Ministry of Environment and Climate Change

Romania's Sixth National Communication on Climate Change and First Biennial Report

December 2013

Introduction

Romania is resolutely working towards fighting climate change and transforming this fight into a component of all major governmental and administrative policies. We are firmly committed, along with our European partners, to do our best towards meeting the highest standards in this respect.

But not only standards and figures are our main target: we are striving to integrate the fight against climate change into the everyday behavior of both companies and citizens. And our main instruments are cooperation and education. Through cooperation with companies and common campaigns and initiatives, we work together to make the industry more conscious and more orientated towards "green" practices. Through ecological education, we try to help young generations to grow up caring for the environment and understand the need to fight against climate change.

Citizens with a developed eco-conscience and an eco-minded business community constitute important parts of the solution, especially in regard to the future. Helping local administration prepare for the effects of climate change and prevent them is also an important, present-day part of our work, which we prioritize and value.

The submission of the 6th National Communication to the Secretariat of UNFCCC flags up the momentum of intense debate about the future overarching approach on climate change.

For this reason and in the view of the forthcoming international commitments to be adopted soon, we envisage as extremely important the Annex I Parties' presentations of the elements required by the United Nation Framework Convention on Climate Change on the inventories, policies and measures and their effects, as well as the projections, all these aiming to reflect the implementation stage towards the ultimate objective of this Convention.

As Member State of the European Union, Romania adopts and implements targets related to the reduction of the GHG emissions and adaptation to climate change in line with the European climate change policy. In this respect our country makes its best to efficiently apply the EU Climate and Energy Package provisions, while consequently taking active part in the current debate over the EU's 2030 Framework for Energy and Climate Policies Energy. In terms of GHG emissions Romania is well on track for reaching its GHG emission reduction target under the Kyoto Protocol.

Nevertheless, in the aftermath of a quinquennium of global and domestic economic downturn, reality strongly asserts the need to consolidate the path towards a sustainable and inclusive economic growth, to enhance the competitiveness and fill the development gap that still lies ahead considering Romania's economic status.

In this prospect, our country will constantly endeavor to develop the pathway towards green growth by focusing its effort, *inter alia,* to the retrofit of its building and energy supply sector, to the development of environmental friendly technologies, to putting forward energy efficiency measures and also further pursuing its renewable energy programs and projects through looking ahead to the various technologies and options in this regard.

As it is mentioned in a specific chapter, our country has been encountering the negative effect of the extreme climate events and the modeling of future climate stresses the strong need to develop efficient strategies on adaptation in sectors like biodiversity, agriculture, water resources, forests, infrastructure, focused on rehabilitation of buildings, energy-efficient constructions, eco-tourism, green energy, industry and transport and health protection.

One of the national priorities in our climate change policy regards the support enhancement for research and innovation in order to provide a good rationale for the policies and measures to be integrated in the development of sectorial strategies.

Last but not least, we acknowledge as a critical priority to strengthen the education, training and public awareness by these means enabling the national institutions to set and facilitate and the citizens to join in the process of adoption and implementation of the national climate change policy in line with the new targets.

Minister of Environment and Climate Change

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Contents

LIST OF ANNEXES

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

AD	Activity data
ANRE	National Electricity and Heat Regulatory Authority
APPR	Association of Private Forest Owners
ARoTT	Romanian Association for Technology Transfer and Innovation
BR	Biennial Report
CAP	Common Agricultural Policy
CCS	Carbon Capture and Storage
CI	Carbon Intensity
CIEM	International Conference Energy and Environment
CMIP	Coupled Model Intercomparison Project
Comecon	Council for Mutual Economic Assistance
CRES	Centre for Renewable Energy Sources and Saving
CRF	Common Reporting Format
CTF	Common Tabular Format
ECA&D	European Climate Programme and Dataset
ECOMET	Economic Interest Grouping of the National Meteorological Services of the European Economic Area
ECVs	Essential Climate Variables
EERP	European Economic Recovery Plan
EF	Emission Factor
ERT	Expert Review Team
ERTMS	European Railway Traffic Management System
EU	European Union
EU-ETS	European Union-Emission Trading Scheme
EUMETNET	European Organisation for the Exploitation of Meteorological Network
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites

