as well as 423,624 detached houses, including 154,608 (36%) in urban communities and 269,013 (64%) in rural communities. 25.2% of multi-apartment buildings and 53.7% of the living area of the multi-apartment buildings accounted for Yerevan city.

Agriculture and forestry

Agriculture: Agricultural lands in Armenia occupy 2,052.4 thousand ha, including cropland (448.4 thousand ha – 21.9%), perennial plants (33.4 thousand ha – 1.6%), haylands (121.6 thousand ha – 5.9%), pasture (1,056.3 thousand ha – 51.5%), and other lands (392.7 thousand ha – 19.1%).
Armenia practices irrigated agriculture - more than half of agricultural lands is irrigated. Main agricultural crops include: cereals, potato, fruits, grapes, and vegetables. Animal husbandry mainly includes cattle, as well as sheep and goat. The annual average growth of agricultural output in 2000-2006 and 2007-2012 accounted for 7.7% and 2.2% respectively. In recent years the share of plant growing and animal husbandry accounted for 60% and 40% respectively in gross agricultural production.

Forestry: As of 2012, the total area of Armenia's forest land was 457 thousand ha, forest covered lands - 11.2% of the country territory.

In the period of 1992-1999 extensive illegal logging of forests led to extremely negative impact on forest ecosystems. Intensive efforts are required to ensure afforestation and reforestation. 2,150 ha of area underwent reforestation and afforestation activities in 1998-2006, and 2,754 ha in 2006-2012.

Waste

Municipal solid waste: Municipal solid waste (MSW) is collected and disposed in 48 municipal landfills with total area of 137.5 ha. In none of the landfills waste is classified or sorted before disposal. In 2012 total waste amounted to 650.3 thousand tonne, while the amount disposed in landfills was 461.3 thousand tonne (70.9%).

Municipal wastewater: Municipal wastewater includes household, commercial and partly industrial wastewaters. As of 2012, annual volume of water disposal amounted to 431 million m^3. The volume of wastewater discharged into sewerage system totalled to 86.6 million m^3. Until 1990, there were 20 wastewater treatment stations operating in Armenia with total capacity of 958 thousand m^3/day. Currently these stations are in extremely poor technical conditions. Four new mechanical municipal wastewater treatment stations were put into operation in 2012-2014.

Institutional arrangements relevant to the climate change and for continuous preparation of National Communications and Biennial Update Reports

The Republic of Armenia signed the United Nations Framework Convention on Climate Change (UNFCCC) on June 13, 1992 and ratified it as a non-Annex I country on May 14, 1993. On December 26, 2002 Armenia ratified the Kyoto Protocol to the UNFCCC.

The country associated to the Copenhagen Accord in January 2010. Armenia's association to "Doha Amendment to the Kyoto Protocol" was approved by the Government of Armenia and the RA Constitutional Court and in 2015 it was submitted to the RA National Assembly for ratification.

Armenia's post-2020 climate policy under a new international agreement is formulated in "Intended Nationally Determined Contributions" (INDC) endorsed by the RA Government Protocol Decision No 41 from 10 September 2015 and submitted to the UNFCCC Secretariat on 22 September, 2015.

Government Decree No 1594-N on "Approval of the Action Plan of RA Obligations Resulting from International Environmental Conventions" has defined measures and responsible agencies for implementation of RA obligations under the Convention for the period of 2011-2015.

By the RA Prime Minister Decision No 955-A (02.10.2012) "Inter-agency Coordinating Council for Implementation of Requirements and Provision of the UN Framework Convention on Climate Change" was established. Obligations of this Council particularly include coordination of the

activities aimed at the fulfilment of obligations under the Convention and evaluation of implementation thereof. In 2015, a Division of Climate Change and Atmospheric Air Protection Policy was established under the Environment Protection Policy Department of the Ministry of Nature Protection of RA which responsibilities include coordination of activities related to the preparation of national communications and biennial update reports.

The concept of the new edition of RA Law on "Atmospheric air protection" is developed and currently is under discussion. Among other amendments, the new Law will also provide for a set of provisions for greenhouse gas emissions inventory and climate change mitigation.

Currently a draft decision on amendments to the Government Decree No 1594-N on "Approval of the Action Plan of RA Obligations Resulting from International Environmental Conventions" is under development to include 2016-2020 Action Plan for implementation of obligations under UNFCCC.

Considering obligations under the Convention on developing of biennial update reports on a continuous basis (including GHG Inventory) as well provisions of Paris Agreement with regard to transparency and accessibility of information, different approaches for establishing transparent unified database on climate change related activities are being assessed.

S-2. National Greenhouse Gas Inventory

The inventory of greenhouse gases covers the years 2011 and 2012. It has been compiled in line with the UNFCCC Biennial Update Reporting Guidelines for Parties not included in Annex I to the Convention, COP Decision 17 (2/CP.17, Annex III, Chapter 3) applying 2006 IPCC Guidelines for National Greenhouse Gas Inventories and has been submitted to the UNFCCC Secretariat as a separate report in 2015.

GHG Inventory covers the following sectors:

- Energy;
- Industrial Processes and Product Use (IPPU);
- Agriculture, Forestry and Other Land Use (AFOLU);
- Waste.

The following improvements have been made to the GHG Inventory:

- Five country - specific emission factors for the key sources were developed;
- Data for 6 new subcategories were included;
- For 11 subcategories higher tier was applied;

GHG emissions in 2012

Armenia's GHG emissions in 2012 totalled 9,829 Gg $CO_{2eq.}$ (Table S-1). The emissions in 2012 were 60% lower than in 1990 and 37% higher than those in 2000.

Table S-1. GHG emissions (+) and removals (-) by sectors and by gases for 2012, Gg

Sector	Net CO_2	CH_4	N_2O	HFCs $CO_{2\ eq.}$	Total $CO_{2\ eq.}$
Energy	5,296.5	75.5	0.1	N/A	6,912.8
Industrial Processes and Product Use	277.9	N/A	N/A	384.6	662.5
Agriculture	N/A	54.4	1.55	N/A	1,621.5
Waste	7.3	26.9	0.19	N/A	632.4
Total GHG emissions	***5,581.7***	***156.8***	***1.84***	***384.6***	***9,829.1***
Forestry and Other Land Use	-522.1	N/A	N/A	N/A	-522.1
Net emissions	***5,059.6***	***156.8***	***1.84***	***384.6***	***9,307.1***

The "Energy" sector was by far the largest producer of GHG emissions – its share of the total emissions was 70.3%. The second-largest source of emissions was Agriculture with an emission share of 16.5% followed by IPPU and Waste sectors – with shares of 6.7% and 6.4%, correspondingly.

The most significant greenhouse gas of Armenia's inventory is carbon dioxide. Its share in 2012 was 56.8%. Methane emissions were 33.5% of the total emissions, nitrous oxide accounted for 5.8% and F-gases – for 3.9% of the country's total emissions.

The "Energy" sector produced the prevailing part of all carbon dioxide emissions - about 95% in 2012. The majority of CO_2 emissions were from electricity generation based on the combustion of natural gas as well as from road transport and residential sector. IPPU accounted for 5% of total CO_2 emissions.

Methane emissions were also mostly from the "Energy" sector - 48.1%, 34.7% were from the AFOLU sector and 17.2% - from the "Waste" sector.

The prevailing part of nitrous oxide emissions - 84.2% in 2012 were from the AFOLU sector, "Waste" sector produced 10.3% and "Energy" sector - 5.4% of nitrous oxide emissions.

Precursor emissions in 2012 made up: CO - 46.2 Gg, NOx - 19.4 Gg, NMVOC - 17.1 Gg, SO_2 - 36.6 Gg.

Emission trends in 2000 – 2012

In general, there was an increase in GHG emissions in 2000 - 2012 conditioned by GDP growth with exception of 2009-2010 when there was a decrease mainly from "Energy" and IPPU sectors caused by global economic crisis (Figures S-1, S-2).

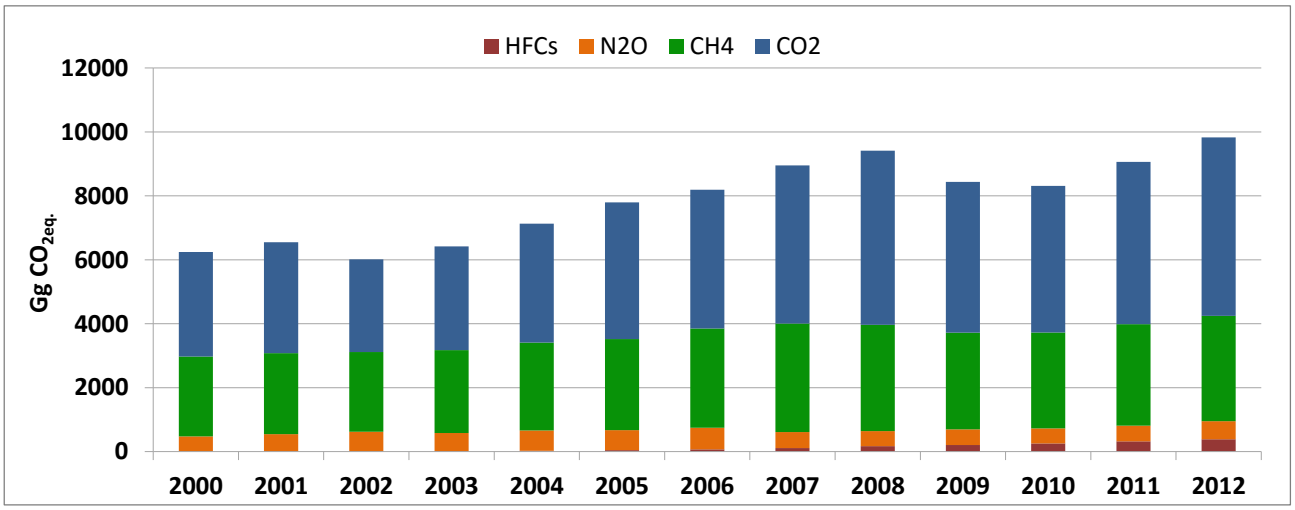

Figure S-1. GHG emissions by gases for 2000-2012

Armenia's annual GHG emissions have varied considerably due to changes in export of electricity produced by natural gas fired thermal power plants. Thus the increase in CO_2 emissions in 2011 and 2012 was mainly conditioned by increase of thermal power plants generation.

The growth of CH_4 emissions in 2011 and 2012 was due to the increased volumes of imported natural gas because of sharp increase of thermal power plants generation as well as due to increased number of cattle.

The increase of N_2O emissions in 2011 and 2012 resulted from the increasing use of organic and non-organic fertilizers.

F-gases (HFCs) emissions has been growing continuously due to the rapid growth of HFCs application since 2008.

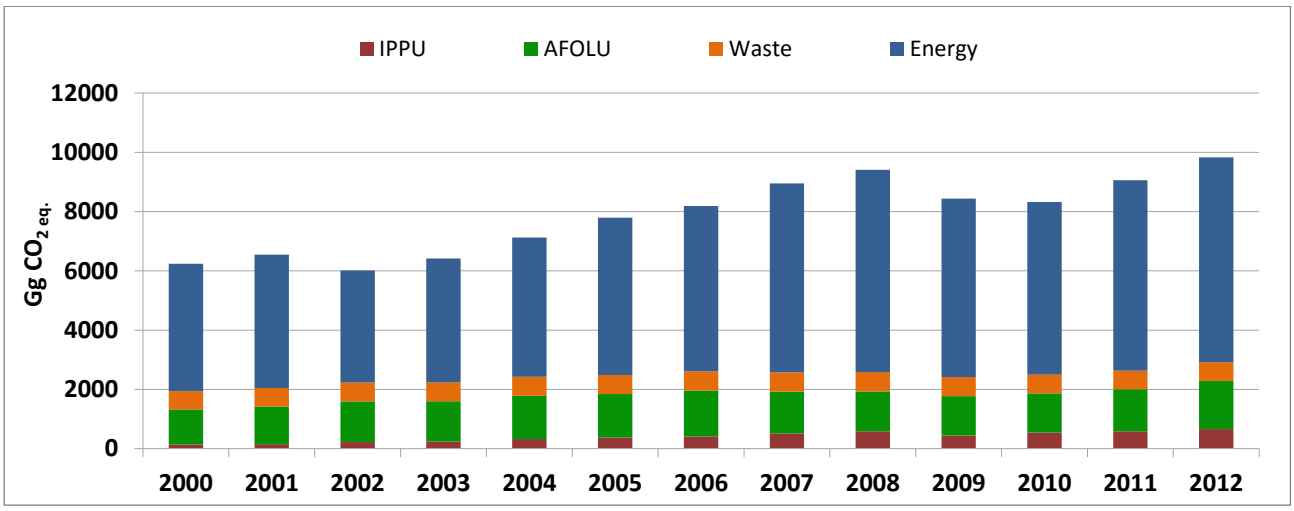

Figure S-2. GHG emissions by sectors

The emissions from "Energy" sector in 2012 were 18.7% higher than in 2010 due to the sharp increase of thermal power plants generation.

After the sharp decline of GHG emissions in 2009 from IPPU sector there was a some increase in construction volumes and cement production and consequently GHG emissions in 2010 while increase of emissions in 2011 and 2012 from IPPU sector (in 2012 the emissions were 21.8% higher than in 2010.) was due to the increase of F-gases emissions.

The increase of GHG emissions from AFOLU sector in 2012 was mainly because of the increase of the number of cattle.

Emissions changes from "Waste" sector within 2000-2012 are insignificant.

S-3. Climate Change Mitigation: Actions, Projections and Impact Assessment

The impact of climate change mitigation actions was assessed for 2012-2030 and calculation therein are based on projected volumes from respective activities in various sectors of economy according to Long-term Development Strategy Program of RA for 2014-2025 which envisages 5.7% annual average economic growth. According to WB projections the estimated economic growth in 2027 – 2030 is 3%.

Three scenarios for GHG emissions for all sectors (4 scenarios for "Energy" sector) were considered in mitigation analysis and comparative evaluation was made for all scenarios.

Given the fact that the development programs for main sectors of economy set forth target indicators with performance schedules, the scenarios of GHG emissions forecasting were calculated based on expected volumes of relevant activity. Scenario analysis for "Energy" sector was made by running LEAP (Long-range Energy Alternatives Planning) software.

National potential for climate change mitigation

National GHG emissions projections for three scenarios are provided in Table S-2.

In case of without measures (WOM) scenario total GHG emissions in 2030 will amount to 18,698.5 Gg $CO_{2eq.}$, in case of with measures (WM) scenario it will make 12,797 Gg CO_{2eq}. while in case of with additional measures (WAM) scenario, which includes the maximum potential of mitigation actions, total GHG emissions will amount to 12,051.0 Gg $CO_{2eq.}$ or 47.6% from 1990 level.

In case of WAM scenario the share of carbon dioxide of total GHG emissions in 2030 will amount to 62.8% (including 91.1% from "Energy" sector), methane - 32.6%, nitrous oxide - 4.6%.

Table S-2. GHG emissions projections by sectors, Gg $CO_{2\ eq.}$

Scenarios/Sectors	2012	2015	2020	2025	2030
Without measures					
Energy	6,914	7,615	11,336	13,091	15,393
IPPU*	277.9	320.1	410.2	527.7	678.6
AFOLU**	1,621.5	1,755.6	1,866.9	1,972.9	2,010.2
Waste	632.4	628.5	624.5	621.9	616.7
Total	***9,444.5***	***10,319.2***	***14,237.6***	***16,213.5***	***18,698 .5***
With measures					
Energy	6,914	7,173	10,698	11,627	9,812
IPPU*	277.9	320.1	409.9	519.0	669.9
AFOLU**	1,621.5	1,667.1	1,777.4	1,851.7	1,888.7
Waste	632.4	623.5	584.6	437.1	426.4
Total	***9,444.5***	***9,783.7***	***13,469.9***	***14,434.8***	***12,797***
With additional measures					
Energy	6,914	7,059	10,297	10,977	9,066
IPPU *	277.9	320.1	409.9	519.0	669.9
AFOLU**	1,621.5	1,667.1	1,777.4	1,851.7	1,888.7
Waste	632.4	623.5	584.6	437.1	426.4
Total	***9,444.5***	***9,669.7***	***13,068.9***	***13,784.8***	***12,051***

* without HFCs emissions (384.6 $GgCO_{2eq.}$ in 2012) and their projection
** without forestry and other land use

Energy sector will account for the prevailing part of 2030 GHG emissions (75.2%) and mitigation potential (95.2%) (Table S-3).

Table S-3. Mitigation potential by sectors for 2015 – 2030, Gg $CO_{2\ eq.}$

Sector	2015	2020	2025	2030
Energy	556.0	1,039	2,113.8	6,327
IPPU	0.0	0.3	8.7	8.7
AFOLU	88.5	89.5	121.2	121.5
Waste	5	39.9	184.8	190.3
Total	***649.5***	***1,168.7***	***2,428.7***	***6,647.5***

Implementation of WAM scenario will result in GHG emissions reduction per GDP unit by 43.0% in 2030 (from 0.89 t $CO_{2eq./}$thousand USD to 0.51). Per capita GHG emissions will increase by 31% (from 3.12 t CO_2 to 4.08) due to increase in energy consumption.

Evaluation of mitigation potential by sectors

Energy

GHG emissions for 2012 – 2030 were assessed based on the energy consumption forecast according to Long-term Development Strategy Program of RA for 2014-2025. The Energy sector development

scenarios up to 2030 were developed in compliance with the Republic of Armenia Government strategy in the energy sector aimed at increasing the country's energy security and provision of affordable, qualitative, reliable and environmentally friendly energy supply. This strategy is reflected in the most recently adopted strategic papers (2013-2015) and international agreements signed by the country, which along with the demand side energy efficiency/energy saving and renewable energy projects and programmes formed the basis for assessing the Energy sector development scenarios.

The forecast of GHG mitigation potential in Energy sector is provided in Table S-4.

Table S-4. Mitigation potential in Energy sector, Gg $CO_{2\ eq.}$

Scenarios/Mitigation measures	2015	2020	2025	2030
With measures				
New nuclear power plant (1028 MW)	**0**	**0**	**0**	**-3,959**
Renewable energy sources, including:	**-25.8**	**-177.0**	**-961.1**	**-1,065**
new small and medium HPPs	-25.8	-153.6	-806.1	-834.9
new wind farms	0.0	0.0	0.0	-73.2
geothermal power plant	0.0	0.0	-108.3	-108.3
solar PVs	0.0	-23.4	-46.8	-46.8
Demand side mitigation measures	**-416.7**	**-523.1**	**-560.8**	**-558.0**
Total	***-442.5***	***-700.1***	***-1,522***	***-5,582***
With additional measures				
Renewable energy sources, including:	**0.0**	**-81.5**	**-269.1**	**-269.1**
new wind farms	0.0	-73.2	-219.5	-219.5
new solar PVs	0.0	0.0	-35.1	-35.1
biogas plants	0.0	-8.3	-14.5	-14.5
Demand side mitigation measures	**-113.5**	**-257.1**	**-322.8**	**-475.4**
Total	***-113.5***	***-338.6***	***-591.9***	***-744.5***

Energy consumption indicators resulted from implementation of WAM scenario are provided in Table S-5.

Table S-5. Projection of energy consumption indicators for 2012-2030

Indicators	2012	2015	2020	2025	2030
GDP, million USD	10,619.4	11,758	15,509	20,456	23,708
Population, million	3.027	3.01	2.99	2.97	2.95
Primary energy supply (TPES), thousand toe	3,185	3,275	4,040	4,294	5,125
GDP energy intensity, toe/thousand USD	0.300	0.279	0.260	0.210	0.216
TPES per capita, toe/person	1.05	1.09	1.35	1.45	1.74
GHG emissions, thousand t $CO_{2\ eq.}$	6,913	7,059	10,297	10,977	9,066
GHG emissions per unit of TPES, t $CO_{2\ eq.}$ /toe	2.17	2.16	2.55	2.56	1.77

Implementation of mitigation actions will contribute to reduction of GDP energy intensity by 28% (from 0.30 toe/ thousand USD to 0.216) and increase in primary energy consumption per capita by 65% (from 1.05 to 1.74 toe/person) in 2030.

In case of the projected 61% increase in TPES, GHG emissions per unit of TPES (carbon intensity of energy consumption) will drop by 19% which comes to witness the low carbon development trends in Armenia.

Industrial processes and product use

The main emissions in IPPU sector originate from cement production (CO_2 emissions) and refrigeration and air conditioning (HFCs emissions).

Cement production growth forecast was done in accordance with projected construction volumes according to the Long-term Development Strategy Program of RA for 2014-2025. Mitigation measures potential is not significant and is envisaged from technology improvements in the factories (Table S- 6).

F-gases growth forecast and mitigation measures were not considered because of great uncertainties in projections of F gases growth.

Table S-6. Projection of GHGs emissions in IPPU sector (cement production), Gg $CO_{2\ eq.}$

Scenario	2012	2015	2020	2025	2030
Without measures	227.9	320.1	410.2	527.7	678.6
With measures	227.9	320.1	409.9	519.0	669.9

Agriculture, Forestry and Other Land Use

Agriculture. Projection of GHG emissions from livestock were estimated according to the 2015-2025 Agriculture Development Strategy of RA and are based on the projected livestock population and livestock species.

As a mitigation measure manure management and utilization was considered for biogas production and for power generation by biogas power plants (Table S-7).