FMIMS	National forest monitoring and management system
FP	EU 7th Framework Programmes
GCOS	Global Climate Observing System
GD	Governmental Degree
GDP	Gross Domestic Product
GEO	Government Emergency Ordinance
GeoEcoMar	National Institute of Research and Development on Marine Geology and Ecology
GEOSS	Global Earth Observation System of Systems
Gg	Giga gram
GHG	Greenhouse Gas
GOME	Global Ozone Monitoring Experiment
GOOS	Global Ocean Observing System
GVA	Gross Value Added
HHI	Hirschman – Herfindahl indicator
ICAS	Forest Research and Management Planning Institute
IEE	Intelligent Energy Europe programme
IGBP	International Geosphere-Biosphere Programme
IHDP	International Human Dimensions Project
IPCC	Intergovernmental Panel on Climate Change
IPCC 1996	IPCC Guidelines for National Greenhouse Gas Inventories -1996
IPCC GPG 2000	IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories -2000
IPCC GPG 2003	IPCC Good Practice Guidance for Land Use, Land Use Change and Forestry -2003
IPCC SRES	Special Report on Emission Scenarios of Intergovernmental Panel on Climate Change
ISPE	Institute for Studies and Power Engineering

ITU	Intermodal Transport Units
JPI	Joint Program Initiative
KCA	Key Category Analysis
KP	Kyoto Protocol
LAFO	Local Associations of Forest owners
LULUCF	Land Use, Land Use Change and Forestry
M/A	Mitigation/Adaptation
MAWS	Meteorological Automatic Weather Stations
MECC	Ministry of Environment and Climate Change
MoEO	Ministry of Environment Order
MS	Member States
NAQ	National Authority for Qualifications
NAPCC	National Action Plan for Climate Change
NCCC	National Commission on Climate Change
NDP	National Development Plan 2007-2013
NE	Not Estimated
NEPA	National Environmental Protection Agency
NGHGI	National Greenhouse Gas Inventory
NGO	Non-Governmental Organisation
NIR	National Inventory Report
NIS	National Institute for Statistics
NMA	National Meteorological Administration
NMVOC	Non-Methane Volatile Organic Compounds
NPP	Nuclear power plant
NPS	National Power System
NS	National System for the estimation of anthropogenic emissions by sources and removals by skins of all greenhouse gases not controlled by the Montreal Protocol

NSCC	National Strategy for Climate Change
NTS	National Transmission System
OHL	Overhead Electric Lines
PCF	Prototype Carbon Fund
PMU	Project Management Unit
PNAEE	National Action Plan on Energy Efficiency
PTG	Power Transmission Grid
QA	Quality Assurance
QC	Quality Control
RBCN	Regional Basic Climatological Network
RBSN	Regional Basic Synoptic Network
RCP	Representative Concentration Pathways (concentration scenario for GHG concentrations in future)
SEAP	Sustainable Energy Action Plan
SIMIN	National Meteorological Integrated System
SME	Small and Medium Enterprises
UEDIN	University of Edinburgh
UNFCCC	United Nations Framework Convention on Climate Change
UPB	University "Politehnica"of Bucharest
WAM	with Additional Measures
WCRP	World Climate Research Programme
WEM	with Measures
WEC-RNC	Romanian National Committee of World Energy Council
WMO	World Meteorological Organisation
WOM	without Measures

I. SUMMARY

Romania's Sixth National Communication on Climate Change, updating the progress in addressing climate change, reflects considerable progress since the submission of the Fifth National Communication in 2010.

The key achievements since Romania's Fifth National Communication on Climate Change are the following:

- Improvement the Ministry of Environment and Climate Change (MECC) institutional capacity within the climate change by including National Environmental Protection Agency (NEPA) climate change related structure (personnel, attribution, responsibilities) into the existing structure, in order to increase the efficiency in implementation of activities related to the National System administration;
- Improvement of greenhouse gas (GHG) emissions estimation for several sectors, performed by NEPA, following the studies results which involved new data (activity data and emission factors) , methods and categories;
- Optimization of the data collection from the operators from the Energy Sector (Energy Industries and Manufacturing Industries and Construction) and from the Waste Sector (Solid Waste Disposal on Land and Waste Water Handling) due to the implementation of an integrated informational system;
- Development and implementation of an integrated software application for key category analyses;
- Adoption in 2013 of Romania's National Climate Change Strategy for 2013-2020, as a key driver for sectoral strategies development in order to achieve the GHG emissions reduction and to implement adaptation measures to climate change effects.