Table S-7. Projection of GHG emissions in manure management, Gg

Scenarios	2012	2015	2020	2025	2030
Without measures					
CH_4	3.86	4.0	4.22	4.34	4.43
N_2O	0.241	0.249	0.28	0.282	0.309
With measures					
CH_4	3.86	4.0	4.19	4.28	4.35
N_2O	0.241	0.249	0.279	0.281	0.306

Forestry: GHG projections/removals in Forestry sector is based on implementation of forest protection, reforestation and afforestation measures envisaged by the Forest Management Plans and RA National Forest Programme (2005) contributing to CO_2 removals, as well as taking into account the volumes of timber removal estimated according to the 10-year management plans (Table S-8).

Table S-8. CO_2 removals by forests in Armenia and projections till 2030, Gg

Scenario	1990	2010	2012	2015	2020	2025	2030	2030, %	
								1990 level	2012 level
Without measures	-905	-560	-522	-490	-468	-594	-446	49%	85%
With measures				-590	-594	-642	-602	66%	114%

Waste

The mitigation scenario considered is based on strategic program to improve the solid waste management system which is currently is under phased implementation in Kotayk marz and in the city of Yerevan (Table S-9).

Table S-9. Projection of GHG emissions in "Waste" sector, Gg $CO_{2\ eq.}$

Scenario	2012	2015	2020	2025	2030
Without measures	632.6	628.5	624.5	621.9	616.7
With measures	632.6	623.5	584.6	437.1	426.4

S-4. Information on Support Received and Needs

Various international donor organizations provide support to implementation of climate change activities. The information on the support received from bilateral and multilateral sources since 2011 (including funding, technology transfer, capacity building, and technical assistance) with particular emphases to mitigation measures is provided. In order to fulfil the obligations arising from the Cancun and Durban Conference of Parties decisions related to the submission of national communications and biennial update reports, further support is needed to continue to develop and consolidate existing technical and institutional capacities and to continue the efforts of integrating climate change into national policies, plans and programs.

S-5. Measurement, Reporting and Verification System

The Measuring, Reporting and Verification system (MRV) establishment is envisaged as gradual process based on national circumstances and local capacities as well as taking into account good practices of other countries. It implies institutional improvements aimed at coordination of all activities for development of national communications and biennial reports with clear defined responsibilities for developing national GHG inventories and measurement and reporting on mitigation policies, activities/projects.

CHAPTER 1. NATIONAL CIRCUMSTANCES

1.1 Location and Natural Resources

The Republic of Armenia (RA) is located approximately between 38° and 42° northern latitudes, 43° and 47° longitudes in the Southern Caucasus bordering Georgia to the north, Azerbaijan to the east, Iran to the south and Turkey to the southwest. The territory of Armenia covers 29743 km^2 being the 138th in the world.

Relief: Armenia is a mountainous landlocked country, 90% of its area is 1,000 m above sea level, among which 40% is above 2000 m. The highest peak is Mountain Aragats (4095 m), the lowest point is the upper flow of River Debed with 1830 m average absolute height. Ararat valley is located in the southwestern part of the country and is the most important agricultural region in the country. As a result of the split relief and slope processes, active exogenic processes that cause landslides and erosion are characteristic for Armenia.

Climate: The climate of Armenia is highly variable, even on small territories, due to the country's complex relief. Almost all types of climatic patterns can be observed in Armenia – the country's climate ranges from arid subtropical to cold, high mountainous. The average annual temperature ranges from -8^{o}C in high-altitude mountainous regions (2,500 m and higher) to 12-14°C in low-traced valleys.

Summer is temperate. The average temperature in July is 16.7°C, although in Ararat valley it varies between 24-26°C. Winter is cold. January is the coldest month of winter with an average temperature of -6.7°C. Winter is temperate in the north-eastern and south-eastern regions of the country.

The climate of Armenia is rather dry. The average annual precipitation in Armenia is 592 mm. The most arid regions are Ararat valley and Meghri region. The annual precipitation there is 200-250 mm. The highest annual precipitation, 800-1000 mm, is observed in high-altitude mountainous regions. In Ararat valley, the average precipitation during summer does not exceed 32-36 mm.

Armenia's climate is characterized by the abundance and intensity of solar radiation, which respectively comprise on average 1700 kWh/m^2 and 2500 hours.

The temperature significant increase was observed in recent decades. The annual average temperature was increased by 0.4^{0}C for the period of 1935-1996, by 0.85^{0}C for the period of 1935-2007 and by 1.1^{0}C for the period of 1935-2014.

The decrease tendency of precipitation is observed: annual average precipitation is decreased by 6% for the period of 1935-1996 and about by 10% for the period of 1935-2012.

The territory of Armenia is characterized by high seismic activity and intensive exogenous processes; these contribute to landslide occurrence and erosion. The frequency and magnitude of hazardous hydrometeorological phenomena also contribute to emergencies and incur significant losses to the population and the economy.

Land resources: According to the land balance of 2012, agricultural lands occupy 69% of the territory of the country, forest lands - 11.2%, lands of specially protected areas of nature (SPAN) - 11.2%, wetlands – 0.9%, settlement, industrial, communication, transport, utility infrastructure lands -6.6% and other lands-1.1%.

Water resources: Rivers in Armenia are tributaries of the large Araks and Kura rivers in South Caucasus. About 9500 small and midsize revers 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.

The annual average flow of surface waters total to 6.8 billion m^3 while ground water resources is estimated about 4.0 billion m^3 . The largest lake is Lake Sevan which is one of the largest freshwater high-altitude lakes in Eurasia.

Biological resources: Armenia is peculiar for its rich biodiversity due to the expressed vertical zonation and diversity of climatic conditions of the territory, i.e. more than 100 species in 1 km^2. The majority of species are endemic or rare.

Natural resources: Armenia is rich in copper molybdenum, polymetallics, constructional stone, mineral water, precious metals and semiprecious stones; these are the base of industrial production.

1.2 Population

The population of the Republic of Armenia is 3,027 thousand people (2012), urban population is 1,918 thousand people (63.4%), rural population is 1,109 thousand people (36.6%).

The average population density is 102 person/km^2. The distribution of the population is extremely disproportionate due to the country's mountainous relief and the different level of economic development. The maximum density of population - 686 person/km^2, is in the zones up to 1000 m above sea level, the minimum density - 22 person/km^2, is observed in high-altitude zones of up to 2000-2500 m above sea level.

The largest cities are Yerevan - the capital city (1,061 thousand people), Gyumri (122 thousand people) and Vanadzor (86 thousand people). 66% of the urban population and 42% of the total population live in these three cities.
The number of the employed people is 1,173 thousand people (2012).

After 1990 there was a sustainable trend of reduction in population of Armenia which is due to reduced natural population growth and emigration. Compared to 1990, the population in 2012, decreased by 494 thousand people (14 %) while the natural growth fell 3 times (Table 1-1).

Table 1.1. Population of RA

	1990	1995	2000	2005	2010	2011	2012
Number (thousand people)	3,515	3,260	3,227	3,156	3,055	3,021	3,027
Natural growth (per 1000 people)	16.3	7.4	3.1	3.5	5.2	4.7	4.9

Source: Statistical Yearbook of Armenia (2015)

1.3 Economy

After the collapse of the USSR followed by the sharp economic downturn (53%) of 1991-1993, Armenia managed to overcome the difficulties of the transition period and to ensure economic growth. During 1995-2000, Armenia's GDP increased annually by 5.4% and between 2001-2006 the average annual GDP growth amounted to 12.4%. This annual growth slowed to 2.2%, on average, during 2007-2010 due to the worldwide financial crisis. The average annual growth for 2010-2013 was 4.4% (Table 1-2).

Table 1.2. Main macroeconomic indicators of Armenia, 1995-2012

Indicator	1995	2000	2005	2010	2011	2012
GDP (billion AMD)	522	1,031	2,243	3,460	3,778	4,266
GDP (million USD)	1,287	1,912	4,900	9,260	10,142	10,619.4

Indicator	1995	2000	2005	2010	2011	2012
GDP (PPP) (million USD)	6,900	7,300	12,600	20,400	20,200	22,035
GDP (PPP) per capita (million USD)	2,116	2,262	3,392	6,665	6,686	7,398.5
GDP index in comparison to the previous year, (%)	106.9	105.9	113.9	102.2	104.7	107.2
Inflation (%)	32.2	0.4	2.2	8.2	7.7	2.6
Export (million USD)	271	300	974	1,041	1,334	1,380
Import (million USD)	674	885	1,801	3,749	4,115	4,261
External state debt (million USD)	373	860	1,093	3,300	3,570	3,739

Source: Statistical Yearbook of Armenia (1995, 2001, 2006, 2011, 2015), http://data.worldbank.org/indicator/NY.GDP.MKTP.PP.CD, http://data.worldbank.org/indicator/NY.GDP.PCAP.PP.CD

Structural changes in economy resulted in changes in GDP structure, i.e. reduction of the share of manufacturing industry and increasing the share of the services sector (Table 1-3).

Table 1.3. GDP structure, (%)

Components	1990	1995	2000	2005	2010	2011	2012
Industry	44.0	24.3	21.9	18.8	15.5	17.1	17.9
Agriculture	13.0	38.7	23.2	18.7	17.0	20.3	16.1
Construction	18	8.5	10.3	21.7	17.3	13.0	11.7
Services	25	24.8	35.5	32.3	40.8	38.7	43.6
Net taxes	-	3.1	9.1	8.5	9.0	10.9	10.7

Source: Statistical Yearbook of Armenia (1991, 1995, 2006, 2011, 2015)

Social indicators: As of 2012, the official unemployment rate was 7% (according to the International Labour Organization's methodology it was 17.3%). The monthly average nominal salary is AMD 113.163 (USD 281). The poverty rate (monthly income per person less than USD 92) is 32.2%. As of 2014, the human development index was 0.729 (87th in the world).

1.4 Energy

Armenia has no domestic fossil fuel resources and strongly depends on imported fuel resources to meet its energy demand. Domestic primary energy resources (hydro, nuclear, wind, biomass) provide only 35% of the country's energy demand.

Due to the economic and energy crisis in 1991-1993, the primary energy consumption fell sharply: in 1995 primary energy supply was 23% and primary energy consumption per capita was 26% of the level of 1990. Since 1995, Armenia has recorded growth in primary energy consumption. In 2012 primary energy supply was 40% and primary energy consumption per capita was 46% of the level of 1990. Due to the shift in the economy structure, GDP energy intensity fell by 78% compared to 1995 (Table 1-4).

Electricity is generated by thermal, nuclear and hydro power plants. In 2012, power generation was 8,036 GWh, of which: 42% was generated by TPPs, 29% - by NPP, and 29% - by HPPs.

The economic and energy crisis in 1992-1994 led to sharp decline of heat production for industrial and household needs and most of the district heating systems discontinued operation soon after. At present, the residential sector mainly uses natural gas and electricity consuming household appliances for heating and hot water supply. Heat supply of public/commercial sector is mainly restored through natural gas fired local boiler houses.

Table 1.4. Energy consumption indicators dynamics

Indicators	Unit	1990	1995	2000	2005	2010	2011	2012
Primary energy supply (TPES)	1000 toe	7978	1853	2280	2834	2896	3080	3185
Final energy consumption	1000 toe	5345	1260	1801	1927	1948	2030	2047
Primary energy consumption per capita	toe/person	2.269	0.591	0.706	0.898	0.948	1.019	1.052
GDP energy intensity	toe/1000 USD	-	1.44	1.14	0.465	0.32	0.30	0.30

In 2012, the primary energy sources were: natural gas (60.4%), nuclear energy (18.9%), oil products (9%), hydro energy (6.2%) and biomass (5.1%) (Table 1-5 and Figure 1-1). Compared to 1990, the significant share of the natural gas and nuclear energy, as well as increase in the hydro energy and decrease of the oil products share in TPES, certify the clean energy tendency in Armenia.

Table 1.5. Primary energy sources, ktoe

Sources	1990	1995	2000	2005	2010	2011	2012
Natural gas	3608.2 (45.2%)	1029.2 (55.6%)	1122.4 (49.2%)	1394.6 (49.2%)	1459.0 (50.4%)	1734.9 (56.3%)	1924.5 (60.4 %)
Oil products	3887.6 (48.7%)	506.2 (27.3%)	308.0 (13.5%)	351.0 (12.4%)	381.0 (13.1%)	312.1 (10.1%)	286.6 (9%)
Hydro energy	160.0 (2%)	169.5 (9.2%)	107.5 (4.7%)	152.8 (5.4%)	245.9 (8.5%)	212.5 (6.9 %)	198.8 (6.2%)
Nuclear energy	0	52.5 (2.8%)	518.2 (22.7%)	702.0 (24.8%)	649.5 (22.4%)	663.8 (21.6 %)	602.3 (18.9%)
Coal	320.6 (4%)	9.5 (0.5%)	0	0	0.7 (0.0%)	2.6 (0.1 %)	2.4 (0.07%)
Biomass	2.1 (0.1%)	83.6 (4.5%)	210.0 (9.2%)	212.5 (7.5%)	152.8 (5.3%)	145.4 (4.7%)	163.1 (5.1%)
Liquid gas	0	2.4 (0.1%)	14.3 (0.7%)	21.5 (0.7%)	7.2 (0.3%)	8.3 (0.3%)	7.7 (0. 24 %)
Total	***7978.5 (100%)***	***1852.9 (100%)***	***2280.4 (100%)***	***2834.4 (100%)***	***2896.1 (100%)***	***3079.7 (100%)***	***3185.4 (100%)***

Source: RA Ministry of Energy and Natural Resources, Public Services Regulatory Commission, "Gazprom Armenia" CJSC, Statistical Yearbook of Armenia, RA Custom Service

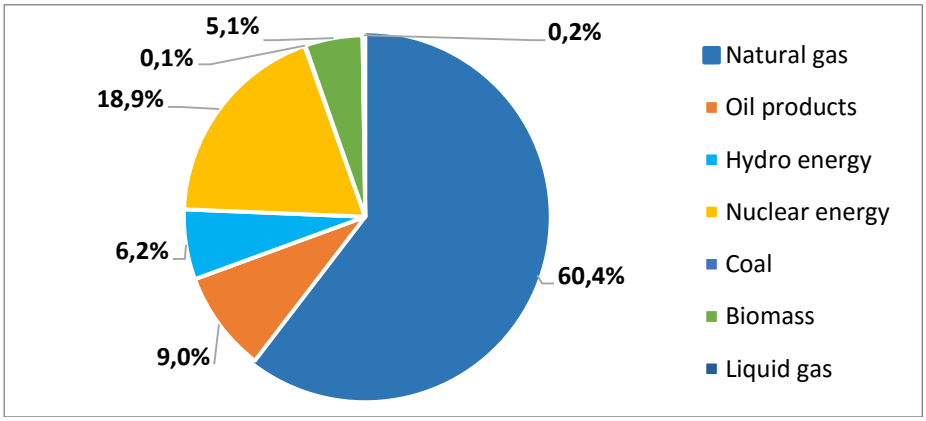

Figure 1-1. Primary energy sources, %

1.5 Industry

Hardships of the initial transition period to a market economy were the main reasons for industrial failure in Armenia. In 1993, the industrial production fell to 43% of the 1990 level. Since 1994, the

situation has stabilized and slow growth in industrial production has been achieved. The industrial production annual growth in 2000-2005 was 8%, in 2006-2012 - 3%.

Industrial production in Armenian by types of economic activities as of 2012 had the following structure: processing industries – 62.3%; mining industries – 17.2%; electricity, gas, and steam supply – 18.9%; water supply, sewerage and waste management – 1.6%. In 2012, the processing industries included the following sectors: food (54%), metallurgy (23.5%), construction materials (6.9%), chemical (4.1%), machine building (4.4%), jewellery (1.5%), light industry (1.1%) and other (4.5%).

1.6 Transport

After 1993, as a result of significant structural changes in the economy and transportation blockade, the transport sector underwent substantial transformation. Compared to 1990, goods turnover in 2012 fell 27 times in all types of transportation. The total passenger turnover decreased twice. In 2012 the share of road transportation accounted for 66.3% and 90.1% respectively in the total goods and passenger turnover.

In 2012 the urban passenger on-ground electric transportation reduced by 11 times, and its share of total passenger turnover decreased from 12.4% to 2.3% (Table 1-6).

The use of motor fuel in 2012 compared to 1990 reduced by 2.6 times. Since 2000, the share of natural gas rapidly increased and made up 70.2 % of the total volume of fuel used in road transport (Table 1-7).

Table 1.6. Goods and passenger turnover per common use transport types

Transport type	1990	1995	2000	2005	2010	2011	2012
Goods turnover (1000 t, %)							
Railway	15724 (5.7%)	2149.4 (45.7%)	1423.5 (40.5%)	2612.3 (36.9%)	3063.3 (33%)	3269.4 (39.7%)	3460.2 (35.6%)
Road	261522 (94.3%)	2499.0 (53.2%)	2077.0 (59.1%)	4479.7 (63.0%)	6196.0 (66.9%)	4944.2 (60 %)	6840.1 (66.3%)
Air	18.0 (0%)	51.4 (0.1%)	13.8 (0.4%)	9.3 (0.1%)	8.8 (0.1%)	10.0 (0.1%)	12.3 (0.1%)
Total	***277264***	***4699.8***	***3514.3***	***7101.3***	***9268.1***	***8223.6***	***10312.6***
Passenger turnover (million passenger, %)							
Railway	3.5 (0.7%)	3.0 (1.7%)	1.1 (0.8%)	0.7 (0.4%)	0.8 (0.4%)	0.6 (0.3%)	0.6 (0.3%)
Road	377.4 (76.2%)	81.6 (46.7%)	100.4 (73.9%)	181.8 (89%)	206.0 (88.3%)	207.0 (89.4%)	208.0 (90.1%)
Air	1.8 (0.4%)	1.0 (0.7%)	0.6 (0.5%)	1.2 (0.6%)	1.7 (0.7%)	1.7 (0.7%)	1.8 (0.8%)
Underground	51.1 (10.3%)	55.4 (31.7%)	15.5 (12.4%)	15.8 (7.7%)	19.9 (8.5%)	17.0 (7.3%)	14.9 (6.5%)
Tram	18.7 (3.8%)	11.8 (6.7%)	5.2 (4.4%)	0	0	0	0
Trolleybus	42.7 (8.6%)	21.8 (12.5%)	9.5 (8.0%)	4.8 (2.3%)	4.9 (2.1%)	5.3 (2.3%)	5.4 (2.3%)
Total	***495.2***	***174.6***	***132.3***	***204.3***	***233.3***	***231.6***	***230.7***

Source: Statistical Yearbook of Armenia (1991, 2000, 2005, 2015)

Table 1.7. Motor fuel consumption by transportation means, ktoe, %

Year / Type	1990	1995	2000	2005	2010	2011	2012
Petrol	693.0 (55%)	276.5 (80.1%)	166.8 (74.6%)	166.1 (53.1%)	169.8 (36.7%)	145.4 (30.6%)	110.4 (22.8%)
Diesel	567.0 (45.0%)	68.6 (19.9%)	31.3 (14%)	24.1 (7.7%)	27.1 (5.8%)	30.0 (6.3%)	33.1 (6.8%)
Natural gas	0	0	23.1 (10.3%)	118.8 (38%)	264.9 (57.2%)	296.6 (62.5%)	340.6 (70.2%)
Liquefied gas	0	0	2.4 (1.1%)	3.6 (1.2%)	1.2 (0.3%)	2.2 (0.4%)	1.0 (0.2%)
Total	***1260.0***	***345.1***	***223.6***	***312.6***	***463.0***	***474.4***	***485.1***

Source: RA Ministry of Energy and Natural Resources (1990-2001), «Gazprom Armenia» CJSC (2002-2013), Statistical Yearbook of Armenia, RA Ministry of Finance and State Revenue (2005), RA Ministry of Transport and Communication (2010-2012)

1.7 Buildings[1]

As of 2012, the RA housing stock included 19,019 multi-apartment buildings (436,631 apartments), including 12,029 multi-apartment buildings (63%) in urban communities, 6,990 multi-apartment buildings (37%) in rural areas as well as 423,624 detached houses, including 154,608 (36%) in urban communities and 269,013 (64%) in rural communities. 25.2% of multi-apartment buildings and 53.7% of the living area of the multi-apartment buildings accounted for Yerevan city.

1.8 Agriculture and Forestry

Agriculture: Agricultural lands in Armenia covers 2,052.4 thousand ha, including cropland (448.4 thousand ha – 21.9%), perennial plants (33.4 thousand ha – 1.6%), haylands (121.6 thousand ha – 5.9%), pasture (1,056.3 thousand ha – 51.5%), and other lands (392.7 thousand ha – 19.1%).

Armenia's agriculture has also suffered the consequences of the severe economic crisis of 1991-1994. The area and structure of agricultural land changed as well: sown areas fell approximately by 30% (Figure 1-8). Livestock number also decreased: cattle by 13%, sheep and goats by 55%, pigs by 67%, poultry by 91% (Table 1-9). Irrigated land halved, whilst the use of chemical fertilizers fell threefold. In recent years crop production was on average 60% of the gross output of agriculture and the share of animal husbandry was 40%. The annual average growth of the agricultural output was 7.7% for the period of 2000-2006 and 2% for 2007-2012.