  Romania quantified emission reduction target for 2020 includes the reduction of the Emission Trading Scheme (EU ETS) emissions (-21% compared to 2005) and the positive limit established for non-EU ETS sector (+19% compared to 2005), in line with Decision 406/2009/EC.

  The reduction of total GHG emissions at the national level is expected to be achieve as a result of improvement and extending the Emission Trading Scheme involving more stringent emissions caps, as well as energy efficiency enhancement (by 19 % until 2020), increase of energy share from renewable sources in gross final consumption of energy (by 24% until 2020) and promotion of clean an energy efficient road transport.

Romania's Sixth National Communication includes:

- Description of Romania's national circumstances, as context for emissions profile and responses to climate change (Chapter 2);
- The evolution of GHG emissions and the improvement performed for each sector, in terms of data collection and applied methodologies for emissions estimation (Chapter 3);
- Details on the progress on climate change policies and measures, since Romania's Fifth National Communication (Chapter 4);
- Sectoral projections for Romania's GHG emissions (Chapter 5);

- Romania's vulnerability to climate change impacts and adaptation measures for addressing those impacts (Chapter 6);
- Details of progress by research programs and institutions in climate research, systematic observation, and adaptation and mitigation technologies (Chapter 8);
- An overview of efforts to increase knowledge of climate change issues through public awareness-raising education and training activities (Chapter 9).

I.1 NATIONAL CIRCUMSTANCES

Romania is a Republic organized based on the principle of the separation and balance of powers – legislative, executive, and judicial - within the framework of constitutional democracy.

The President of Romania is elected by universal, equal, direct, secret and free suffrage for a term of office of 5 years, not more than two consecutive offices.

The legislative power is represented by the Parliament, the supreme representative body of the Romanian people and the sole legislative authority of the country.

The executive power is represented by the Government. It consists of the Prime Minister, Ministers, and other members as established by an organic law and ensures the implementation of the domestic and foreign policy of the country, and exercise the general management of public administration.

Justice, judicial power, is administered by the High Court of Cassation and Justice, and the other courts of law set up by the law. The High Court of Cassation and Justice provides a unitary interpretation and implementation of the law by the other courts of law, according to its competence.

The responsibility for addressing climate change in Romania is shared between the Romania Government and 42 local government authorities (including Bucharest).

The Ministry of Environment and Climate Change is the lead authority in the Romania Government's responses to climate change.

The Romanian territory is divided into administrative units, such as communes, towns and counties. Romania is divided into 41 counties and one municipality (Bucharest, the capital). The 41 counties are further structured into 2,686 communes (for rural areas) and 265 cities and municipalities (for urban areas). Communes are divided into villages (which have no individual administration and hence not being an administrative division). There are 13,092 villages.

Main cities and towns in Romania account for more than half of the total population, 25 of them have over 100 thousands inhabitants each; this represent in total 54% of the urban population. Among the cities with the largest population, Bucharest ranks first (with 1883.4 thousand inhabitants), followed by Iaşi, Cluj-Napoca, Timişoara, Constanţa and Craiova (each with more than 300 thousand inhabitants). These 6 cities concentrate over 30% of the urban population.

The evolution of Romania's population shows a slight decrease of about 7% between 2005 and 2011:

Table I_ 1 *Evolution of Romania's population 2005-2011*

Year	**1990**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011***
Population (mill. people)	23.211	21.624	21.584	21.538	21.504	21.470	21.431	20.122

*Source: National Institute of Statistics - Romanian Statistical Yearbook – 2012, *Final results of the Population and Dwellings Census*

Romania is situated in the south-eastern part of the Central Europe inside and outside of the Carpathians Arch, on the Danube lower course.

Romania's climate is a transitional temperate-continental one with oceanic influences from the West, Mediterranean modulations from the South-West and excessive continental effects from the North-East.

In the last 112 years, the warmest year was 2007 (with an average temperature of 11.5°C) and the coldest one, 1940 (with an average temperature of 8°C) (Figure I_1). An absolute minimum temperature of - 38.5°C was recorded at Bod in Brasov County and an absolute maximum temperature of 44.5°C at Ion Sion in the Bărăgan Plain.

As for the precipitation, the analysis of the data recorded during the interval 1901-2012 revealed a slightly decrease in the annual amount of precipitation (23.6 mm). The highest annual rainfall amount recorded in Romania was 2401.5 mm in 1941, Omu weather station. The largest monthly amount of rainfall, 588.4 mm was recorded in June 2011 at the Bâlea Lac (Figure I_1).