Table 1.8. Agricultural lands, 1000 ha

Years / Lands	1990	1995	2000	2005	2010	2011	2012
Total area, including	1,384.0	1,391.4	1,391.4	1,391.4	2,010.9	2,077.0	2,052.4
cropland	492.0	483.5	494.3	494.3	448.5	449.2	448.4
perennial plants	83.6	74.1	64.2	64.2	32.9	33.0	33.4
hayfields	137.5	138.9	138.9	138.9	127.1	128.3	121.6
pasture	666.1	694.0	694.0	694.0	1,104.3	1,067.2	1056.3
other lands	-	-	-	-	388.1	399.3	392.7
Sown area	436.6	351.9	303.2	331.8	283.6	286.7	304.2
Fruit and grape plantations	79.4	57.6	37.8	49.8	55.1	53.4	56.7

Source: Statistical Yearbook of Armenia (1991, 1995, 2001, 2006, 2013)

[1] *Source: RA Housing Stock and Municipal Service (2013), NSS*

Table 1.9. Livestock and poultry, thousand heads, as of January 1, 2012

Description	1990	1995	2000	2005	2010	2011	2012
Cattle	690.0	503.7	478.7	573.3	570.6.	571.4	599.2
Sheep and goats	1,291.5	636	548.6	603.3	511.0	532.5	590.2
Pigs	329.3	82.3	70.6	89.1	112.6	114.8	108.1
Poultry	11,714.4	2,912.6	4255.1	4861.7	4134.6	3462.5	4023.5

Source: Statistical Yearbook of Armenia (1991, 1995, 2001, 2006, 2015)

Forestry: As of 2012, the total area of Armenia's forest fund was 457 thousand ha, including forest covered land - 11.2% of the country territory.

As a result of the energy crisis in 1992-1999 around 6.0 million m^3 forest was logged. Massive illegal logging brought about negative impacts on forest ecosystems. Intensive efforts are required to ensure restoration of the forest ecosystems. 2,150 ha of area underwent reforestation and afforestation activities in 1998-2006, and 2,754 ha in 2006-2012. In 2012 forest covered territory reduced in a result of "Teghut" mine exploitation as well cleaning of coastal area vegetation of the "Sevan" national park due to lake level increasing measures.

According to the assessment done based on data received from "Hayantar" SNCO and ''Sevan'', ''Dilijan'' and ''Arevik'' national parks as well as on the annual monitoring results received from the State Forest Monitoring Center of "Hayantar" SNCO and Inspectorate of the RA Ministry of Nature Protection the volume of harvested wood volume has increased in 2011 and 2012.

1.9 Waste

Municipal solid waste. Municipal solid waste (MSW) is collected and disposed in 48 municipal landfills with total area of 137.5 ha. In none of the landfills waste is classified or sorted before disposal.

All landfills, except the largest one in Yerevan, are not managed. The decomposable organic carbon in MSW reaches 50-60%. In 2012 due to reduction of population the amount of MSW decreased by 20% compared to 1990. However the change of MSW amount per urban dweller is insignificant (Table 1-10).

Table 1.10. Municipal solid waste generation, (1000 t)

Waste	1990	1995	2000	2005	2010	2011	2012
Generated waste	822.2	841.0	839.2	700.8	707.1	709.9	650.3
Waste disposed in landfill	583.7	597.1	593.0	497.6	502.0	504.1	461.3
Per urban dweller (t)	0.246	0.239	0.240	0.246	0.258	0.262	0.240

Source: RA Housing Stock and Municipal Service, Statistical Collection, Statistical Yearbook of Armenia, 1991-2013

Municipal wastewater. Municipal wastewater includes households, commercial, and partly industrial wastewaters. Total volume of water disposal amounts to 431 million m^3 per year. The volume of wastewater discharged into sewerage system totals to 86.6 million m^3. Until 1990, there were 20 wastewater treatment stations operating in Armenia with total capacity of 958 thousand m^3/day. Currently these stations are in extremely poor technical conditions while some of them are demolished. Four new mechanical municipal wastewater treatment stations were put into operation in 2012-2014.

1.10 Institutional arrangements relevant to the climate change and for continuous preparation of national communications and biennial update reports

The Republic of Armenia signed the United Nations Framework Convention on Climate Change on June 13, 1992 and ratified it as a non-Annex I country on May 14, 1993. On December 26, 2002 ratified the Kyoto Protocol to the UNFCCC.

The country associated to the Copenhagen Accord in January 2010. Armenia's association to "Doha Amendment to the Kyoto Protocol" was approved by the Government of Armenia and the RA Constitutional Court and in 2015 it was submitted to the RA National Assembly for ratification.

Armenia's post-2020 climate policy under a new international agreement is formulated in "Intended Nationally Determined Contributions" (INDC). It was endorsed by the RA Government Protocol Decision No 41 dated 10 September 2015 and submitted to the UNFCCC Secretariat on 22 September, 2015.

The GHG National Inventory Reports, Biennial Reports and National Communications are the key tools for supporting the development of climate change policy and action plans, as well as for the monitoring of the implemented measures. Some steps towards ensuring continuous preparation of national communications and biennial update reports have already been implemented in Armenia.

Government Decree No 1594-N on "Approval of the Action Plan of RA Obligations Resulting from International Environmental Conventions" has defined measures and responsible agencies for their implementation for the period of 2011-2015.

The "Inter-agency Coordinating Council for Implementation of Requirements and Provision of the UN Framework Convention on Climate Change" was established in 2012 by the RA Prime Minister Decision No 955-A. The obligations of the Council in particular include coordination of the activities aimed at the fulfilment of obligations under the Convention and evaluation of implementation thereof. Establishment of the Inter-agency Coordinating Council was also extremely important for coordinating National Communications and Biennial Reports preparation and verification. However the definition of the Interagency Council responsibilities are given in a general way without assigning clear roles and responsibilities of the agencies for development of national communications and biennial reports.

With this regard, it is worth to mention that in 2015, a Division of Climate Change and Atmospheric Air Protection Policy was established under the Environment Protection Policy Department of the Ministry of Nature Protection of RA. The functions of the division inter alia include fulfilment of the commitments under UNFCCC and provisions of the recommendations on climate change legal framework (normative and regulatory legal acts). In fact, the division assumes the role of coordinating the processes associated with the preparation of national communications and biennial reports. However certain legal arrangements still have to be enacted.

The concept of the new edition of RA Law on "Atmospheric air protection" is developed and currently is under discussion. Among other amendments, the new Law will also provide for a set of provisions for greenhouse gas emissions inventory and climate change mitigation policy.

Currently a draft decision on amendments to the Government Decree No 1594-N on "Approval of the Action Plan of RA Obligations Resulting from International Environmental Conventions" is under development for the period of 2016-2020.

Considering obligations of the country under the Convention related to biennial reporting on a continuous basis (including GHG Inventory preparation) as well provisions of Paris Agreement with regard to transparency and accessibility of information on climate change related activities, the approaches for establishing a transparent and unified database are being assessed.

CHAPTER 2. NATIONAL GREENHOUSE GAS INVENTORY

2.1 Basic Information on GHG Inventory

The inventory of greenhouse gases covers the years 2011 and 2012. It has been compiled in line with the UNFCCC Biennial Update Reporting Guidelines for Parties not included in Annex I to the Convention and COP Decision 17 (2/CP.17, Annex III, Chapter 3) applying 2006 IPCC Guidelines for National Greenhouse Gas Inventories. The National Inventory Report has been submitted to the UNFCCC Secretariat as a separate report in 2015.

According to 2006 IPCC Guidelines the following sectors were considered:

- Energy;
- Industrial Processes and Product Use;
- Agriculture, Forestry and Other Land Use;
- Waste.

National GHG Inventory includes:

- Assessment of anthropogenic emissions of CO_2, CH_4 and N_2O gases by sources and removals by sinks and report on HFCs, CO, NOx, NMVOC and SO_2 emissions;
- Key Category Analysis;
- Summary Report for National Greenhouse Gas Inventories for 2012 (Tables 1 and 2 of the Guidelines);
- Inventory sectoral tables;
- Consistent time series back to the years reported in the previous national communications.

2.2 Improvements

The following improvements have been made to the GHG inventory:

- For the key sources five country - specific emission factors were developed;
- Data for 6 new subcategories were included;
- Higher tier for 11 subcategories was applied.

Considering that the "Energy" sector is the biggest producer of greenhouse gas emissions, the improvements were mostly done to the "Energy" sector GHG inventory.

Since natural gas is the main fuel consumed in the country the inventory improvements have been done in assessment of GHG emissions from natural gas combustion and fugitive emissions of natural gas by applying Tier 2 Methodology.

In IPPU sector CO_2 emissions from cement production were assessed applying Tier 3 Methodology.

2.3 Overview of institutional mechanism and processes for inventory development

The Ministry of Nature Protection as Designated National Authority for coordination of issues relevant to UN Framework Convention on Climate Change (UNFCCC) coordinates the works on development of national communications and biennial update reports in fulfilment of obligations under Convention. In 2015 Climate Change and Atmospheric Air Protection Division of the Environmental Protection Policy Department of the Ministry of Nature Protection was established. Its responsibilities inter alia includes coordination of works on development of national communications and biennial reports for ensuring provision of information in a consistent, transparent, complete and timely manner.

The UNFCCC Focal Point provides strategic guidance and support on behalf of the Ministry of Nature Protection. The Inter-Agency Coordinating Council on Implementation of Requirements and

Provisions of the UNFCCC ensures high-level support and policy guidance thus giving sustainability to the preparation of the national communications and biennial reports.

UNDP Country Office through the UNDP Climate Change Program Unit supports the Ministry of Nature Protection in fulfilment of obligations under Convention including development of national communications and biennial update reports. With this aim the expert group was formed on competitive basis, with the involvement of experts engaged in preparation of the previous inventories and familiar with 2006 IPCC Guidelines and software. The expert group worked in close cooperation with the Climate Change and Atmospheric Air Protection Division of the Environmental Protection Policy Department of the Ministry of Nature Protection, National Statistical Service and other relevant stakeholders.

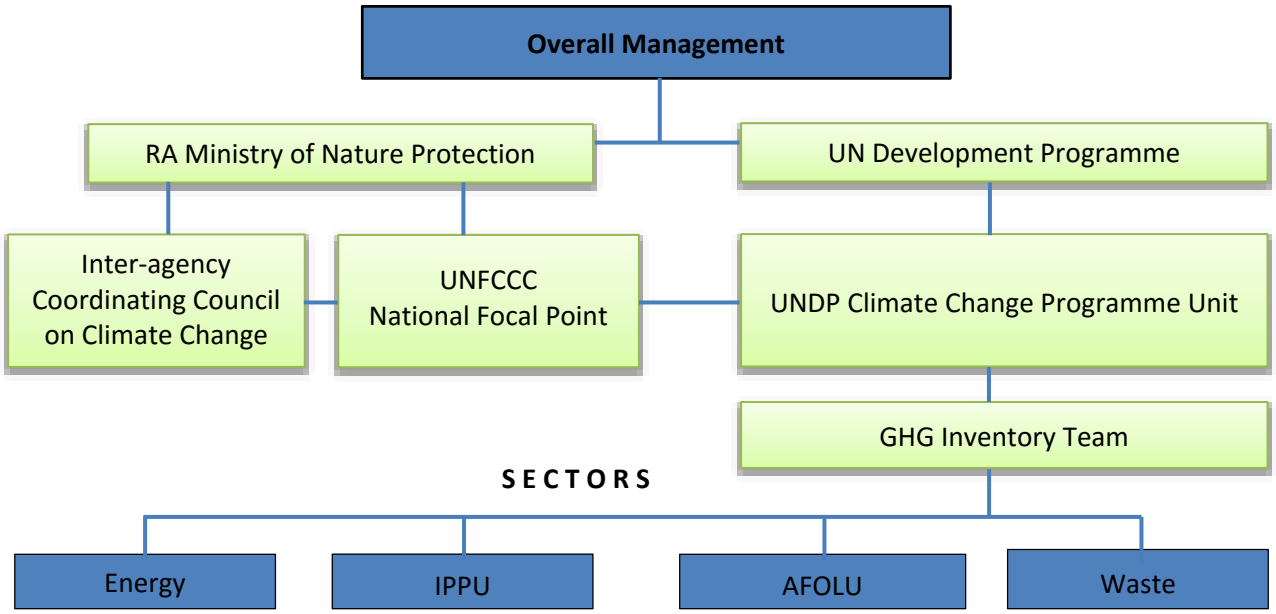

Figure 2.1. Organization chart of national inventory development

2.4 Overview of used methodology and data sources

2011 and 2012 GHG National Inventories were developed according to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories applying IPCC 2006 Inventory Software for data entry, emission calculation, results analysis and conclusions. As needed approaches and default data of "1996 IPCC Revised Guidelines for preparation of GHG National Inventories" and "Good Practice Guidelines and Uncertainty Management in National GHG Inventories" (IPCC 2000), "Good Practice Guidelines for Land Use, Land Use Change and Forestry" (IPCC 2003) and "Air Pollutant Emission Inventory Guidebook" (EMEP/EEA, 2013) were also used.

GHG emissions were estimated in units of tonne carbon dioxide equivalent ($CO_{2\ eq.}$) using 100-year Global Warming Potentials (GWPs) values according to the IPCC's Second Assessment Report.

The following principles were applied while developing GHG National Inventory:

- Clear observation of the rationale and structure of 2006 IPCC Guidelines;
- Priority given to the use of national data and indicators;
- Utilization of all possible sources of information;
- Maximal use of the capacities of national information sources.

National Statistical Service (NSS) of RA has served as main data source for various sectors. Information was also provided by the Ministry of Energy and Natural Resources, Ministry of Finance,

Ministry of Agriculture, Ministry of Economy, Public Services Regulatory Commission, State Committee of Real Estate Cadaster, "Gazprom Armenia" CJSC, "Settlement Center" CJSC, "ArmForest" SNCO, and municipalities of Yerevan, Gyumri, Vanadzor and other cities of Armenia.

2.5 GHG emissions by sectors and by gases

The Table 2.1 below provides greenhouse gases emissions estimate in Armenia for 2012.

Table 2.1. GHG emissions (+) and removals (-) by sectors and by gases for 2012, Gg

Sector/Category	Net CO_2	CH_4	N_2O	HFCs $CO_{2\ eq.}$	Total $CO_{2\ eq.}$
Energy	5,296.5	75.5	0.1	N/A	6,912.8
Industrial Processes and Product Use	277.9	N/A	N/A	384.6	662.5
Agriculture	N/A	54.4	1.55	N/A	1,621.5
Waste	7.3	26.9	0.19	N/A	632.4
Total emissions, without Forestry and Other Land Use	***5,581.7***	***156.8***	***1.84***	***384.6***	***9,829.1***
Forestry and Other Land Use	-522.1	N/A	N/A	N/A	-522.1
Total emissions with Forestry and Other Land Use (net emissions)	***5,059.7***	***156.8***	***1.84***	***384.6***	***9,307.1***

Armenia's biggest source of GHG emissions is the "Energy" sector. In 2012 its share of the total GHG emissions was 70.3% , followed by Agriculture sector – 16.5% (Figure 2.2).

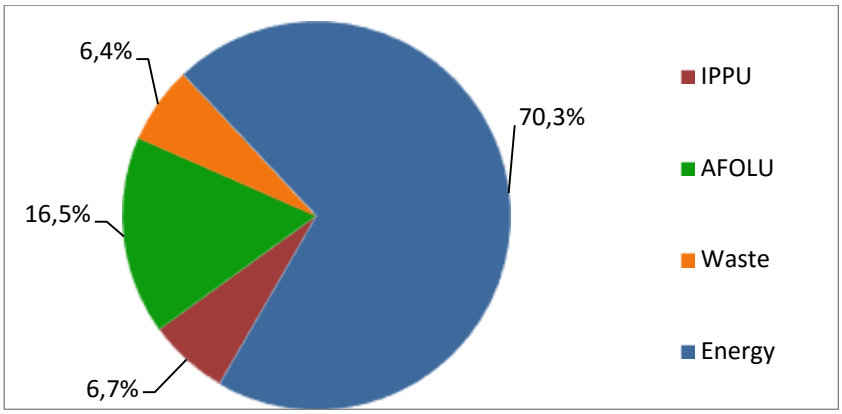

Figure 2.2. GHG emissions by sectors without forestry and other land use in 2012, $CO_{2\ eq.}$

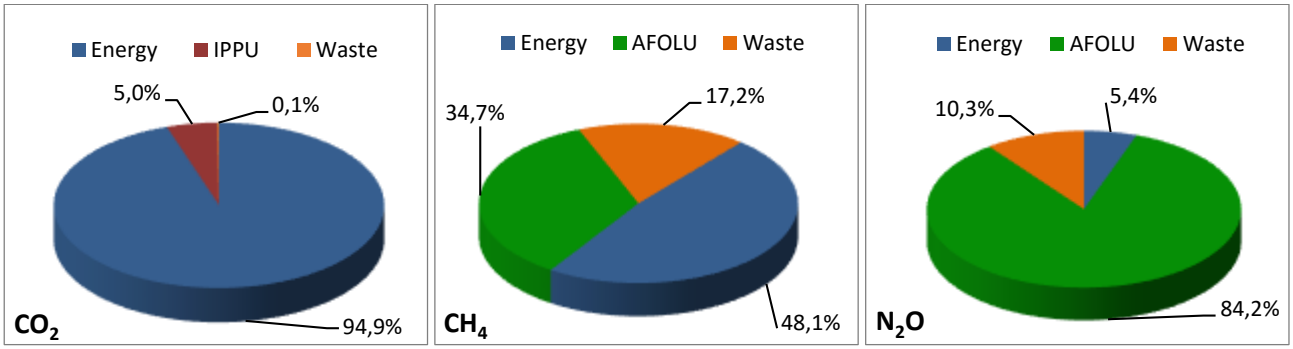

Figure 2.3. 2012 GHG emissions by gases (without Forestry and Other Land Use subsector)

In 2012 the "Energy" sector produced about 95% of all CO_2 emissions. The majority of CO_2 emissions were from electricity generation based on the combustion of natural gas as well as from road transport and residential sector.

CO_2 emissions from IPPU sector in 2012 were significantly less accounting for 5% only.

The majority of methane emissions in 2012 were also mostly from the "Energy" sector (48.1%) due to the fugitive emissions of natural gas. 34.7% of methane emissions were from AFOLU sector resulted from emissions from enteric fermentation of cattle. Methane emissions from "Waste" sector made up 17.2%.

In 2012 the prevailing part of nitrous oxide emissions (84.2%) originated from the AFOLU sector due to the direct and indirect N_2O emissions from manure management and managed soils.

2.6 Trends of GHG emissions

The increase of 2012 Armenia's GHG emissions compared to those in 2010 was mostly due to the increase in emissions from "Energy" sector and Agriculture.

To ensure time series consistency, emissions for 2000-2010 have been recalculated for those categories where methodology have been changed. In particular, in "Energy" sector CO_2 emissions originated from natural gas combustion and methane fugitive emission were recalculated applying Tier 2 Methodology and CO_2 emissions from cement production in IPPU sector were recalculated applying Tier 3 Methodology.

Figure 2.4 provides GHG emissions by sectors and Figure 2.5 – by gases for the period of 2000-2012.

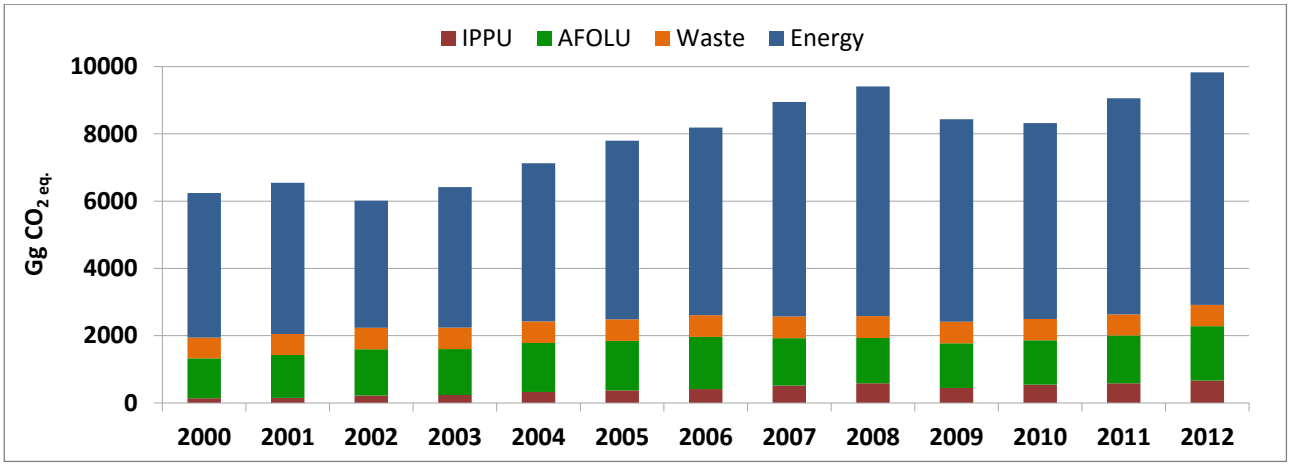

Figure 2.4. Time series of GHG emissions by sectors (without "Forestry and Other Land Use subsector)

In 2012 the "Energy" sector emissions were 18.7% higher than in 2010 due to the significant increase of thermal power plants generation (in 2012– 3.4 billion kWh versus 1.4 billion kWh in 2010) pursuant to the contractual obligations under Iran-Armenia Electricity-for-Gas Swap Agreement (in 2012 electricity exports to Iran totalled to 1.58 billion KWh).

After the decline of GHG emissions from IPPU sector in 2009 because of the economic crises, which resulted in the decrease of construction volumes and, thus, cement production, in 2010 the construction volumes and cement production increased to a certain degree, which resulted in the increase of GHG emissions. The increase of GHG emissions in 2011 and 2012 was due to the continuous trend of substituting the ozone layer depleting substances with HFCs.

In 2012 emissions from agriculture were 22.8% higher than in 2010 due to the increase of emissions from enteric fermentation because of the increase of the number of cattle. GHG emissions by gases for 2000-2012 are provided in Figure 2.5.

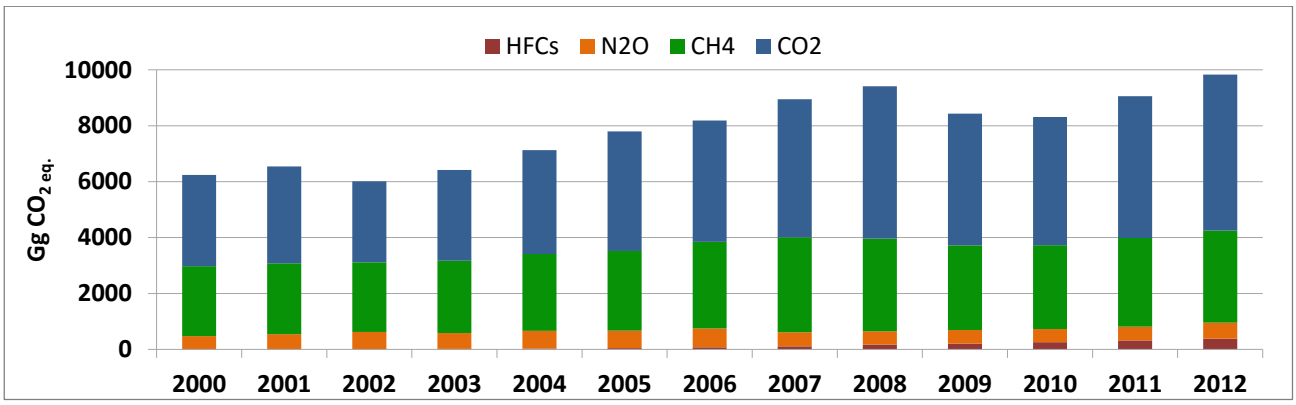

Figure 2.5. Time series of GHG emissions by gases (without "Forestry and Other Land Use subsector)

The most significant greenhouse gas of Armenia's inventory is carbon dioxide (CO_2). Its share in 2012 was 54.4%, growth was 21.8% compared with the year 2010. The "Energy" sector produced the prevailing part of all carbon dioxide emissions - about 95% in 2012.

In 2012 methane emissions increased by 9.8% compared with the year 2010 due to both sharp increase in thermal power generation (135%) requiring more imported natural gas, as well as increased number of cattle.

The increase of N_2O emissions resulted from the increased use of organic and non-organic fertilizers. In 2012 nitrous oxide emissions increased by 20.7% compared with the year 2010.

Emissions of F-gases (HFCs) have increased strongly in the past few years. The growing emission trend has been mainly driven by the substitution of ozone depleting substances in many applications. In 2012 HFCs emissions increased by 50.6% compared with the year 2010.

2.7 GHG emissions by sectors

Energy

The "Energy" sector is by far the biggest producer of greenhouse gas emissions. In 2012 its share was 70.3% of the total GHG emissions. The "Energy" sector emissions can be divided into emissions from fossil fuel combustion and fugitive emissions related to the transmission and distribution of natural gas. The majority of the sector's emissions (78.2%) results from fossil fuel combustion. The "Energy" sector emissions have strong annual variation depending on the amount of electricity exported.

Natural gas is the main fuel consumed in Armenia. In 2012 it accounted for 84% of all fossil fuels consumed in the country (Fig. 2.6), and therefore the inventory improvements have been done in assessment of GHG emissions from natural gas combustion and fugitive emissions of natural gas by applying Tier 2 Methodology.

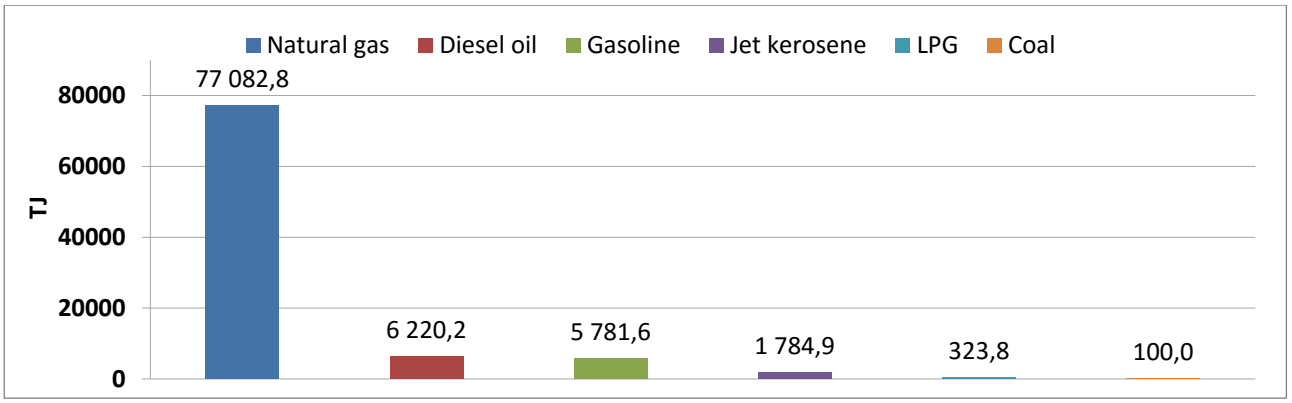

Figure 2.6. Fossil fuel consumption structure by types of fuel, 2012

Figure 2.7 provides the share of annual CO_2 emissions from fuel combustion activities by subcategories for 2012.

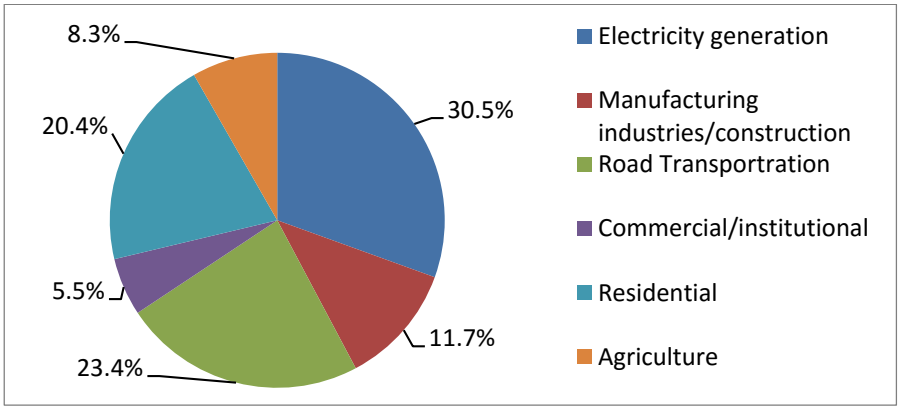

Figure 2.7. Annual CO_2 emissions from fuel combustion activities by subcategories, 2012

"Electricity Generation" subcategory is the biggest producer of CO_2 emissions which are fully originated from natural gas fired thermal power plants.

For verifying assessment results derived by Sectoral Approach, CO_2 emissions from fossil fuel combustion were also assessed by Reference Approach. Emission values derived applying Reference Approach were 5481.7 Gg that is 3.4% higher than those estimated by Sectoral Approach (5296.5 Gg) which is justified given that according to the IPCC Guidelines natural gas leakage from pipelines, emissions from energy transformation, etc. are included in Apparent Consumption in Reference Approach estimate.

For ensuring consistency of time series, annual CO_2 emissions from "Fuel Combustion Activity" for 2000-2012 were recalculated applying Tier 2 Methodology.

Table 2.2. CO_2 emissions time series from "Fuel Combustion Activity" for 2000-2012

Subcategory/ Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total	***3,120.5***	***3,314.8***	***2,679.4***	***3,017.2***	***3,410.1***	***3,936.7***	***3,995.2***	***4,528.9***	***5,028.0***	***4,469.0***	***4,287.1***	***4,798.8***	***5,296.5***
Electricity Generation	**1,703.6**	**1,727.2**	**1,002.6**	**995.0**	**1,036.7**	**1,184.0**	**977.3**	**972.4**	**1,162.3**	**939.9**	**840.9**	**1,074.7**	**1,616.3**
Manufacturing Industries/ Constr.	**452.7**	**372.6**	**394.7**	**424.2**	**556.3**	**700.6**	**694.3**	**774.3**	**705.1**	**514.9**	**541.0**	**637.4**	**620.1**
Road Transportation	**643.0**	**592.4**	**678.2**	**763.8**	**817.3**	**849.2**	**944.8**	**1,071.9**	**1,262.2**	**1,164.4**	**1,213.8**	**1,217.2**	**1,241.7**
Other Sectors, including:	**321.1**	**622.7**	**604.0**	**834.3**	**999.8**	**1,202.8**	**1,378.8**	**1,709.7**	**1,898.4**	**1,849.8**	**1,691.3**	**1,869.5**	**1,817.4**
Commercial/ Institutional	*40.4*	*92.1*	*86.3*	*143.7*	*154.9*	*172.1*	*204.7*	*270.4*	*324.8*	*348.9*	*311.4*	*361.4*	*296.1*
Residential	*198.9*	*211.7*	*202.2*	*340.9*	*477.6*	*648.0*	*808.9*	1,053.0	1,152.9	1,115.2	*956.1*	1,105.1	*1,082.8*
Agriculture	*81.9*	*319.0*	*315.5*	*349.7*	*367.3*	*382.7*	*365.2*	*386.3*	*420.7*	*385.7*	*423.8*	*403.0*	*438.5*
Memo items													
International aviation	*90.5*	*121*	*117.9*	*94.8*	*110*	*111.7*	*115.8*	*178.1*	*176*	*92.6*	*136.2*	*125*	*127.6*
Biomass	*731.1*	*732.4*	*716.8*	*703.0*	*679.7*	*655.3*	*613.7*	*439.4*	*432.0*	*422.7*	*586.4*	*616.0*	*692.2*

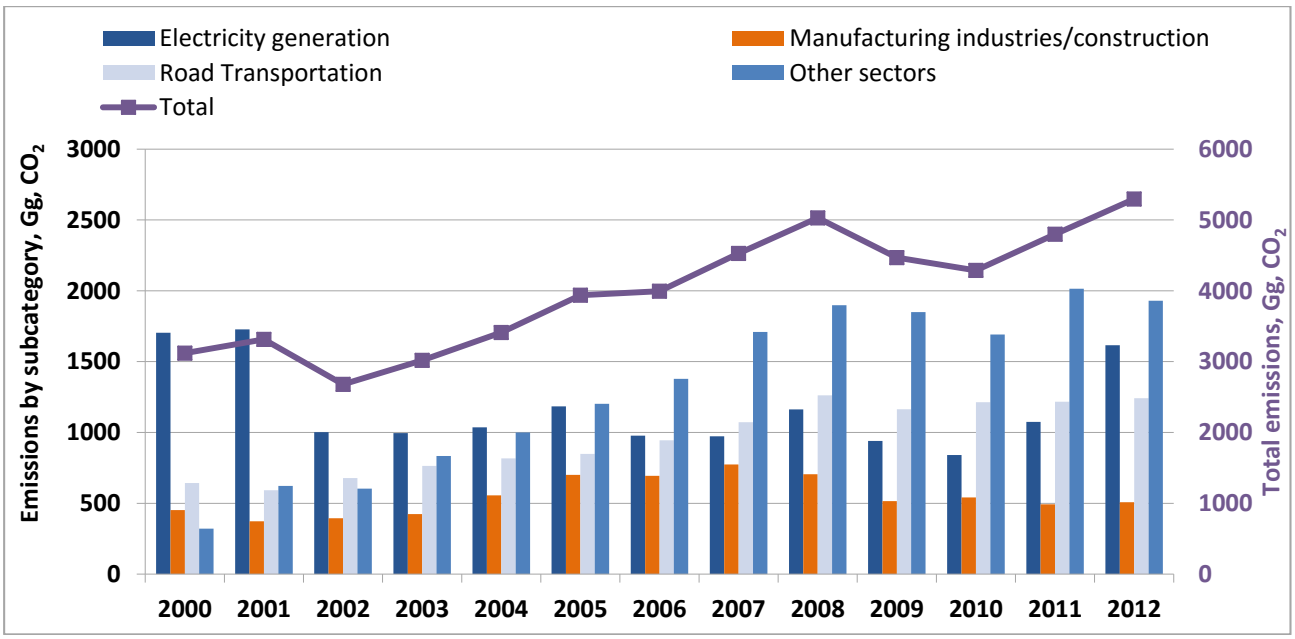

Figure 2.8. CO_2 emissions time series from fuel combustion activities

The second highest source of emissions in the "Energy" sector are fugitive emissions of natural gas. Although, according to official sources, there is a reduction in losses in natural gas transmission and distribution networks in recent years (6.5% in 2011 and 5.7%2 in 2012) however the absolute values of losses increased conditioned by increasing volumes of imported natural gas.

For ensuring consistency of time series, fugitive emissions for 2000-2012 were recalculated applying Tier 2 Methodology (Figure 2.9).

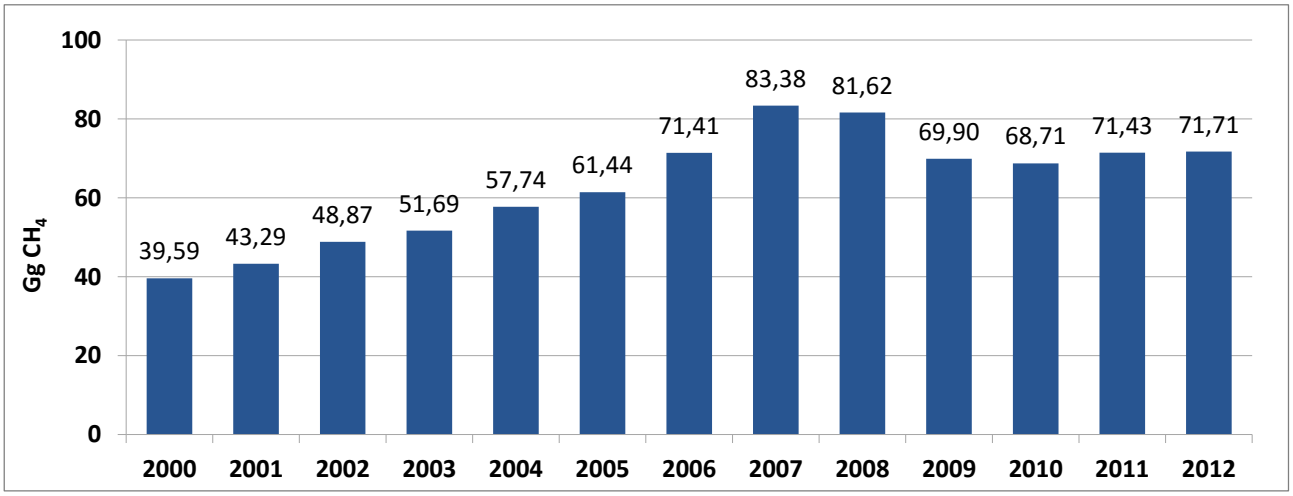

Figure 2.9. Time series of CH_4 fugitive emissions from natural gas for 2000-2012

Industrial Processes and Product Use

Emissions in "Industrial Processes and Product Use" sector in 2012 were mainly originated from cement production - 277.9 Gg CO_2,, and product use (HFCs)- 384.58 Gg $CO_{2eq.}$. Armenia has no domestic production of HFCs and started importing HFCs and HFCs containing products after 2005 when the country launched its first national program on alternatives of substances depleting the ozone layer. There are different applications of HFCs of which refrigeration and air conditioning are the key ones.

[2] Main indicators for gas supply system, PSRC, 2011, 2012

In 2012 carbon dioxide emissions from cement production accounted for 2.98% of total GHG emissions, while HFCs emissions from refrigeration and air conditioning totalled to 4.13%. "Cement Production" and "Refrigeration and Air Conditioning" categories in IPPU sector were key sources of GHG emissions in 2012.

Emission of gases with indirect greenhouse impact (non-methane volatile organic compounds - NMVOCs, and sulphur dioxide – SO_2) accounted for 45.853Gg. SO_2 emissions originated from ferromolybdenum and converter copper production, while NMVOCs were emitted from bitumen use (asphalt pavement), food and beverage production, paints use, and use of solvents by households.

Time series of carbon dioxide and HFCs emissions for 2000-2012 are provided in Figure 2.10. For ensuring consistency of time series, annual carbon dioxide emissions from cement production for 2000-2012 were recalculated applying Tier 3 Methodology.

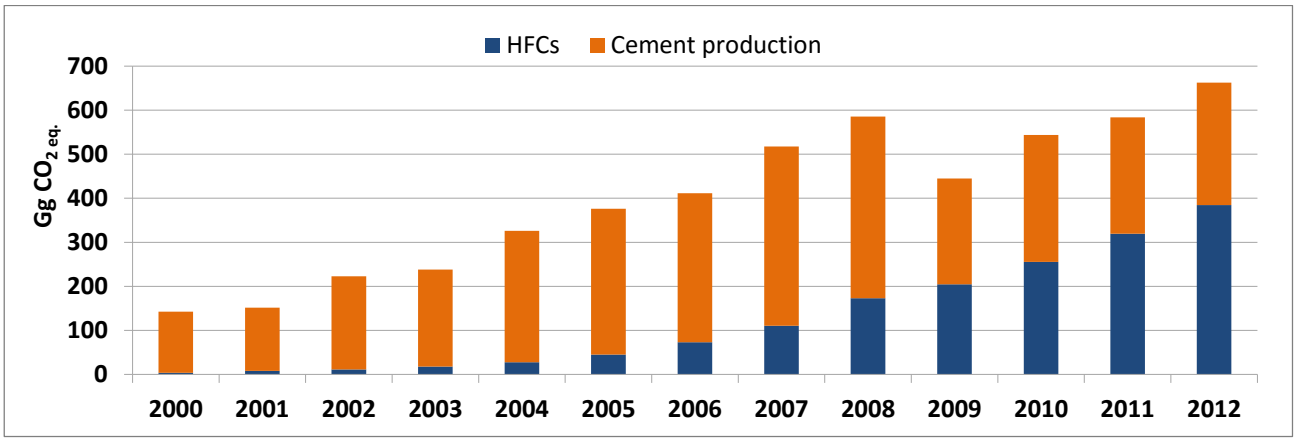

Figure 2.10. Time series of emissions from IPPU sector

Sharp decline in emissions in IPPU sector in 2009 was due to economic crisis, which resulted in the sharp decrease of construction volumes and, thus, cement production. After 2010, the construction volumes and cement production increased to a certain degree resulted in the increase of GHG emissions.

The increase of F-gases emissions in 2011 and 2012 was due to the continuous trend of rapid growth of HFCs application in Armenia since 2008.

Agriculture, Forestry and Other Land Use

The prevailing part of emissions in this sector were methane emissions from enteric fermentation and nitrous oxide emissions from ''Direct emissions from managed soils" and "Indirect emissions from managed soils".

"Enteric Fermentation" category is the key source of GHG emissions accounting for 10% of total emissions.

There was a significant increase in methane emissions in 2012 from enteric fermentation and manure management conditioned by increasing number of livestock, increase in average live weight, milk yield rate, and etc.

Time series of methane emissions from enteric fermentation of cattle and manure management in $CO_{2\ eq}$. are provided in Figure 2.11 below.

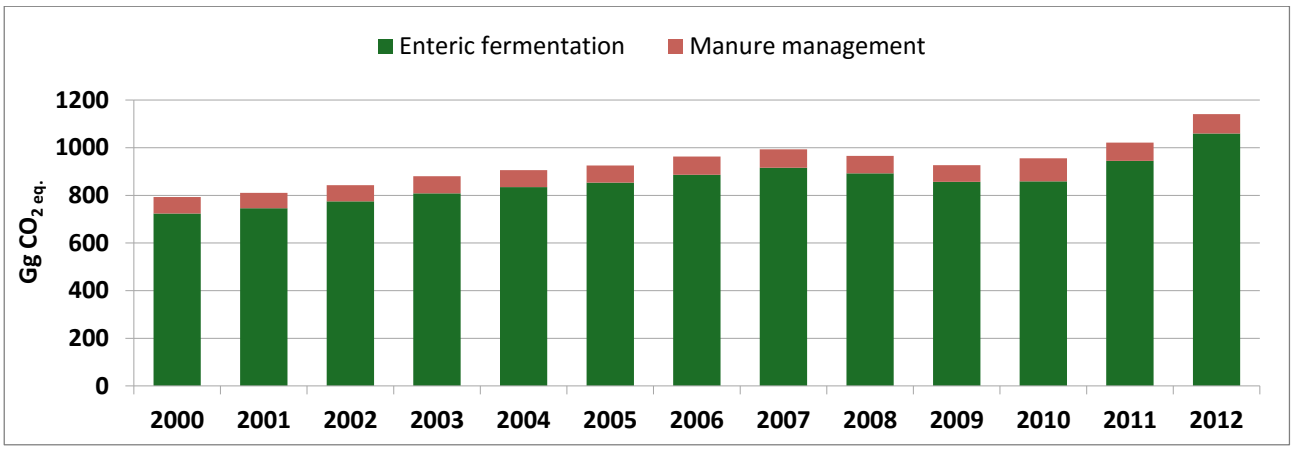

Figure 2.11. Time series of methane emissions from enteric fermentation and manure management

Carbon dioxide emissions/removals of "Forest Land Remaining Forest Land" subcategory were assessed based on official data. In comparison with 2010, carbon dioxide removals in 2012 were decreased by 5.6% because of increased volumes of firewood extraction and commercial felling[3] as well as because of forest clearing activities in "Sevan" National Park lakeside forest covered areas and operation of "Teghut" mine.