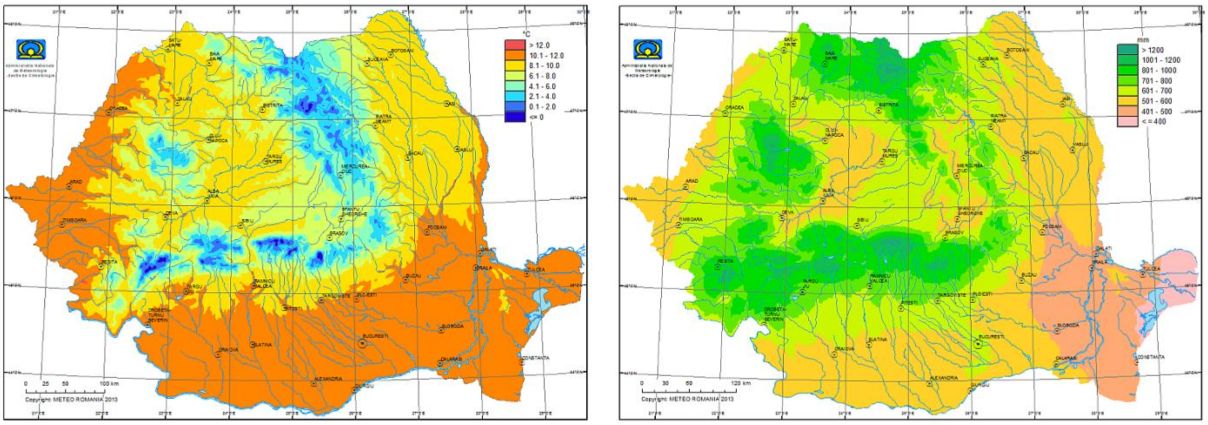


Figure I_ 1 *Multiannual mean of in air temperature (in °C, left panel) and of precipitation amount (in mm, right panel) for the interval 1961-2012*

The economic development of Romania during 2000 – 2012, strongly linked to the worldwide economic development, including the global economic-financial crisis, in terms of GDP, is presented in the following table

***Table I_ 2** Romanian GPD evolution within the 2000 – 2012 period*

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012*
GDP bill. Euro	40.58	45.32	48.64	52.57	61.03	79.75	97.79	124.65	139.76	118.27	124.40	131.36	132.28
GDP bill. Euro 2010	83.45	88.19	92.67	97.52	105.80	110.19	118.87	126.38	135.67	126.03	124.40	127.13	128.02

*Source: National Institute of Statistics – Romanian Statistical Yearbook – collections *Estimation based on real GDP growth rate*

Romania's main export goods are: machinery and equipment, metals and metal products, textiles and footwear, chemicals, agricultural products, minerals and fuels. The exports value rose with about 12% in 2011 against 2010 figures. In the structure of exports the main categories in 2011 included: machinery and transport equipment 41.1%, 17.9% manufactured goods classified mainly by the raw material, 15.3% miscellaneous manufactured articles, 6.2% chemicals and related products, 5.7% mineral fuels, lubricants and related materials and 13.8% other goods.

GHG emissions per unit of GDP are continuing to decrease, due to the technical improvements, applications of different policies and due to the structural change of GDP.

One should mentioned a general decreasing trend for the GHG emissions per capita between 1989 and 2011, followed after year 2010 by a small increase. All trends are presented in the Figure I_2:

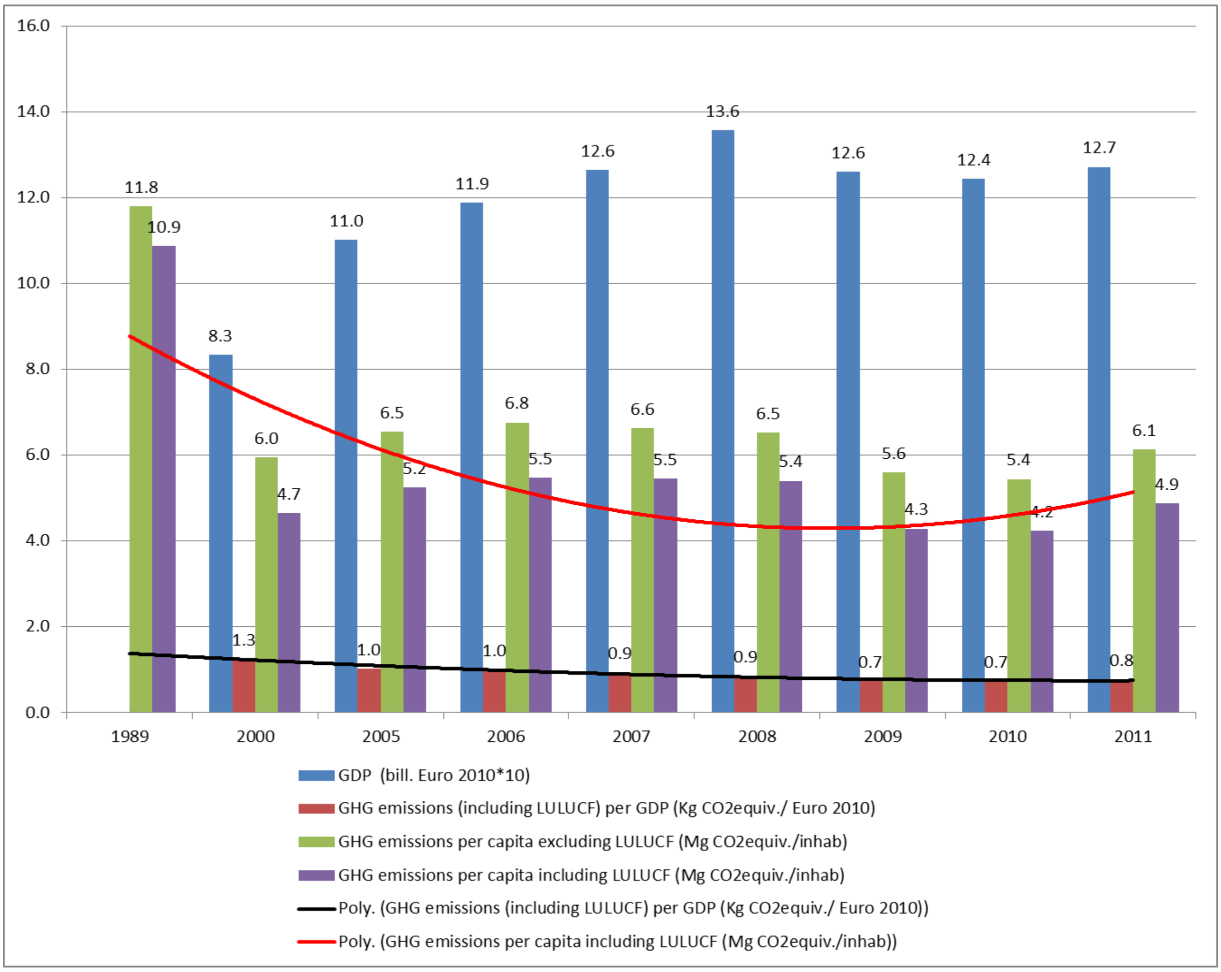


Figure I_ 2 *GHG data and national circumstances*

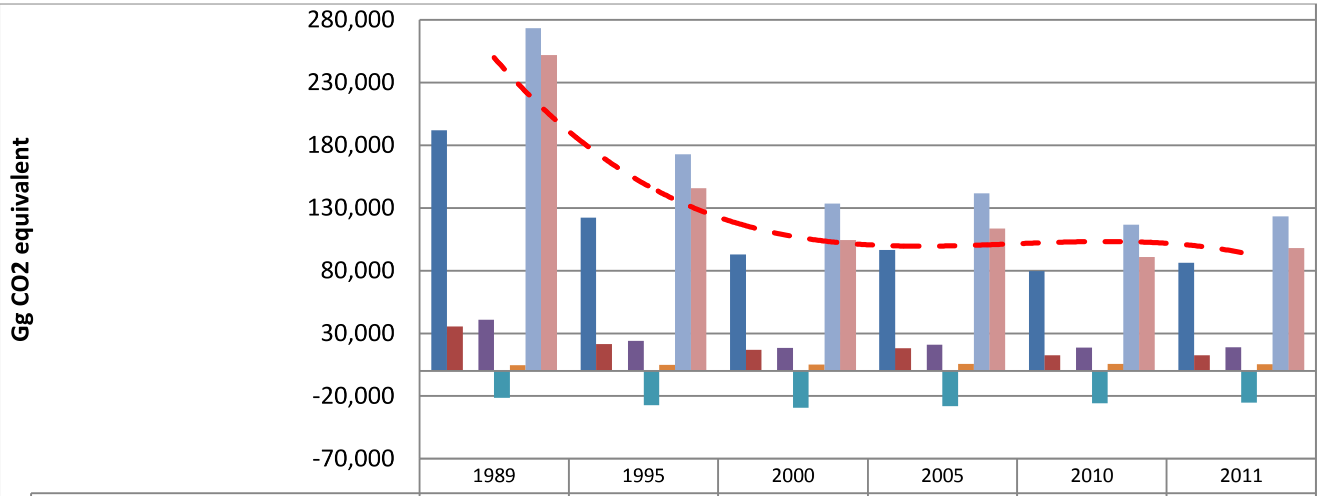
I.2 GREENHOUSE GAS INVENTORY INFORMATION, INCLUDING ON NATIONAL SYSTEM AND NATIONAL REGISTRY