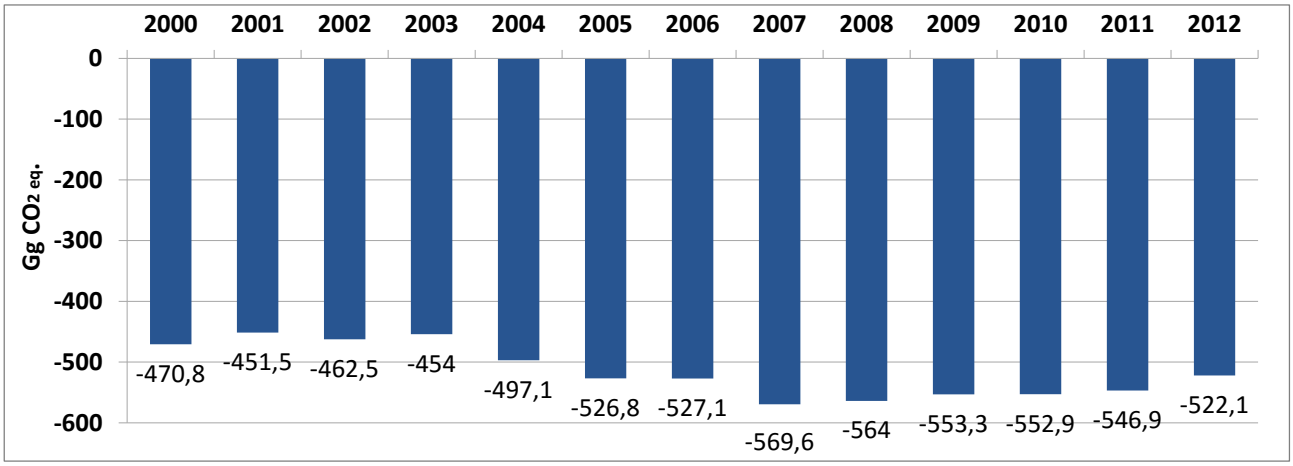

Figure 2.12. Time series of carbon dioxide removals in Forest Land Remaining Forest Land

Time series for other land use are not provided due to lack of data on land conversion.

Waste

GHG emissions in "Waste" sector originated from the following categories: methane emissions from solid waste disposal; carbon dioxide, methane and nitrous oxide emissions from incineration and open burning of waste; methane and nitrous oxide emissions from domestic wastewater treatment and discharge; and nitrous oxide emissions from industrial wastewater treatment and discharge.

In 2012 solid waste disposal (methane emissions) was the key source of emissions accounting for 4.3% of the total emissions. Increase in emissions in this sector in 2012 compared to 2010 was insignificant.

[3] The volume of harvested wood in 2011 and 2012 was assessed based on data received from "Hayantar" SNCO and ''Sevan'', ''Dilijan'' and ''Arevik'' national parks, as well as on the annual monitoring results received from State Forest Monitoring Center of "Hayantar" SNCO and Inspectorate of the RA Ministry of Nature Protection.

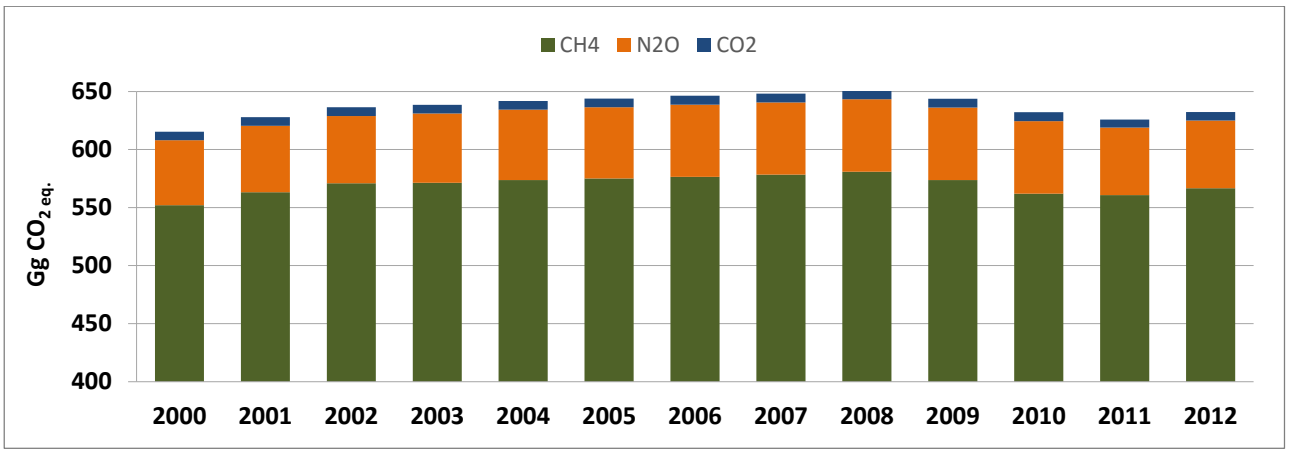

Figure 2.13. Time series of GHG emissions in "Waste" sector by gases

2.8 Analysis of key sources

In total national GHG emissions the 1.A1.ai "Electricity generation" subcategory had the highest share of emissions due to sharp increase in power generation by thermal power plants in 2012 (in 2010 the subcategory was the fourth).

The second largest source was 1B2b "Fugitive emissions of natural gas" subcategory (sixth in 2010) that was conditioned by sharp increase of natural gas import due to increased power generation by thermal power plants. Fugitive emissions of natural gas were assessed by developing country-specific emission factors for gas transmission and distribution networks considering the country's gas supply network structure and physical-chemical parameters of the imported natural gas.

Although emissions in 1.A.4 "Other Sectors - Gaseous Fuels" and 1.A.3.b "Road Transportation" subcategories demonstrated a slight increase, these sources moved from first and second places in 2010 to third and fourth places in 2012 respectively. The share of these four subcategories in "Energy" sector made up more than 50% of total national GHG emissions.

Table 2.3. Key category analysis (level assessment), 2012

A	B	C	D	E	F
IPCC category code	IPCC category	GHG	2012 emissions (Gg $CO_{2\ eq.}$)	2012 emissions level from the given category	Total of the column E, %
1.A.1.ai	Electricity Generation	CO_2	1,616.28	0.153	15
1.B.2.b	Fugitive emissions of Natural Gas	CH_4	1,505.97	0.142	29
1.A.4	Other sectors - gaseous fuels	CO_2	1,351.74	0.128	42
1.A.3.b	Road transportation	CO_2	1,241.73	0.117	54
3.A.1	Enteric fermentation	CH_4	1,060.01	0.100	64
3.B.1.a	Forest land remaining forest land	CO_2	-522.14	0.070	71
1.A.2	Manufacturing industries and construction - gaseous fuels	CO_2	620.14	0.059	77
1.A.4	Other sectors - liquid fuels	CO_2	456.21	0.043	81
4.A	Solid waste disposal	CH_4	453.16	0.043	85
2.F.1	Refrigeration and air Conditioning	HFCs	372.67	0.035	89
2.A.1	Cement production	CO_2	277.90	0.026	92
3.C.4	Direct N_2O emissions from managed soils	N_2O	230.63	0.022	94
3.C.5	Indirect N_2O Emissions from managed soils	N_2O	117.69	0.011	95

2.9 Quality assurance and quality control

The quality requirements set for the GHG inventories – transparency, consistency, comparability, completeness and accuracy – were fulfilled by implementing the QA/QC procedures. General QC checks was done by the members of the expert group.

Category-specific QC checks including technical reviews of the source categories, activity data, emission factors and other methods were applied on a case-by-case basis focusing on key categories and on categories where significant methodological and data revision have taken place. This was done by experts selected for these purposes.

The QA reviews were performed after the implementation of QC procedures concerning the finalized inventory. The draft Inventory Report was submitted to the RA Ministry of Nature Protection for comments and recommendations. Further, the RA Ministry of Nature Protection circulated NIR among the stakeholder and data provider ministries and organizations-. The Report was reviewed also by experts of Climate Change Intergovernmental Working Group. The Inventory Report was reviewed by the international expert involved by kind assistance of UNDP-UNEP Global Support Programme (GSP) for National Communications and Biennial Update Reports. Received comments and recommendations were valuable and contributed to the improvement of the GHG inventory report.

2.10 Improvements foreseen

GHG Inventory further improvements are split into three groups in terms of target areas, including:

- Application of higher Tier methodology for Key Sources by developing country-specific emission factors.
- Ensuring completeness and accuracy of the activity data. To this aim a standard forms for activity data collection should be developed according to IPCC sectors with identification of institutions/organizations having such data at their disposal;
- Consideration of new subcategories.

The improvements foreseen by sectors are described below.

"Energy" sector: The Road transportation is the key source of GHG emissions. As of 2012, emissions from road transportation accounted for 18.7% of total emissions in "Energy" sector. For 2011 and 2012 National Inventory CO_2 emissions from compressed natural gas combustion in road transport were calculated by Tier 2 Methodology applying country-specific emission factors for natural gas developed within the frames of the FBUR. Further improvements for assessing GHG emissions from road transport should cover development of country-specific emission factors for estimate of CO_2 emissions from gasoline, diesel fuel, and liquid gas combustion.

New subcategories will be considered in *"Manufacturing Industry and Construction"* category.

"IPPU" sector: Separate calculation have to be provided for asphalt production and asphalt pavement (compared with those calculated based on bitumen use) for more accurate assessment of NMVOCs emissions.

Given the continuous trend in increasing HFCs application it is envisaged to improve data collection process especially for refrigeration and air conditioning application as well as for foam blowing and fire protection applications.

It is envisaged to assess GHG emissions from glass production applying Tier 3 Methodology due to the availability of the required activity data.

AFOLU sector: Manure management and Direct N_2O emissions from managed soils are the key sources. It is planned to improve GHG emissions assessment for these subcategories by applying Tier 2 Methodology.

Application of higher level assessment Methodology for Forest Lands category currently hampered by incompleteness and uncertainty of the activity data on forest logging, afforestation and forest rehabilitation, fuelwood extraction, etc. The shortcomings are due to the lack of forest inventory and comprehensive monitoring of forest resources. Another obstacle is the fact that currently forests and forest lands in Armenia are managed by two institutions - RA Ministry of Agriculture and RA Ministry of Nature Protection which in some cases creates discrepancies in recorded activity data.

For improving GHG emissions inventory for "Croplands" it is necessary to adjust land Use categories of the 2006 IPCC Software to the national land classification and apply appropriate factors taking into account climatic conditions and soil types.

For improving GHG emissions inventory for "Grassland" it is necessary to reclassify the national classification to the IPCC categories of land use and adjust them with country's climatic zones and land types.

It is envisaged to consider new subcategories – "Emissions from biomass burning in croplands"", and "Emissions from biomass burning in grasslands".

CHAPTER 3. CLIMATE CHANGE MITIGATION: ACTIVITIES, PROJECTIONS AND IMPACT ASSESSMENT

3.1. Basic approaches

The impact of climate change mitigation actions was assessed for 2012-2030 and calculation therein are based on projected volumes from respective activities in various sectors of economy according to the Long-term Development Strategy Program of RA for 2014-2025 which envisages 5.7% annual average economic growth. For the 2027 – 2030 the annual average economic growth of 3% was considered according to WB projections.

Three scenarios were considered for mitigation actions impact assessment, including:

Scenario 1 - Without measures (WOM). This scenario provides for maintaining the existing business-as- usual practices without considering the climate change targets;

Scenario 2- With measures (WM). This scenario takes into account the mitigation measures envisaged by sectoral programs in line with sectoral development objectives;

Scenario 3 - With additional measures (WAM). This scenario provides for enhancing the expected policies and activities for GHG emissions reduction and employs the maximum potential of mitigation measures.

3.2 Report on mitigation actions and their impact

To assess the forecasted impact mitigation actions were split into two groups in terms of the feasibility of their implementation.

WM scenario includes those mitigation actions which are highly probable for implementation, i.e. which have already been started or planned for the nearest future with the secured financing or which are priority projects in the sectoral strategic and planning documents (Table3.1 and Table 3.3).

WAM scenario includes mitigation actions with a relatively high degree of uncertainty for implementation, i.e. those which are assessed and recommended but have not yet secured financing (Tables 3.2 and 3.4).

Table 3.1. Description of mitigation measures on generation side and transmission and distribution networks

Description of mitigation measure	Year	Annual GHG emission reduction, Gg CO_{2eq}.	Type of support received
Energy			
Mitigation measures			
Electricity Generation (new Renewables)			
Goals / Objective: Increasing the share of renewables in power generation mix			
Coverage: CO_2 , CH_4 reduction through the increased share of renewables in power generation mix			
Implemented measures			
***Assumptions/Methodology*:** Annual GHG emission reduction was assessed by applying grid emission factor of 0.444 t CO_2/MWh (CDM Standardized Baseline)			
Construction of 26 small HPPs, total installed capacity 55 MW and annual generation 190.6 GWh	2011	84.6	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.
Construction of 27 small HPPs, total installed capacity 52.8 MW and annual generation 221.1 GWh	2012	98.2	
Construction of 11 small HPPs, total installed capacity 21.2 MW and annual generation 76 GWh	2013	33.7	
Construction of 2 small HPPs, total installed capacity 9 MW and annual generation 32.1 GWh	2014	14.3	

Planned measures The construction of these generating capacities are included in Energy Security Action Plan and RA " Energy System Long-Term (up to 2036) Development Ways " Program.			
***Assumptions/Methodology*:** The assessment of the emission reductions was done using LEAP-Armenia model which calculated emission reduction from fuel combustion and associated reduction of fugitive emissions from reduced generation of thermal power plants.			
Construction of new nuclear power plant, installed capacity 1028 MW	2027	3959 (in 2030)	N/A
Construction of new small HPPs, total installed capacity up to 145 MW and annual generation up to 500 GWh	2015-2021	839.3 (in 2030)	
Shnokh HPP, installed capacity 70 MW and annual generation 270 GWh	2022		
Loriberd HPP, installed capacity 66 MW and annual generation 210 GWh	2022		
Wind Farm, installed capacity 50 MW and annual generation 131 GWh	2030	73.2 (in 2030)	
Solar PV, installed capacity 40 MW and annual generation 84.1 GWh	2018-2021	46.8 (in 2030)	SREP resources will be used to develop roughly 40-50 MW of utility-scale solar PV. The WB in the frames of SREP project provided a US$ 8.55 million grant to confirm whether the geothermal resource at the Project Site is suitable for power generation.
Geothermal Plant, installed capacity 30 MW and annual generation 194.5 GWh	2024	108.3 (in 2030)	

Energy efficiency measures on generation and transformation side			
Goals/Objective: Increasing energy efficiency on Generation and Transformation Side			
Coverage: CO_2 and CH_4 reduction through increased energy efficiency			
Implemented measures			
***Assumptions/Methodology*:** New efficient gas fired thermal power plant (CCGT technology) using 40% less gas per 1 kWh compared to the old Hrazdan TPP			
Commissioning of CCGT Unit #5, Hrazdan TPP, annual energy savings about 700 GWh	2012	141.4	
Planned measures			
Assumptions/Methodology: The assessment of the emission reductions from Power Supply Rehabilitation Project was done using LEAP-Armenia model which calculated emission reductions from energy savings resulted from rehabilitation of key substations and transmission lines. The resulting emission reductions are 10.91 Gg of $CO_{2\,eq}$. including reduction of fugitive emissions from reduced generation of electricity. The assessment of the reduction of fugitive emissions was done using LEAP-Armenia model assuming continuation of the current trends in their reduction (losses in gas transmission and distribution networks reduced due to the measures implemented by GazProm Armenia from 6.48% in 2011 to 5.66 in 2012 calculated from imported natural gas volumes[4]).			
Power Supply Rehabilitation Project	2016	10.9 (in 2030)	EBRD loan and E5P grant co-financing
Reduction of fugitive emissions		17.03 (in 2030)	N/A

[4] PSRC- Natural gas balance for 2011, 2012.

Table 3.2. Additional mitigation measures on generation side and transmission and distribution networks

Description of mitigation measure	Year	Annual GHG emission reduction, (Gg CO_{2eq})	Assumptions/Methodology
Goals/Objective: Increasing the share of Renewables in power generation mix and implementation of energy efficiency measures			
Coverage: CO_2, CH_4 reduction through the increased share of renewables in power generation mix			
Wind Farm, installed capacity 150 MW and annual generation 394.2 GWh	2020-2030	219.5 (in 2030)	The construction of these Renewables is envisaged by the Energy Security Action Plan but they are not included in RA "Energy System Long-Term (up to 2036) Development Ways" Program . The assessment of the emission reductions was done using LEAP-Armenia model which calculated emission reduction from fuel combustion and associated reduction of fugitive emissions from reduced generation of thermal power plants.
Solar PV, installed capacity 30 MW and annual generation 63.1 GWh	2025-2030	35.1 (in 2030)	
Biogas plants, installed capacity 3.3 MW and annual generation 26 GWh	2020-2030	14.5 (in 2030)	The assessment of the emission reductions was done based on the assessment of GHG emissions mitigation potential in animal farming sector (2010) of RA.
Reduction of losses in gas transmission and distribution networks	2015-2030	33.68 (in 2030)	The additional works aimed at improving gas transmission and distribution networks which currently are not envisaged by "Gazprom Armenia".

Table 3.3. Demand side mitigation measures and distributed Renewables

Name and description of mitigation measure	Quantitative Goals/Objectives	Status	Progress indicators	Methodologies/ Assumptions	Estimated GHG emission reduction, Gg CO_{2eq}	Coordination and management/ Type of support received
Energy						
Coverage – CO_2 and CH_4 emissions reduction through the implementation of energy efficiency/energy saving measures and introduction of renewable energy sources						
"Improving Energy Efficiency of Municipal Heating and Hot Water Supply" UNDP-GEF Project	Reduction of GHG emissions from heat supply through combination of measures - EE and RE pilot projects, their replication, increasing the awareness on EE advanced technologies, capacity building and policy development support.	Implemented	39 multi apartment buildings and 1 kinder-garten connected to the new constructed cogeneration-based district heating sys-tem, 2 pilots with ap-plication of infrared technology and heat pumps, 8 pilot solar water heating sys-tems, reconstruction of small-scale heating systems, improvement of legal and regulatory framework.	Emission reduction assessment was done assuming savings of natural gas and electricity for both heat and hot water needs.	885.6 of direct and indirect CO_2 emission reduction in 20-year period[5]	**MoNP, MoENR, UNDP, UNDP-GEF Project** US$ 2.95 million GEF grant and leveraged US$ 12 million foreign private direct investments in cogeneration-based district heating system
"Energy Efficiency Project" WB – GEF	Reduction of energy consumption in social and other public facilities through pilot projects' implementation, their replication, capacity building	Ongoing	44 public facilities have been reconstructed with actual energy savings of 40-50 percent from baseline.	Emissions reducti-on assessment was done consi-dering electricity savings resulted	By 2030 the annu-al energy savings are expected to be 193.450 GWh (both electricity	**MoENR, WB, R2E2** US$ 1.82 million GEF grant in for matching GoA resources and on-lending through revolving fund of R2E2

[5] Lessons Learned from the UNDP-GEF "Improving Energy Efficiency of Municipal Heating and Hot Water Supply" Project, 2012

	activities and policy development support.			from street lighting projects and natural gas savings from energy efficiency retrofits of buildings.	and gas) with resulting emission reduction of 74.243 Gg $CO_{2eq.}$, including reduction of fugitive emissions.	
"Improving energy efficiency in buildings" UNDP-GEF Project	To reverse the existing trends and reduce energy consumption of new and restored, primarily residential buildings in Armenia through design and enforcement of new mandatory EE building codes, outreach, training and educational campaign on integrated building design, piloting integrated building design.	Ongoing	Reduced energy consumption in pilot buildings from 185 kWh/m^2 to 111 kWh/m^2	Emissions reduction assessment was done considering energy savings of both natural gas and electricity.	By 2030 the annual energy savings are expected to be 66.720 GWh of electricity and 155.680 GWh of gas, emission reduction: 89.18 Gg CO_{2eq}, including reduction of fugitive emissions.	**MoNP, MoUD, UNDP, UNDP-GEF Project.** US$ 1.045 million of GEF and UNDP US$ 150 thousand grant, US$ 2.0 million RA Government co-financing27
"Green Urban lighting" UNDP-GEF Project	GHG reduction from promoting energy efficiency in municipal lighting through: pilot projects, establishment of financial and institutional mechanisms for scaling up municipal EE lighting programs and policy instruments, educational and capacity building activities.	Ongoing	649 high pressure sodium bulbs were replaced by EE LEDs	Emissions reduction assessment was done considering emission reduction from fuel combustion and associated reduction in fugitive emissions.	By 2030 the annual energy savings are expected to be 145.27 GWh of electricity, emission reduction: 95.714 Gg CO_{2eq}, including reduction of fugitive emissions.	**MoNP,** **local authorities,** **UNDP, UNDP-GEF Project** US$ 1.6 million GEF and US$ 150 thousand UNDP grant, US$ 200 thousand co-financing from municipalities.