As a Party to the UNFCCC and the Kyoto Protocol, Romania has the obligation to prepare, publish and update greenhouse gas inventories on an annual basis.

In 2011, the Romania's total GHG emissions, excluding removals by sinks, amounted to 123.359,15 Gg CO_2 equivalent. The Energy sector has the biggest share of total GHG emissions (69.97%), followed by the Agriculture sector (15.35%) and Industrial Processes (10.22%). The GHG emissions from the Waste sector and Solvent Use and Other Product Use sector are relatively low (4.35 % respectively 0.10 %).

In 2011, the carbon dioxide had the largest share of Romania's total GHG emissions (excluding the LULUCF sector) (71.30%), followed by methane (18.04%) and nitrous oxide (10.27%).

The emissions trends reflect the changes in this period characterized by a process of transition to a market economy and by financial/economic crisis (Figure I_3).

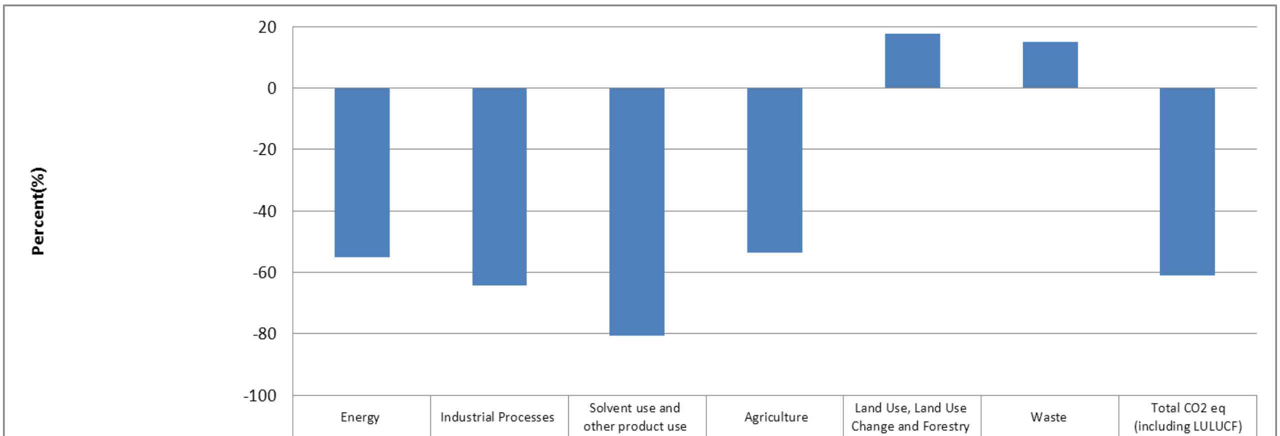


	1989	1995	2000	2005	2010	2011
Energy	191,809.14	122,320.62	92,894.36	96,602.11	79,624.01	86,320.46
Industrial Processes	35,466.12	21,405.55	16,826.43	18,223.69	12,414.25	12,605.14
Solvent use and other product use	645.80	229.40	224.30	269.65	124.74	125.61
Agriculture	40,734.14	24,135.56	18,455.10	20,949.57	18,760.94	18,941.46
Land Use, Land Use Change and Forestry	-21,512.67	-27,192.55	-29,219.59	-28,062.87	-25,830.81	-25,304.94
Waste	4,670.31	4,764.89	5,157.70	5,539.28	5,715.62	5,366.48
Total CO2 eq (excluding LULUCF)	273,325.51	172,856.02	133,557.88	141,584.31	116,639.55	123,359.15
Total CO2 eq (including LULUCF)	251,812.84	145,663.46	104,338.29	113,521.44	90,808.74	98,054.21

***Figure I_ 3** GHG gas source and sink categories*

The trend of GHG emissions between 1989 and 2011 was defined by a substantial decrease of emissions from Solvent use and other product use sector (80.55%) followed by Industrial Processes sector (64.46%) and Energy sector (55%), as well as a clear increase of emissions from Waste sector (14.91%) and LULUCF sector (17.63%).