Yerevan Street Lighting Project	To reduce energy consumption and modernize Yerevan street lighting system by introducing new energy-efficient LED lighting and its replication.	Planned	NA	Emissions reduction assessment was done considering emission reduction from fuel combustion and associated reduction in fugitive emissions.	By 2030 the annual energy savings are expected to be 43.2 GWh of electricity, emissions reduction: 28.33 Gg CO_{2eq}, including reduction of fugitive emissions.	**EBRD, MoNP, Yerevan Municipality** The EBRD's sovereign loan, US$ 2.0 million E5P grant.
Irrigation System Enhancement Project	To reduce energy consumption and improve irrigation conveyance efficiency in targeted irrigation schemes.	Ongoing	38 GWh energy savings achieved	Emissions reduction assessment was done considering emission reduction from fuel combustion and associated reduction in fugitive emissions.	By 2030 the annual emission reductions are expected to be 25.037 Gg of $CO_{2eq,}$ including reduction of fugitive emissions.	**WB, MoA and State Committee of Water Economy** US$ 30 million WB/IBRD loan
USAID Clean Energy and Water Program	Increasing energy efficiency in rural areas through introducing EE and RE solutions aimed at improving water supply, outdoor lighting, heating.	Implemented	18 RE and EE pilot projects were implemented	Emissions reduction assessment was done considering emission reduction from fuel combustion and associated reduction in fugitive emissions.	By 2030 the annual energy savings are expected to be 0.725 Gg of $CO_{2\ eq.}$, including reduction of fugitive emissions.	**USAID** US$ 577 thousand (including community and partner contributions)

Green for Growth Fund	To support the development of an energy efficiency-lending product within the institution, enabling households to reduce energy costs, consumption and CO_2 emissions.	Ongoing	EE sub loans will produce 78.6 GWh annual energy savings	Emissions reduction assessment was done considering reduction of natural gas consumption resulted from sub-loans and reduction in fugitive emissions	By 2030 the annual energy savings are expected to be 78.6 GWh of natural gas. GHG emission reduction: 22.831Gg $CO_{2eq.}$, including reduction of fugitive emissions.	US$20.354 million loan facilities from the Green for Growth Fund
"Supporting participation of Eastern Partnership and Central Asian Cities in the Covenant of Mayors"	To support the local authorities to reduce their dependency on fossil fuels via implementation of the energy saving measures.	Ongoing	European Covenant of Mayors efforts in Armenia is gradually evolving with now 10 city signatories, of which 3 already have approved their Sustainable Energy Action Plans	GHG reduction assessment was done based on the energy savings assessment provided in Sustainable Energy Action Plans developed by 3 cities.	By 2020 the annual energy savings are expected to be 19 GWh (of both electricity and natural gas), emissions reduction: 6.9 Gg $CO_{2eq,}$ including reduction of fugitive emissions.	**European Commission** EU Grant
The IFC Armenia Sustainable Energy Finance Project (ArmSEFF)	To 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	Ongoing	New renewable power generation capacity of 35 MW 20 GWh annual energy savings in Industry	To avoid duplication, emission reduction resulted from new Renewables are not considered here (see corresponding line in Table 3.1). Only emission reductions resulted from the implementation of EE measures were considered.	The annual energy savings by 2030 are expected to be 20 GWh and the resulting emission reductions-10.23 Gg of $CO_{2\ eq.}$ considering energy savings of natural gas and electricity as a result of EE measures	**Armenia Sustainable Energy Finance Project** US$30 million IFC loan and technical assistance grant from the Armenia Sustainable Energy Finance Project.

Caucasus Sustainable Energy Finance Facility (branded as "Energo-credit")	The EBRD is operating a credit line to provide financing to 6 local participating financing institutions that on-lend for energy efficiency and renewable energy.	Ongoing	4,878 residential loans and 9 corporate/SME EE loans are provided	The assessment of the emission reductions was done considering natural gas savings on demand side resulted from EE loans, including reduction of fugitive emissions.	The annual emission reductions are expected to be 6.913 Gg of CO_{2eq} in 2030.	EBRD loan of EUR 15 million along with advisory support from the Armenia Sustainable Energy Finance Project
Continuous replacement of mini buses by larger passenger buses in Yerevan	Optimization of public road transport route grid and reduction of annual running distance; replacement of minibuses by larger buses.	Ongoing	1,536 minibuses were replaced by 351 new urban buses in the 2009-2013 period, 9 different routes of minibuses were removed and 20 routes of minibuses were replaced by public bus routes. As a result, the total annual average running distance of the Yerevan public minibus fleet was reduced by 37.5% During 2015-2020 another 1,020 minibuses are expected to be replaced by 468 new Euro 4 and higher technology standard buses.	GHG reduction assessment was done based on the energy savings assessment provided in the second NEEAP.	The annual emission reductions are expected to be 158.25 Gg of CO_{2eq} in 2030.	**Yerevan Municipality**

Household energy efficiency and EE mortgage loans	The Program aims at providing 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 (approximately 3,000 households).	Ongoing	136 MWh annual energy savings	Emissions reductions were assessed considering natural gas savings resulted from EE investment in housing which leads to an average of 44% energy saving on demand side, including fugitive emissions reduction	GHG emissions reduction assessment was done based on the average annual savings projections of 2.450 GWh. The annual emission reductions are expected to be 0.712 Gg of CO_{2eq} in 2030.	**Central Bank** **National Mortgage Company** Loan of EUR 10 million from the French Development Agency. The Program is complemented by technical assistance funding from the EU Neighbourhood Investment Facility (NIF) to Partner Financial Institutions (PFI) as well as non-refundable grant funding from the EU NIF to borrowers.
Installation of solar water systems in communities	To promote the demonstration, development, transfer and widespread use of renewable energy technologies at the community level	Ongoing	Total area of collectors installed is 435 m^2	Emissions reduction was assessed considering natural gas savings on demand side	The annual emission reductions are expected to be 0.21 Gg of $CO_{2\ eq}$. by 2030.	**UNDP-GEF** Small Grants Programme, "Improving Energy Efficiency of Municipal Heating and Hot Water Supply" Project GEF Grant
GoA Decision "On implementation of energy saving and energy efficiency improvement measures in facilities constructed by state funding" (2014)	Implementation of energy saving and energy efficiency improvement measures in facilities being constructed (reconstructed, renovated) under the state funding	Planned	13.67 GWh annual energy savings of both electricity and natural gas by 2030.	Energy savings were estimated based on the state funding envisaged for EE improvement measures and assuming reduction of specific energy consumption in buildings from 160 kWh/m^2 to 96 kWh/m^2	The annual emission reductions are expected to be 5.482 Gg of $CO_{2eq.}$ by 2030.	**MoUD**

Geothermal Heat Pump and Solar Thermal Project (SREP)	Increase deployment of geothermal heat pumps and solar water heaters will help reduce gas imports through reduction of demand for gas-based electricity and gas used for heating/hot water.	Planned	Generation capacities and production targets for 2025 indicated in SREP: Geothermal heat pumps: installed capacity–25 MW, generation –33 GWh; solar thermal: installed capacity –25MW, generation – 33 GWh	Emission reduction assessment is based on the projected reduction of demand for gas-based electricity and gas used for heating/hot water.	The annual emission reductions are expected to be 16.847 Gg of CO_{2eq} in 2030	**Caucasus Energy Efficiency Program (EBRD)** US$3 million of SREP funding
Industrial Processes and Product Use						
Clinker production technology upgrading in cement factories	Reduction in CO_2 emissions will resulted from implementation of the measures described in item 3.4.2	Planned	Emission reduction from technology improvement	The assessment of CO_2 emissions reduction was done in comparison with baseline.	The emission reductions are expected to be 0,168 Gg of CO_2 in 2020, 8,68 Gg in 2025 and 131 Gg of CO_2 for the 20-year period.	Private companies
Agriculture, Forestry and Land Use						
Forestry, biodiversity and nature protection	The increase in CO_2 removals through the reforestation and afforestation measures - 1983 ha in 2015, 947 ha in 2020, 3750 ha in 2025, 3750 ha in 2030.	Ongoing	Afforestation and reforestation measures on the area of 555 ha	The assessment was done based on the area targeted for the reforestation and afforestation	29 Gg of CO_2 removal in 2030	MoNP, MoA, Hayantar SNCO, WWF, GIZ, UNDP, CNF, Armenia's Reforestation and Woodland Development Foundation

Waste						
Nubarashen Landfill Gas Capture and Power Generation CDM Project	CH_4 emission reduction through the capture and combustion of landfill gas	Ongoing	The gas capture and combustion system was constructed in the Nubarashen landfill	CDM methodology	The certified emissions from the period of 01.10.2010 to 30.12.2014 makes 44.848 Gg of CO_{2eq}	**Registered CDM project** Yerevan Municipality, Shimizu Corporation (Japan)
Kotayk Solid Waste Management Project	Prevention or reduction of negative impact on the environment (e.g. the pollution of surface water, groundwater, soil and air and greenhouse gas emissions), as well as any resulting risk to human health resulting from the use of landfills to dispose of waste.	Planned	Construction of the first EU compliant regional landfill and relevant infrastructure in Hrazdan town, to serve 7 municipalities of Kotayk region and Sevan city	ERBD assessment methodology of GHG emissions, 2010	The total emission reductions are expected to be 3.59 Gg of CO_{2eq} in 2016, 6.28Gg - in 2020, 8.49Gg - in 2025 and 10.8 Gg - in 2030	**MoUD, EBRD, Municipalities** EBRD Loan
Solid Waste Management in Yerevan	The new sanitary landfill will reduce adverse environmental, health and climate impact from the current landfill, which will be closed and rehabilitated when the new site becomes operational.	Planned	To improve the municipal solid waste management in Yerevan.		The total emission reductions are expected to be 82 Gg of CO_{2eq} in 2025 and 186 Gg of CO_{2eq} in 2030	**Yerevan Municipality, EBRD** EBRD Loan

Table 3.4. Additional mitigation measures on demand side

Description of mitigation measure	Quantitative Goals/Objectives	Methodologies/ Assumptions	Estimated GHG emission reduction, (Gg CO_{2eq})
"Energy Efficient Public Buildings and Housing in Armenia" NAMA registered in UNFCCC NAMA Registry for seeking investments	To contribute to the energy efficiency improvements in the public buildings and housing	Emissions reduction assessment was done considering energy savings of both natural gas and electricity.	The annual emission reductions are expected to be 105.6 Gg of CO_{2eq} in 2030.
Energy Efficient Rehabilitation of Schools	Modernization of 15-25 schools by increasing energy efficiency, improving learning environment and reduce energy consumption	The assessment of the emission reductions was done considering natural gas savings in comparison with baseline consumption.	The annual emission reductions are expected to be 2.440 Gg of $CO_{2eq.}$ in 2030.
Increasing energy efficiency in public transport system	Expansion and modernization of the electrified public transport in Yerevan	Emissions reduction assessment was done considering reduction of natural gas consumption in public transport	The annual emission reductions are expected to be 0.129 Gg of CO_{2eq} in 2030.
Increasing energy efficiency in industrial sector	To promote EE through introduction of mandatory energy audits, introduction of Best Available Technologies (BAT)	Emissions reduction assessment was done considering energy savings of both natural gas and electricity.	The annual emission reductions are expected to be 145.4 Gg of CO_{2eq} in 2030.
Energy efficiency retrofit in buildings	To reduce energy consumption of existing residential buildings in Armenia through design and enforcement of new mandatory EE building codes	Emissions reduction assessment was done based on the projected natural gas savings resulted from the EE retrofits.	By 2030 the annual natural gas savings are expected to be 186.5 GWh and annual emission reductions are expected to be 54.16 Gg of CO_2 eq.
Energy efficiency lighting in residential sector	To increase share of EE bulbs from 4% to 20% in 2030	Emissions reduction assessment was done based on the projected energy savings resulted from the increased share of EE bulbs and corresponding reduction of electricity consumption.	By 2030 the annual electricity savings are expected to be 149.3 GWh, and annual emission reductions are expected to be 98.34 Gg of $CO_{2\ eq.}$
Energy efficiency in residential appliances	To reduce energy consumption through the introduction of the EE refrigerators and air conditioners		By 2030 the electricity savings are expected to be 105.1 GWh and annual emission reductions are 69.24 Gg of $CO_{2\ eq.}$

3.3 National potential for climate change mitigation

National GHG emission projections by gases and by sectors for three development scenarios are provided in Tables 3-5 and Table 3-6 correspondingly and in Figure 3-1.

In case of implementation WAM scenario the share of carbon dioxide in total GHG emissions in 2030 will amount to 62.8% (the "Energy" sector is responsible for 91.1%), methane - 32.6%, nitrous oxide - 4.6%.

Table 3.5. Projection of GHG emissions by gases*, Gg

Scenarios/gases	2012	2015	2020	2025	2030
Without measures (WOM)					
CO_2	5,582	6,147.8	9,369.9	10,583	12,755
CH_4	156.8	167.2	199.9	233.0	253.5
N_2O	1.837	1.844	1.875	1.992	2.0
With measures (WM)					
CO_2	5,582	5,810.1	8,719.9	9,636	8,143.9
CH_4	156.8	162.0	174.3	202.4	217.8
N_2O	1.837	1.844	1.854	1.769	1.765
With additional measures (WAM)					
CO_2	5,582	5,732	8,438.9	9,052	7,580.9
CH_4	156.8	160.3	135.6	199.3	187.2
N_2O	1.837	1.844	1.854	1.769	1.765

* without forestry and other land use

In case of WOM scenario total GHG emissions in 2030 will amount to 18,698.5 Gg $CO_{2eq.}$, while in case of WAM scenario – 12,051.0 Gg $CO_{2eq.}$ (47.6% from 1990 level) with "Energy" sector accounting for the prevailing part of 2030 GHG emissions - 75.2% (Table 3-6).

Table 3.6. Projection of GHG emissions by sectors, Gg $CO_{2\ eq.}$

Scenarios/sectors	2012	2015	2020	2025	2030
Without measures					
Energy	6,913	7,615	11,336	13,091	15,393
IPPU*	277.9	320.1	410.2	527.7	678.6
AFOLU**	1,621.5	1,755.6	1,866.9	1,972.9	2,010.2
Waste	632.4	628.5	624.5	621.9	616.7
Total	***9,444.5***	***10,319.2***	***14,237.6***	***16,213.5***	***18,698 .5***
With measures					
Energy	6,913	7,173	10,698	11,627	9,812
IPPU*	277.9	320.1	409.9	519.0	669.9
AFOLU**	1,621.5	1,667.1	1,777.4	1,851.7	1,888.7
Waste	632.4	623.5	584.6	437.1	426.4
Total	***9,444.5***	***9,783.7***	***13,469.9***	***14,434.8***	***12,797***
With additional measures					
Energy	6,913	7,059	10,297	10,977	9,066
IPPU *	277.9	320.1	409.9	519.0	669.9
AFOLU **	1,621.5	1,667.1	1,777.4	1,851.7	1,888.7
Waste	632.4	623.5	584.6	437.1	426.4
Total	***9,444.5***	***9,669.7***	***13,068.9***	***13,784.8***	***12,051***

* without HFC emissions (384.6 $GgCO_{2\ eq.}$ in 2012) and their projection

** without forestry and other land use

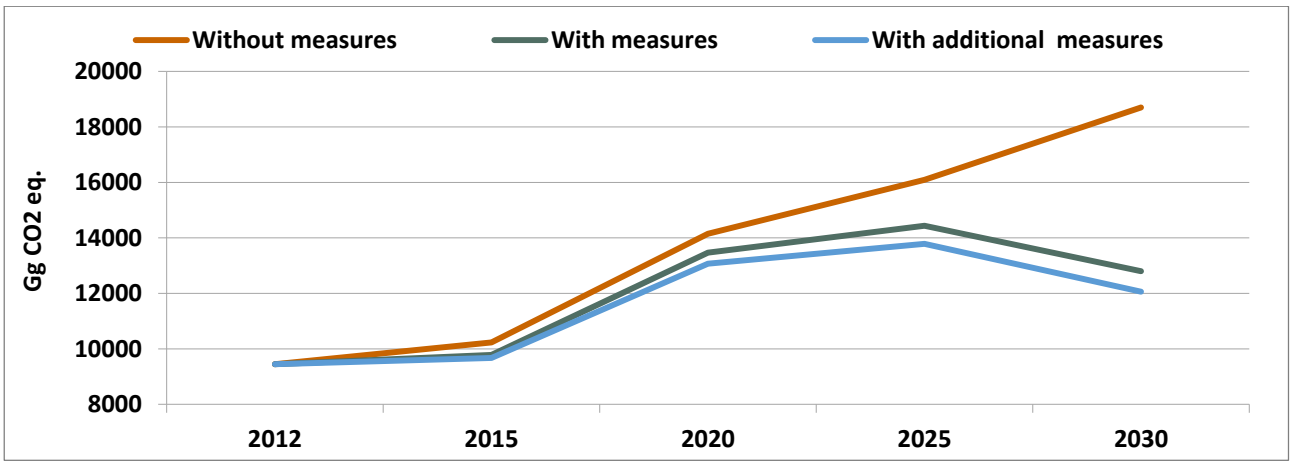

Figure 3.1. Projection of National GHG emissions

The mitigation potential by sectors is provided in Table 3-7. The "Energy" sector will account for the prevailing part (95.2%) of 2030 mitigation potential.

Table 3.7. Mitigation potential by sectors for 2015 – 2030*, Gg $CO_{2\ eq.}$

Sector	2015	2020	2025	2030
Energy	556.0	1,039	2,113.8	6,327
IPPU	0.0	0.3	8.7	8.7
AFOLU *	88.5	89.5	121.2	121.5
Waste	5.0	39.9	184.8	190.3
Total	***649.5***	***1,168.7***	***2,428.7***	***6,647.5***

* without forestry and other land use

Table 3.8. Projection of GHG emission indicators

Indicator	2012	2015	2020	2025	2030
GDP, million USD	10,619.4	11,758	15,509	20,456	23,708
Population, million	3.027	3.01	2.99	2.97	2.95
Without measures					
Emissions per GDP unit, t $CO_{2eq.}$/thousand USD	0.89	0.88	0.92	0.79	0.79
Per capita emissions, t $CO_{2\ eq.}$/person	3.12	3.43	4.76	5.46	6.34
With additional measures					
Emissions per GDP unit, t $CO_{2\ eq.}$/thousand USD	0.89	0.82	0.84	0.67	0.51
Per capita emissions, t $CO_{2\ eq.}$/person	3.12	3.21	4.37	4.64	4.09

Implementation of With additional measures scenario will enable in 2030 to reduce GHG emissions per GDP unit by 43%. The GHG emissions per capita will increase by 31% due to increase of energy consumption.

3.4 Assessment of mitigation potential by sectors

3.4.1 Energy

The "Energy" sector is by far the largest producer of GHG emissions – its share of the total emissions was 70.3% (2012). At the same time, this sector has the greatest mitigation potential.

According to the energy strategy of RA, the future of development of the Armenia energy system is mainly expected to be based upon nuclear energy and modern gas fired thermal plants, development and expansion of economically viable and technically available renewable energy sources and diversification of fuel supply chains and regional cooperation and integration.

This strategy is reflected in the most recently adopted Strategic Papers (2013-2015) and International Agreements which along with the demand side energy efficiency/energy saving and renewable energy projects and studies that can best contribute to Armenia's energy security and economic and environmental development goals has formed the basis of Energy sector development scenarios.

Strategic papers

Energy Security Concept of the RA, 2013

The concept defines the main ways for ensuring energy security and- compensation of the lack of domestic fossil fuel resources of industrial significance for providing affordable and reliable energy supply. The concept identifies 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 Investment Plan identifies renewable energy technologies and projects that can best contribute to Armenia's energy, economic and environmental development goals and outline the activities that must be carried out to realize the projects. Three investment priorities have been identified – geothermal power development; development of Utility-Scale solar PV; development of Geothermal Heat Pump and Solar-Thermal Projects.

As of 2012, the share of renewables (without large HPPs) in power generation mix was 6.4[6] percent. The Government's target is for such generation to represent 21 percent of total generation by 2020, and 26 percent by 2025.[7]

Long-term Development Strategy Program of RA for 2014-2025, 2014

The program provides a strategic coordinated framework of the Government policy formation for the long-term vision of the country's development, given the current conditions and global development challenges.

The programme provides 2014-2025 GDP growth projections with annual average growth rate in range of 5.5% - 6.5% .

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.

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 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.

[6] "Settlement Center" CJSC of the RA MENR

[7] Scaling Up Renewable Energy Program (SREP), Investment Plan for Armenia, 2014

Second National Energy Efficiency Action Plan (as of 2015 is under discussion)

The 2nd NEEAP is considered to be a key document in setting up the energy saving targets and measures that should be implemented to reach these targets for period of 2015-17 with the baseline data of 2012.

International agreements

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

Intergovernmental agreement between RA and Russian Federation - on lending for Armenian Nuclear Power Plant (ANPP) life-extension (up to 2026) related work, 2015.

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

Studies

- Wind Energy in Armenia - Study on Potential and Development Opportunities, USAID, 2010.
- Renewable Energy Roadmap, R2E2 Fund, 2011.
- Small Hydro Power (SHPP) Sector Framework, Status, Development Barriers and Future Development, USAID, 2012.
- Study on Hydropower input evaluation - Loriberd HPP and Shnokh HPP, USAID, 2013.
- Armenia Least Cost Energy Development Plan, USAID, 2015.
- Armenia -Low Carbon Economic Growth Opportunities in Developing Countries, WB, 2015

The following Scenarios were considered for Energy sector:

Scenario 1 (*without measures)* was considered to assess the GHG emissions growth risks in the case of a delay of the new nuclear plant's construction. Construction of new Renewables is also not provided. All the growing demand including fulfilment of the contractual obligations under 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 only on generation side) implies development of the energy system according to above mentioned strategic papers, i.e. construction of new 1028 MW Nuclear Power Plant, new Renewables - small and medium HPPs, wind and geothermal power plants, solar PVs (Table 3.1). The scenario was considered for assessing GHG emissions reduction potential due to changes in power generation structure only. Demand side mitigation actions were not provided.

Scenario 3 (with measures) provides for demand side mitigation measures while the generation side remains unchanged (similar to Scenario 2). Scenario 3 includes mitigation measures provided in Tables 3.1 and 3.3.

Scenario 4 (with additional measures) provides for the implementation of additional mitigation measures on both the generation and demand side and along with measures provided in Tables 3.1 and 3.3 includes additional measures provided in Tables 3.2 and 3.4. On generation side further development and expansion of economically viable and technically available renewable energy sources was considered.

Mitigation assessment was done using LEAP v.2014.0.1.19 (Long Range Energy Alternatives Planning System) software. The LEAP was used to assess individual measures, which then were combined in different combinations and permutations into alternative integrated With Measures (Scenario 3)

and With Additional Measures (Scenario 4) 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.

Table 3.9. Projection of power generation, domestic consumption and export, GWh

Scenarios	Consumption	2012	2015	2020	2025	2030
Scenario 1	Generation, including:	7,640	7,854	13,551	15,270	16,037
	Domestic consumption	6,440	6,654	7,551	8,370	9,137
	Export	1,200	1,200	6,000	6,900	6,900
Scenario 3	Generation, including:	7,640	7,480	13,163	14,841	15,607
	Domestic consumption	6,440	6,280	7,163	7,941	8,707
	Export	1,200	1,200	6,000	6,900	6,900
Scenario 4	Generation, including:	7,640	7,392	12,857	14,447	15,114
	Domestic consumption	6,440	6,192	6,857	7,547	8,214
	Export	1,200	1,200	6,000	6,900	6,900

The implementation of demand side mitigation measures considered under Scenario 3 and Scenario 4 will result in reduction of domestic consumption and in decrease in power generation for 2015-2030 (Table 3.9).

Projections of GHG emissions in "Energy" sector are provided in Tables 3.10 and 3.11 and in Figure 3.2.

Table 3.10. GHG emissions projection in "Energy" sector by scenarios, Gg $CO_{2\ eq}$.

Scenario/Category	2012	2015	2020	2025	2030
Scenario 1 (without measures)					
Electricity generation	1,618	1,705	3,976	4,699	5,896
Manufacturing Industry/Construction	622	701	820	929	1,031
Transport	1,292	1,515	1,870	2,209	2,535
Residential	1,138	1,227	1,365	1,496	1,624
Commercial/institutional	297	334	392	444	492
Agriculture	441	468	506	539	568
Fugitive emissions from natural gas transmission, storage and distribution	1,506	1,665	2,406	2,775	3,246
Total	***6,913***	***7,615***	***11,336***	***13,091***	***15,393***
Scenario 2 (mitigation on generation side only)					
Electricity generation	1,618	1,684	3,884	3,966	1,815
Manufacturing Industry/Construction	622	701	820	929	1,031
Transport	1,292	1,515	1,870	2,209	2,535
Residential	1,138	1,227	1,365	1,496	1,624
Commercial/institutional	297	334	392	444	492
Agriculture	441	468	506	539	568
Fugitive emissions from natural gas transmission, storage and distribution	1,506	1,660	2,384	2,605	2,305
Total	***6,913***	***7,589***	***11,221***	***12,187***	***10,369***
Scenario 3 (with measures)					
Electricity generation	1,618	1,484	3,708	3,771	1,621
Manufacturing Industry/Construction	622	699	819	928	1,029
Transport	1,292	1,481	1,756	2,095	2,421
Residential	1,138	1,192	1,329	1,459	1,587
Commercial/institutional	297	285	334	381	429
Agriculture	441	468	506	539	568
Fugitive emissions from natural gas transmission, storage and distribution	1,506	1,563	2,245	2,454	2,158
Total	***6,913***	***7,173***	***10,698***	***11,627***	***9,812***
Scenario 4 (with additional measures)					
Electricity generation	1,618	1,438	3,566	3,435	1,199
Manufacturing Industry/Construction	622	686	766	875	977
Transport	1,292	1,480	1,754	2,093	2,419
Residential	1,138	1,185	1,293	1,422	1,548
Commercial/institutional	297	271	285	331	379
Agriculture	441	468	506	539	568
Fugitive emissions from natural gas transmission, storage and distribution	1,506	1,531	2,127	2,283	1,976
Total	***6,913***	***7,059***	***10,297***	***10,977***	***9,066***

GHG emissions in 2030 under Scenario 2 are lower by 5024 Gg $CO_{2\ eq.}$ than in Scenario 1 (79.5% of total potential) because of changes in power generation structure (sharp increase of thermal power plants generation) as well as due to increase in fugitive emissions under Scenario 1. Transport and

residential sectors remain the main emitters during planning period with total share of about 66.5% from demand sectors emissions in 2030.

Emissions reduction from "Electricity generation" subcategory under Scenario 4 in comparison with Scenario 2 resulted from commissioning of new renewable capacities.

Table 3.11. Projection of GHG emissions in "Energy" sector by gases, Gg

Scenario/GHG	2012	2015	2020	2025	2030
Scenario 1 (without measures)					
CO_2	5,296.5	5,825	8,782	10,147	11,957
CH_4	75.5	84	120	138	161
N_2O	0.1	0.1	0.1	0.2	0.2
Scenario 3 (with measures)					
CO_2	5,296.5	5,487	8,310	9,010	7,474
CH_4	75.5	79	112	122	109
N_2O	0.1	0.1	0.1	0.2	0.2
Scenario 4 (with additional measures)					
CO_2	5,296.5	5,405	8,029	8,533	6,911
CH_4	75.5	77	106	114	100
N_2O	0.1	0.1	0.1	0.2	0.2

Table 3.12 provides the assessment of mitigation potential in "Energy" sector.

Table 3.12. Mitigation potential in "Energy" sector, Gg $CO_{2\ eq.}$

Mitigation measures	2015	2020	2025	2030
Scenario 3 (with measures)				
New nuclear power plant- 1028 MW	0	0	0	**-3,959**
New renewable energy sources, including:	**-25.8**	**-177.0**	**-961.2**	**-1,065**
new medium and small HPPs	-25.8	-153.6	-806.1	-834.9
wind farms	0.0	0.0	0.0	-73.2
geothermal PPs	0.0	0.0	-108.3	-108.3
solar PVs	0.0	-23.4	-46.8	-46.8
Demand side mitigation measures	**-416.7**	**-523.1**	**-560.8**	**-558.0**
Total	***-442.5***	***-700.1***	***-1,522***	***-5,582***
Scenario 4 (with additional measures)				
Renewable energy sources, including:	**0.0**	**-81.5**	**-269.1**	**-269.1**
wind farms	0.0	-73.2	-219.5	-219.5
solar PVs	0.0	0.0	-35.1	-35.1
biogas plants	0.0	-8.3	-14.5	-14.5
Demand side mitigation measures	**-113.5**	**-257.1**	**-322.8**	**-475.4**
Total	***-113.5***	***-338.6***	***-591.9***	***-744.5***

Combined impact of all mitigation measures under Scenario 4 results in eliminating the need for construction of 220 MW new thermal power unit.

Table 3.13. Summary table of GHG emissions by scenarios, Gg $CO_{2\ eq.}$

Scenarios	2000	2005	2010	2012	2015	2020	2025	2030
Scenario 1	4023	5307	5826	6913	7,615	11,336	13,091	15,393
Scenario 2					7,589	11,221	12,187	10,369
Scenario 3					7,173	10,698	11,627	9,812
Scenario 4					7,059	10,297	10,977	9,066

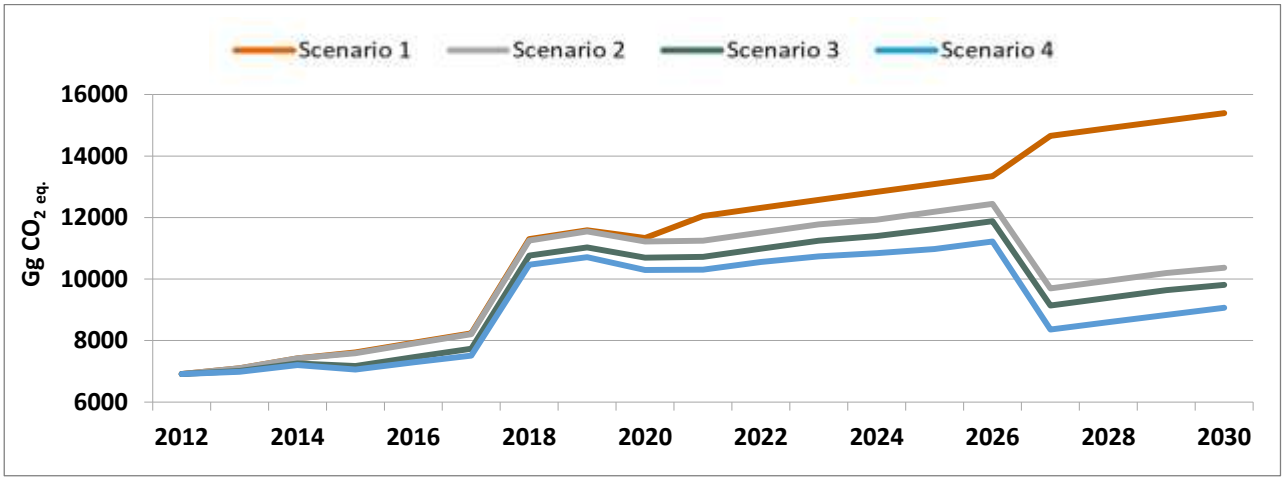

Figure 3.2. Projection of GHG emissions in "Energy" sector

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. In 2018 the differences between Scenarios in relation to the GHG emissions significantly increase. GHG emissions under Scenario 2 in 2025 are lower by 7%, while in 2030 – by 33% from those under Scenario 1 which is only because of changes in power generation structure.

The sharp reduction of GHG emissions in 2027 in Scenarios 2, 3 and 4 (versus Scenario 1) is due to decommissioning of 400 MW nuclear power unit and commissioning of new 1028 MW nuclear power plant, while in Scenario 1 the old 400 MW nuclear power plant is replaced by new thermal power plants.

The GHG emission reduction potential in 2030 in "Energy" sector is provided in Table 3.14.

Table 3.14. GHG emissions reduction potential for 2030

Mitigation measures	GHG emission reduction, Gg $CO_{2eq.}$	Share, %
Construction of new nuclear power plant	-3,959	62.6
Introduction of new renewable energy sources	-1,065	16.9
Implementation of demand side mitigation measures	-558	8.8
Introduction of additional renewable energy sources	-269	4.2
Implementation of additional demand side mitigation measures	-475	7.5
Total	***-6,326***	***100***

Table 3.15 provides projection of energy consumption indicators from the implementation of the mitigation measures.

Table 3.15. Projection of energy consumption indicators for 2012-2030

Indicators	2012	2015	2020	2025	2030
GDP, million USD	10,619.4	11,758	15,509	20,456	23,708
Population, million people	3.027	3.01	2.99	2.97	2.95
Primary energy supply (TPES), thousand toe	3,185	3,275	4,040	4,294	5,125
GDP energy intensity, toe/thousand USD	0.300	0.279	0.260	0.210	0.216
Per capita primary energy consumption, toe/person	1.05	1.09	1.35	1.45	1.74
GHG emissions, thousand t $CO_{2\ eq.}$	6,913	7,059	10,297	10,977	9,066
GHG emission per unit of TPES, ton $CO_{2\ eq.}$ /toe	2.17	2.16	2.55	2.56	1.77

Implementation of mitigation actions will contribute to reduction of GDP energy intensity by 28% (from 0.30 USD to 0.216 toe/ thousand) and increase in primary energy consumption per capita by 65% (from 1.05 to 1.74 toe/person) in 2030. In case of the projected 61% increase in TPES, GHG emissions per unit of TPES (carbon intensity of energy consumption) will drop by 19% which comes to witness the low carbon development trends in Armenia.

3.4.2 Industrial Processes and Product Use

The Cement production (CO_2) and Refrigeration and air conditioning (HFCs) are key sources of GHG emissions in "IPPU" sector in Armenia.

Because of great uncertainties in projections of F-gases growth no mitigation assessment for F-gases was considered.

The cement production growth forecast was done in accordance with construction volumes projections provided in the Long-term Development Strategy Program of RA for 2014-2025. The mitigation will be achieved from the implementation of the technological improvements in the factories:

- Modernization of sleeve filter system ("Araratcement" CJSC)
- Reconstruction of kiln heat exchangers ("Mika Cement" CJSC)
- Reconstruction of two 3.2m x 15m cement mills with full replacement of grinding equipment and installation of separator ("Mika Cement" CJSC).

Projection of CO_2 emissions from cement production for both scenarios is provided in Table 3.16 below.

Table 3.16. GHG emissions projection in IPPU sector (cement production), Gg $CO_{2\ eq.}$

Scenarios	2012	2015	2020	2025	2030
Without measures	227.9	320.1	410.2	527.7	678.6
With measures	227.9	320.1	409.9	519.0	669.9
GHG emissions reduction	0.0	0.0	0.3	8.7	8.7

3.4.3 Agriculture, Forestry and Other Land Use

Agriculture. Projection of GHG emissions from livestock was made according to the 2015-2025 Agriculture Development Strategy of RA and is based on the projected livestock population and livestock composition.

The use of part of manure and bird droppings from poultry farms for biogas production and power generation in biogas power plants was considered as a mitigation measure.

The projections of GHG emissions from manure management for two scenarios are provided in Table 3.17.

Table 3.17. Projection of GHG emissions from manure management, Gg

Scenarios	2012	2015	2020	2025	2030
Without measures					
CH_4	3.86	4.0	4.22	4.34	4.43
N_2O	0.241	0.249	0.28	0.282	0.309
With measures					
CH_4	3.86	4.0	4.19	4.28	4.35
N_2O	0.241	0.249	0.279	0.281	0.306

Forestry

In the period of 1990-1995 extensive logging of forests driven by economic and energy crisis led to significant reduction of carbon dioxide removals by forests. CO_2 removals in 1990 totalled to 905 Gg, while in 2000 - to 601 Gg (reduced by 34%).

Since 2000 there have been positive trends in Armenia's forestry. A number of programme documents, secondary legislation and regulatory norms have been developed aiming at sustainable development of forest sector, measures aimed at reduction of illegal forest logging were taken. In 2006-2012 forest rehabilitation and afforestation measures have been implemented on 2,754.2 ha aiming at both increasing the area of forests and increasing forest productivity. These measures contributed to increasing CO_2 removals up to 631 (without losses) in 2012. However considering increased volumes of firewood and commercial felling in recent years as well as because of forest clearing activities in "Sevan" National Park lakeside forest covered areas and operation of "Teghut" mine, carbon dioxide removals decreased and in 2012 were by 5.6% lower compared with those in 2010.

GHG projections/removals in Forestry are assessed based on the measures envisaged by the Forest Management Plans and RA National Forest Programme (2005) - forest protection, reforestation and afforestation, as well as taking into account the volume of timber to be removed which were assessed according to the volumes envisaged by 10-year management plans. According to the afforestation plans and projections made by "Armforest" SNCO mitigation actions in forestry until 2030 includes:

- Rehabilitation of degraded forest ecosystems, afforestation of forest lands: in 2015 - 1983 ha, in 2020 -947 ha, in 2025 - 3750 ha and in 2030 - 3750 ha.
- Implementation of forest protection measures - use a control measures for preventing mass pest outbreak in forests on the territory of 15.0 thousand ha.
- Reduction of forest wildfire risks by preventive measures on 30-35 ha annually.
- Prevention of illegal forest logging and ensuring compliance to the permitted annual volumes of forest harvesting.

The projections for both scenarios are provided in Table 3.18.

Table 3.18. CO_2 removals and projections in Forestry up to 2030, Gg

Scenarios	1990	2010	2012	2015	2020	2025	2030	2030, %	
								1990 level	2012 level
Without mitigation	-905	-560	-522	-522	-490	-468	-446	49%	85%
With mitigation				-580	-590	-594	-602	66%	114%

Source: Forest management plans, http://hayantar.am, http://forest-monitoring.am, http://www.mnp.am, RA National Forest Development Policy and Strategy (2004.), RA National Forest Programme (2005).

3.4.4 Waste

Emissions from "Waste" sector accounts for 6.7% of total GHG emissions of which 77% is the share of solid waste (SW) and 23% of wastewater.

Mitigation assessment was done for SW in accordance to the Strategic Programme for Improving Solid Waste Management System in Armenia.

A new regional solid waste disposal site with landfill gas capturing system in the city of Hrazdan of Kotayk marz will be constructed to serve 7 municipalities of Kotayk region and Sevan city. In the same time the existing dumpsites in these 5 cities and towns will be conserved.

The European Bank for Reconstruction and Development (EBRD) is providing a loan to finance the construction of a solid waste landfill in Yerevan city that complies with EU regulations. The landfill gas capture and utilization is planned under the programme.

The existing city landfill of Nubarashen will be conserved, its surface will be covered with protection layer, however the CDM project on gas collection and flaring will continue to operate on old landfill. The projections of GHG emissions in "Waste" sector are provided in Table 3.19.

Table 3.19. Projections of GHG emissions in "Waste" sector, Gg $CO_{2\ eq.}$

Scenarios	2012	2015	2020	2025	2030
Without measures					
Solid Waste Disposal	453.6	450.87	447.9	445.2	441.0
Incineration and open burning	35.26	35.26	35.26	35.26	35.26
Wastewater	143.74	142.49	142.07	141.55	140.19
Total	***632.6***	***628.6***	***624.6***	***622***	***616.5***
With measures					
Solid Waste Disposal	453.6	445.83	442.47	296.1	296.1
Incineration and open burning	35.26	35.26	0	0	0
Wastewater	143.74	142.49	142.07	141.03	130.28
Total	***632.6***	***623.6***	***584.5***	***437.1***	***426.4***

CHAPTER 4. INFORMATION ON SUPPORT RECEIVED AND NEEDS

4.1 Support received

Various international donor organizations provide support for implementation of climate change activities. At present this process in not properly coordinated that causes difficulties in collection, analysis and database creation on climate change finance in the country.

Table 4-1 provides information on the support received from bilateral and multilateral sources since 2011 (including funding, technology transfer, capacity building, and technical assistance) with particular emphases to mitigation measures.

Table 4.1. Support received

Year	Project	Donor/ Implementing Agency	Type of support				Project objective
			Financial resources	Capacity building	Technical support	Techno-logy transfer	
2010-2014	Construction of Small HPPs	EBRD, IFC (Sustainable Energy Finance Project), WB and KfW Bank (through German -Armenian Renewable Energy Fund Project)	On-lending through Armenian commercial banks				Promotion of renewable energy development through the involvement of private sector
2010-2016	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 in energy efficiency and renewable energy.
2010-2017	Caucasus Sustainable Energy Finance Facility (branded as "Energocredit")	EBRD, EU, EBRD Special Shareholder Fund, Austrian Ministry of Finance.	Loan from EBRD, USD 28M and Grant from EU Neighbourhood Investment Facility (NIF) and the EBRD Shareholder's Special Fund	X	X		Provision of financing to local participating financial institutions in lending for energy efficiency and renewable energy in residential and private sector investments.
2011-2015	Third National Communication under UNFCCC	GEF-UNDP	Grant USD 500,000	X	X		The development of the Third National Communication of the Republic of Armenia on Climate Change.
2011-2014	Small Grants Programmee	GEF-UNDP	Grant USD 300,000		X	X	Promote the demonstration, development and transfer of low carbon technologies at the community level.