Emissions in one sector systematically increases since 1989 – waste sector, as a result of increasing the waste production and improving the data management (Figure I_4).



	Energy	Industrial Processes	Solvent use and other product use	Agriculture	Land Use, Land Use Change and Forestry	Waste	Total CO2 eq (including LULUCF)
Change from base to latest reported year	-55.00	-64.46	-80.55	-53.50	17.63	14.91	-61.06

***Figure I_ 4** Change from base (1989) to last reported year (2011)*

Based on Article 5 of the Kyoto Protocol, Romania established a National System (NS) for estimating the anthropogenic emissions for all greenhouse gases not covered by the Montreal Protocol through Government Decision (GD) no. 1570/2007. GD no. 1570/2007 was amended by GD no. 668/2012 and GD no. 48/2013 in order to include changes in European Directives, in particular the replacement of national registers by a single system developed by the European Commission.

Starting with 1 April 2013, Ministry of Environment and Climate Change (MECC) is the competent authority responsible for administrating the National System. MECC is also responsible for the estimation of GHG emissions, through the annual achievement of National Inventory of GHG emissions as well as all aspects related to climate change.

Since the Fifth National Communication, Romania has developed a range of measures in order to improve the national greenhouse gas inventory system, based on more accurate emissions estimates.

These measures, described in Chapter 3, include the collection of new data and methods for emissions estimation implemented as a result of studies performed.

Since migration to the EU register in June 2012, the European Commission is now responsible for supplying, maintaining and securing the national register information system concerning the commitments of European Member States as Parties to the Kyoto Protocol (KP register) and as participants in the EU ETS (EU-ETS Register).

I.3 POLICIES AND MEASURES, INCLUDING THOSE IN ACCORDANCE WITH ARTICLE 2 OF THE KYOTO PROTOCOL AND DOMESTIC AND REGIONAL PROGRAMMES AND/OR LEGISLATIVE ARRANGEMENTS AND ENFORCEMENT AND ADMINISTRATIVE PROCEDURES

The adopted and planned policies and measures took into considerations the GHG emissions of the each sector, theirs potentials of the reductions and the national priorities for economic development. For the attainment of the objectives for the reduction of the GHG emissions up to year 2020 through the applications of EU-ETS and of the objectives defined by Decision no. 406/2009/EC are necessary the substantial contributions of all economic sectors and regulate all sources of GHG emissions.

It is strict necessary to create and to strengthen the institutional structure given in Memorandum "Action Plan for the preparation of Romania for the implementation of the legislative packet Energy-Climate Change" signed by Romanian Government in year 2009.

Adopted policies and measures which established the reduction of GHG emissions are the followings:

- Romania's Energy Strategy for 2007 – 2020 (GD 1069/2007):
    - ✓ Withdrawing from service the generating units whose lifespan has been exceeded and which have become obsolete and the replacement thereof with modern units with superior efficiencies;
    - ✓ Re-engineering 330 MW units operating in lignite-fired power plants;
    - ✓ Promoting high efficiency cogeneration; gas turbines with a heat recovery boiler (GT+HRB) and a combined cycle with gas turbines (CC+GT) of approximately 1000 MW and 600 MW biomass-fired units shall be installed;

- ✓ Continuing the upgrade works of district heating supply systems, respectively the units generating heat fluid, the primary heat fluid (hot water) transmission grid, the heating stations and heating modules, the hot water and heat fluid distribution network;
- ✓ Generating electricity from renewable energy sources.

➢ National Action Plan on Renewable Energy Sources
- ✓ Evolution of electricity generated from renewable energy sources from 23.6 TWh in 2013 up to 31.4 TWh in 2020.