2011	Renewable Energy Road Map for Armenia	GEF-WB	Grant	X	X		Identify the economically and financially viable potential and targets of renewable energy as well as outline specific steps towards achieving those targets.
2011- 2015	Clean Energy and Water Program	USAID	Grant USD 76,000 (the mitigation component)	X	X		Increase energy efficiency in rural areas through introducing EE and RE solutions.
2011	National Energy Balance	USAID	Grant USD 500,000	X	X		Support in development of national energy balance according to IEA and Eurostat requirements for years 2010-2012.
2012-2016	Energy Efficiency Project	GEF-WB	Grant USD 1.82M Co-financing from Government of Armenia through R2E2 Fund	X		X	Decrease greenhouse gas emissions through the removal of barriers to the implementation of energy efficiency investments in the public sector.
2012	Support to Development of Energy Efficiency Lending Product	Green for Growth Fund	Loan USD 15.354M (on-lending through Armenian commercial banks)			X	Create credit lines for EE loans for households and private sector.
2012 - 2015	Low Emission Development Strategy/ Armenia Least- Cost Energy Development Plan	USAID	Grant USD 400,000	X	X		Support in elaboration of new energy strategy of Armenia with ultimate objective to ensure the energy security strategy.

2012	Study on Improving Energy Efficiency in Residential Buildings	EBRD	Grant € 90,000	X			Review and analyze the legal, regulatory, institutional, technical and operational framework of urban housing stock in Armenia for implementation of EE improvements.
2013- 2017	Residential Energy Efficiency for Low-Income Households (REELIH) program	USAID-Habitat for Humanity	Grant USD 230,576		X	X	Residential energy efficiency upgrades for low-income households.
2013 - 2017	Green Urban Lighting	GEF- UNDP	Grant USD 1.6M Co-financing from the Municipality of Yerevan	X	X	X	Increase energy efficiency of municipal lighting via implementation of pilots and elaboration of financial and institutional mechanisms.
2013	Irrigation System Enhancement Project	WB	Loan USD 33.1M		X	X	Reduce energy used and to improve irrigation conveyance efficiency in targeted irrigation schemes.
2013	BSBEEP-Black Sea Buildings Energy Efficiency Plan Project	European Neighbourhood and Partnership Instrument (ENPI)	Grant USD 123,000	X			Support to cross border partner-ship 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)	EC-Clima East	Grant €17.71 M (The budget is not separated for each participating country)	X			The project consists of two components: the first, with a budget of EUR 11 million and implemented by UNDP, consists of a number of activities that support the development of ecosystems-based approaches to climate change; the second is a component that seeks to foster improved climate change policies, strategies and market mechanisms
2013	Feasibility Study on Improving and Developing Water Supply and Sanitation Systems in Rural Communities of Armenia	KfW Bank	Grant USD 486,850		X		Assistance for sustainable development of infrastructures in Armenian small municipalities.
2014 - 2018	Access to Renewable Energy and Energy Efficiency in Municipalities of Vayk and of Spitak	EC-Habitat for Humanity	Grant €1.7M			X	Support Spitak and Vayk municipalities by developing and testing a replicable and efficient model(s) of energy savings through use of efficient measures and renewable sources in residential and public buildings, incorporated with their Community Development Plans/Sustainable Energy Action Plans aligned with the Covenant of Mayors requirements.
2014	NAMA - Energy Efficient Public Buildings and Housing in Armenia	UNDP	Grant USD 25,000		X		NAMA document developed and submitted to the UNFCCC NAMA Registry, seeking for investments

2014 - 2015	Mainstreaming Sustainable Land and Forest Management in Dry Mountain Landscapes of North-eastern Armenia	GEF-UNDP	Project Preparation Grant (PPG) USD 63,400		X		Development of full size GEF project on land and forest sustainable management in the north-east Armenia securing continued flow of multiple ecosystem services and ensuring conservation of wildlife habitats.
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)	USD 40M, from which grant USD 14M and soft loan USD 26M		X	X	To identify 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 to realize the projects
2014-2016	Armenia's First Biennial Update Report to the UNFCCC (BUR)	GEF	Grant USD 352,000	X	X		To assist the country in the preparation and submission of its First Biennial Update Report to the Conference of the Parties to the UNFCCC
2014-2018	Social and Energy Efficient Housing Finance Program	French Development Agency (AFD/EU)/ National Mortgage Company of Armenia	€10M credit line and €1.5M grant from EU Neighbourhood Investment Fund (NIF)	X	X		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.

2014 - 2016	Technology Needs Assessment	GEF-UN Environment Programme	Grant USD 120,000	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 Bank	Feasibility Study		X	X	Construction of Kaps reservoir and gravity system.
2014	Feasibility Study of Vedi Reservoir construction	French Development Agency (AFD)	Loan €1.52 M		X		Feasibility study of gravity irrigation for land in Ararat Valley resulted from construction of Vedi reservoir
2014	Preparation of Irrigation System Modernization Project	WB-EBRD	Grant USD 720,000		X		Improvement of irrigation services provision companies' and water users associations' services.

4.2 Needs

In order to fulfil the obligations arising from the Cancun and Durban Conference of Parties (COP) decisions related to the submission of national communications and biennial update reports, further support is needed to continue to develop and consolidate existing technical and institutional capacities and to continue the efforts of integrating climate change into national policies, plans and programs.

Technical and capacity building needs

Activity	Needs
Support to ensure sustainability and quality control of the national GHG inventory process	• Capacity building of national experts on requirements of 2006 IPCC Guidelines and 2006 IPCC Software. • Training of experts on application of international experience and using satellite (GIS) data for reducing uncertainties in assessing emissions/removals in Forestry and Other Land Use. • Inclusion of GHG emissions/removals assessment provisions in forest accounting (inventory) related training programs for local specialists. • Training on development of GHG inventory for wetlands according to the requirements of 2006 IPCC Guidelines.
GHG mitigation analysis	• Various sectors' development plans and programmes are not assessed in terms of their contribution to the climate change mitigation, which hampers identification and analysis of mitigation impact. • Continue training of local experts on using LEAP software for conducting analyses of energy system. • Targeted studies on integrated social cost-benefit analysis of mitigation measures. • Capacity building on learning the requirements of new carbon financing mechanisms and understanding the different reporting requirements of donors for developing project proposals and financial reporting.
Setting up the domestic MRV	• Capacity building on setting up the domestic MRV framework including assistance on identification of needs for establishing appropriate national legal/formal arrangements and the system for collection and management of relevant data.

Funding needs

Activity	Needs
National Communications and Biennial Update Reports	• To fulfil the obligations related to reporting further financial assistance is needed since the available national capacities are not sufficient for making analytical work and assessments in compliance with IPCC Guidelines thus there is a need for involving independent experts for: – GHG Inventory development; – Simulation of various development scenarios and impact assessment; – for assessing financial needs for developing mitigation and adaptation action plans and their implementation; – for implementation of forest accounting (inventory).
Mitigation Actions	• For creation of financial mechanisms to implement climate change mitigation and adaptation projects financed from civil revolving investment fund which should be regularly replenished though environmental fees, ecosystem services including fees for using climatic resources (Carbon taxing).

Technology transfer needs

Activity	Needs
Assessment of technology transfer needs	Establishment of an institutional framework that aids at creation of enabling environment for preparation of the TNA, information dissemination and cooperation with Climate Technology Center and Network (CTCN), identification of barriers for technology transfer.

CHAPTER 5. MEASUREMENT, REPORTING AND VERIFICATION SYSTEM

Measurement, reporting and verification system (MRV) is an essential tool for tracking the country's progress in moving to a low-emission development path and in achieving sustainable development goals. The MRV is considered as important tool which enables to plan and manage mitigation actions and to track their implementation as well as to analyse their impact and effectiveness.

There is a consent that MRV system must be established before 2020 prior to the commitment period for GHG emissions limitation starts.

Proposed pathway for establishing MRV system in Armenia is provided below and includes legal/formal arrangements and methodological issues.

5.1 Recommendations for establishing MRV system

Legal/formal arrangements

National GHG Inventory is the main (Measurement) component of MRV system at the national level since planning of national mitigation actions and their impact assessment is based on the GHG Inventory data. The current institutional arrangements and process of developing the GHG Inventory is described in Chapter 2.

Based on the decisions adopted at COP 16 and 17, non-Annex I Parties now need to measure the specific effects of national mitigation actions as well as the support needed and received, and to provide this information, including a national inventory report, as part of their BURs. Thus is considered that introduction of that system in Armenia should be implemented gradually, taking into account the national circumstances and national priorities and must built on existing domestic systems and capacities as well as considering the international best practices. It implies institutional improvements aimed at coordination of all activities for development of national communications and biennial reports and will define the responsibilities of the authorized body, for:

- ***Development of national GHG inventories***

At present, GHG inventories development is considered within the frames of five-year plan on implementation of requirements and provisions of the UNFCCC approved by the RA Government decision conditioned by available international funding. According to this plan the Ministry of Nature Protection is coordinating the development of national GHG inventories in cooperation with the other ministries and agencies. However, the institutional responsibilities of the other structures involved in the development of GHG Inventory, including those for providing information are not clarified and the arrangements for developing GHG Inventory on a continuous basis are not provided as well.

- ***Measurement and reporting on mitigation policies, activities/projects***

To ensure relevance and consistency of information on mitigation actions, including data on amounts of funding, progress of implementation and outcomes achieved it will be necessary to develop a corresponding templates differentiated by nature of mitigation action to facilitate monitoring and data collection processes. All institutions involved in implementation of mitigation actions including state agencies, regional and local governments should be tasked to provide information on progress of implemented activities. An international donor organizations should be recommended to provide information on planned and ongoing mitigation actions as well.

Verification will be carried out by Interagency Coordinating Council on Climate Change established by RA Prime Minister's decree on implementation of requirements and provisions of the UNFCCC .

Biennial reports are approved by the same procedure.

Methodological issues

GHG Inventory improvements are split into three groups in terms of target areas, including:

- Application of higher Tier Methodology for Key Sources;
- Ensuring completeness and accuracy of the activity data. To this aim a standard forms for activity data collection should be developed according to IPCC sectors with identification of institutions/organizations having such data at their disposal;
- Consideration of new subcategories.

GHG Inventory further improvements by sectors in details are presented in Chapter 2.

Project-level mitigation impact assessment

The existing experience on approaches/methodologies that can be applied for assessment of relevant mitigation projects is provided below.

The methodology developed for CDM projects is quite applicable to project level MRV. Armenia has a certain experience in this area due to six registered CDM projects. Moreover, grid emission factor for RA energy system was developed in the frames of the Third National Communication applying the approved CDM methodology and officially was approved as a standardized baseline (SB) on January 8, 2015 by CDM Executive Board[8]. It is published on the websites of the UNFCCC Secretariat and the RA Ministry of Nature Protection and is valid for 3 years from the date of approval. The SB is applied for assessing GHG emissions reduction from renewable energy and energy saving projects and ensures comparability and credibility of mitigation projects.

Ongoing projects funded by GEF and Climate Investment Fund apply appropriate GHG reduction assessment methodologies. This experience can be applied to the similar projects.

The methodology for conducting energy audit in residential and public building and RA national standards for buildings energy certificates (passports) are developed under UNDP-GEF project enabling measurement and reporting for buildings' EE projects.

The national standard on methodology for conducting energy audit of public lighting systems is under development. This standard will regulate the procedure and scope of energy audit of street lighting systems and in-door lighting in public buildings. This system currently undergoes testing within a pilot project.

Currently the Energy Efficiency Project is under implementation by R2E2 Fund of Armenia which applies energy performance contracts (EPC) based on measurement and reporting of energy savings resulted from implemented EE measures.

The application of MRV system for assessing 2015-2020 progress of commitments of signatory cities of Armenia under the EU "Covenant of Mayors" could be considered as piloting period for establishing MRV system for cities after 2020. In this regard, the guidelines of EU "Covenant of Mayors" for GHG emissions reduction tracking can be assessed and adapted for cities in Armenia while showing flexibility for those that have not accorded to the Covenant.

The first NAMA Project Document "Energy Efficient Public Buildings and Housing in Armenia" was developed and submitted to the UNFCCC NAMA register in 2014 seeking international support. The Project Document provides detailed description of MRV implementation methodology.

Preliminary approaches have been developed for assessing and monitoring organic carbon stock in soil and aboveground biomass, particularly in mountain forests and meadows within the frames of "Sustainable Management of Pastures and Forests in Armenia to Demonstrate Climate Change Mitigation and Adaptation Benefits and Dividends for Local Communities" EU-UNDP ClimaEast pilot project.

[8] https://cdm.unfccc.int

ANNEX

SUMMARY REPORT OF NATIONAL GREENHOUSE GAS INVENTORY FOR 2012

	Emissions (Gg)			Emissions $CO_{2\ eq.}$ (Gg)				Emissions (Gg)				
Categories	**Net CO_2**	**CH_4**	**N_2O**	**HFCs**	**PFCs**	**SF_6**	**Other halogenated gases with $CO_{2\ eq.}$ conversion factors**	**Other halogenated gases without $CO_{2\ eq.}$ conversion factors**	**NOx**	**CO**	**NMVOCs**	**SO_2**
Total national emissions and removals	**5,059.659**	**156.820**	**1.837**	**384.58**	**NA, NO**	**NA, NO**	**NA, NO**	**NA, NO**	**19.737**	**46.154**	**17.106**	**36.632**
1 – Energy	**5,296.501**	**75.484**	**0.100**	**NA**	**NA**	**NA**	**NA**	**NA**	**19.737**	**46.154**	**7.623**	**0.212**
1.A - Fuel Combustion Activities	5,295.567	3.771	0.100	NA	NA	NA	NA	NA	19.737	46.154	7.623	0.212
1.A.1 - Energy Industries	1,616.277	0.028	0.003	NA	NA	NA	NA	NA	4.306	0.574	0.144	NE
1.A.2 - Manufacturing Industries and Construction	620.143	0.011	0.001						1.342	0.267	0.045	NE
1.A.3 - Transport	1,241.732	1.473	0.063						12.293	43.971	7.281	0.058
1.A.4 - Other Sectors	1,817.414	2.259	0.033						1.796	1.342	0.153	0.154
1.A.5 - Not-specified	NO	NO	NO						NO	NO	NO	NO
1.B - Fugitive emissions from fuels	0.934	71.713	NA						NA	NA	NA	NA
1.B.1 - Solid Fuels	NO	NO	NO						NO	NO	NO	NO
1.B.2 - Oil and Natural Gas	0.934	71.7127	NA						NA	NA	NA	NA

1.B.3 - Other emissions from Energy Production	NO	NO	NO						NO	NO	NO	NO
1.C - Carbon dioxide Transport and Storage	NO								NO	NO	NO	NO
1.C.1 - Transportation of CO_2	NO								NO	NO	NO	NO
1.C.2 - Injection and Storage	NO								NO	NO	NO	NO
1.C.3 – Other	NO								NO	NO	NO	NO
2 - Industrial Processes and Product Use	**277.900**	**NA, NO**	**NA, NO**	**384.577**	**NA, NO**	**NA, NO**	**NA, NO**	**NA, NO**	**NA, NO**	**NA, NO**	9.483	36.42
2.A - Mineral Industry	277.900								NO	NO	NO	NE,NO
2.A.1 - Cement Production	277.900								NA	NA	NA	NA
2.A.2 - Lime Production	NO								NO	NO	NO	NO
2.A.3 - Glass Production	NE								NE	NE	NE	NE
2.A.4 - Other Processes Using Carbonates	NO								NO	NO	NO	NO
2.A.5 - Other (please specify)	NO	NO	NO						NO	NO	NO	NO
2.B - Chemical industries	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.B.1 - Ammonium Production	NO								NO	NO	NO	NO
2.B.2 - Nitric acid Production			NO						NO	NO	NO	NO

2.B.3 - Adipic acid production			NO						NO	NO	NO	NO
2.B.4 - Caprolactam, Glyoxal and Glyoxylic Acid Production			NO						NO	NO	NO	NO
2.B.5 - Carbide Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.B.6 - Titanium dioxide Production	NO								NO	NO	NO	NO
2.B.7 – Calciumized Soda Production	NO								NO	NO	NO	NO
2.B.8 - Petrochemical and Carbon Ash Production	NO	NO							NO	NO	NO	NO
2.B.9 – Fluorochemical Production												
2.B.10 - Other(please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C - Metal industries	NA,NO	NA,NO		NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	36.42
2.C.1 - Iron and Steel Production	NO	NO							NO	NO	NO	NO
2.C.2 - Ferroalloys Production	NA	NA							NA	NA	NA	7.29
2.C.3 - Aluminium Production	NO				NO			NO	NO	NO	NO	NO
2.C.4 - Magnesium Production	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 (please specify)	NO								NO	NO	NO	NO

2.D - Non-Energy Products from Fuels and Solvent Use	NA,NE	NA	NA						NO	NO	8.651	NA
2.D.1 - Lubricant Use	NE								NE	NE	NE	NE
2.D.2 - Paraffin Wax Use	NO								NO	NO	NO	NO
2.D.3 - Solvent Use	NA	NA	NA						NA	NA	3.026	NA
2.D.4 - Other (please specify)	NA	NA	NA						NA	NA	5.625	NA
2.D.4 a– Paint Use	NA	NA	NA						NA	NA	3.325	NA
2.D.b - Bitumen Use	NA	NA	NA						NA	NA	2.3	NA
2.E - Electronics industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.E.1 - Integrated Circuit or Semiconductor				NO	NO	NO	NO	NO	NO	NO	NO	NO
2.E.2 - TFT Flat Panel Display					NO	NO	NO	NO	NO	NO	NO	NO
2.E.3 - Photovoltaic					NO	NO	NO	NO	NO	NO	NO	NO
2.E.4 - Heat Transfer Fluid					NO	NO			NO	NO	NO	NO
2.E.5 - Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.F - Product Uses as Substitutes for Ozone Depleting Substances	NA	NA	NA	384.577	NA	NA	NA	NA	NA	NA	NA	NA
2.F.1 – Refrigeration and Air Conditioning				372.671					NA	NA	NA	NA
2.F.2 - Foam Blowing Agents				1.134					NA	NA	NA	NA
2.F.3 - Fire Protection				0.497					NA	NA	NA	NA
2.F.4 - Aerosols				10.274					NA	NA	NA	NA
2.F.5 - Solvents	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

2.F.6 - Other Applications (please specify)									NO	NO	NO	NO
2.G - Other Product Manufacture and Use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.G.1 - Electrical Equipment					NO	NO		NO	NO	NO	NO	NO
2.G.2 - SF6 and PFCs from Other Product Uses					NO	NO		NO	NO	NO	NO	NO
2.G.3 - N2O from Product Uses			NO						NO	NO	NO	NO
2.G.4 - Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.H - Other	NA,NO	NA,NO	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	0.832	NA
2.H.3 - Other (please specify)	NO	NO	NO									
3 - Agriculture, Forestry and Other Land Use	**-521.660**	**54.349**	**1.549**						NA	NA	NA	NA
3.A – Livestock	NO	54.342	0.241						NA	NA	NA	NA
3.A.1 - Enteric Fermentation		50.477							NA	NA	NA	NA
3.A.2 - Manure Management		3.866	0.241						NA	NA	NA	NA
3.B – Land	-522.068	NA	NA, NE						NA	NA	NA	NA
3.B.1 - Forest Lands	-531.401								NA	NA	NA	NA
3.B.2 - Croplands	-7.766								NA	NA	NA	NA

3.B.3 - Grasslands	17.215								NE	NE	NE	NE
3.B.4 - Wetlands	NE		NE						NA	NA	NA	NA
3.B.5 - Settlements	NE								NA	NA	NA	NA
3.B.6 - Other Land	NA								NA	NA	NA	NA
3.C - Aggregate sources and non-CO_2 emissions sources on land	0.408	0.007	1.308						NA	NA	NA	NA
3.C.1 - Emissions from biomass burning		0.007	IE						NO	NO	NO	NO
3.C.2 - Liming	NO								NA	NA	NA	NA
3.C.3 - Urea application	0.408								NA	NA	NA	NA
3.C.4 - Direct N2O Emissions from managed soils			0.744						NA	NA	NA	NA
3.C.5 - Indirect N2O Emissions from manure management			0.38						NA	NA	NA	NA
3.C.6 - Indirect N2O Emissions from manure management			0.184						NO	NO	NO	NO
3.C.7 - Rice cultivation		NO							NO	NO	NO	NO
3.C.8 - Other (please specify)		NO							NO	NO	NO	NO
3.D - Other	NA, NO	NA, NO	NA,NO						NA, NO	NA, NO	NA, NO	NA, NO
3.D.1 - Harvested Wood Products	NO								NO	NO	NO	NO
3.D.2 - Other (please specify)	NO	NO	NO						NO	NO	NO	NO
4 – Waste	**7.326**	**26.987**	**0.188**	**NA**	**NA,**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
4.A - Solid Waste Disposal	NA	21.579	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

4.B - Biological Treatment of Solid Waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4.C - Incineration and Open Burning of Waste	7.326	1.055	0.019	NA	NA	NA	NA	NA	NA	NA	NA	NA
4.D - Wastewater Treatment and Discharge	NA	4.353	0.169	NA	NA	NA	NA	NA	NA	NA	NA	NA
4.E - Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5 – Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5.A - Indirect N2O Emissions from the atmospheric deposition of nitrogen in NOx and NH3	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5.B - Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo Items (5)												
International Bunkers	127.617	0.001	0.004						0.610	0.203	0.102	0.046
1.A.3.a.i - International Aviation (International Bunkers)	127.617	0.001	0.004						0.610	0.203	0.102	0.046
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	NO	NO	NO	NO	NO

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