➢ The second National Action Plan on Energy Efficiency (PNAEE) for the 2011 - 2020 period
- ✓ The improvement of the thermal performance of the buildings;
- ✓ The encouragement of the development of the projects for ecologic houses, passive houses and/or active houses;
- ✓ The modernization of the infrastructure for transport and distribution of heat in centralized system;
- ✓ The program for the improvement of efficient energy in the building occupied by the persons with low income;
- ✓ The program for the encouragement of the consumers for the acquisition of the electrical goods with high energy efficiency taking into consideration the stipulation given by the Regulations no 106/2008/EC;
- ✓ The reduction of the water consumption;
- ✓ For the industrial processes sector the retrofitting and the use of new technologies for the efficient processing of raw materials and energy resources.

➢ The Intermodal Transport Strategy in Romania - 2020
- ✓ Using smart transport systems;
- ✓ Reducing road transport;
- ✓ The program for the renewal of the National car park, funded by the Environmental Fund budget;
- ✓ Upgrading railway cargo and passenger transport by procuring high energy efficiency rolling stock;
- ✓ Implementing a tele-management system of electricity and for the compensation of the power factor in electric traction substations;
- ✓ Implementing the level 2 European Railway Traffic Management System (ERTMS);
- ✓ Reducing the electricity consumption afferent to the generation of compressed air required for the operation of fixed subsystems testing train brakes by replacing old, Reșița type compressors, with modern and efficient equipment;
- ✓ Upgrading underground transport by upgrading the electric train park and the public space lighting systems;
- ✓ Using biofuels (meeting the bio-fuel usage share amounting to 10% of the final national consumption by 2020);
- ✓ Reducing the annual resource consumption by 303 ktoe in the 2014 - 2020 period;
- ✓ Promoting "clean passenger cars" and stimulating the manufacturing thereof. In order to encourage the procurement of such passenger vehicles, Emergency Ordinance no. 40/2011 on the promotion of non-polluting and energy-efficient road

transport vehicles, amended by Emergency Ordinance no. 9/2013 on the environmental stamp for the passenger vehicle, stipulates the granting of a new environmental ticket for each electric passenger vehicle;
   - ✓ Encouraging forms of alternative transport (cycling, car-pooling, car-sharing, etc.) through urban planning and the development of an adequate infrastructure for cycling (bicycle tracks, bicycle racks, special bicycle waggons/compartments in the subway and on trains, etc.) and expanding the pedestrian areas, particularly in large urban agglomerations;
   - ✓ Increasing the degree of using public transportation, by optimizing means of public transport (trains, buses, trolley-buses, trams) and the infrastructure required for the proper operation thereof, expanding the underground.
- ➢ The national action plan on the reduction of GHG emissions in civil aviation has the following scopes:
   - ✓ Improving the efficiency of using aviation fuel by at least 2%/year (reducing fuel consumption on average by 1.5% per hour of flight);
- ➢ National Sustainable Development Strategy of Romania – 2013 - 2020 - 2030 Horizon (GD 1460/2008)
   - ✓ Improving the efficiency in the use of nitrate fertilizers, as well as fertilizer storage to reduce CH_4 and N_2O emissions and to contribute to the mitigation of climate change;
   - ✓ Stimulating/encouraging the use of equipment for the treatment of waste waters in farming.
- ➢ National Strategy for the Sustainable Development of Romania 2013 - 2020 - 2030 Horizon (GD 1460/2008).
   - ✓ Reducing the fragmentation degree of agricultural surfaces and stimulating the concentration of small farms;
   - ✓ Increasing the nutritional value of the herbaceous carpet, ensuring the balanced and efficient meal of various categories of animals, particularly cattle and sheep, in order to obtain non-polluted zootechnical products and an adequate state of health for animals.
- ➢ National Program of Afforestation
- ➢ National Rural Development Program 2007-2013, updated in 2012
   - ✓ The improvement of the methods of use of agricultural and forest lands;
   - ✓ Best use of forest resources.
- ➢ Reduce waste landfill, namely:
   - ✓ Prioritization of the efforts in the waste management field in line with the waste hierarchy;
   - ✓ Increasing the recycling rate and improving the quality of recycled materials, working closely with the business sector and establishments and undertakings which recover waste;
   - ✓ Promoting the recovery of packaging waste.
- ➢ Reduce GHG emissions arising from the wastewater treatment are the following:
   - ✓ Increase the degree of connection to the sewerage and waste water services;
   - ✓ Construction and putting into function of new wastewater treatment plants;

- ✓ Rehabilitation and upgrading of the existing wastewater treatment plants;
- ✓ Use of modern technology with a low power consumption;
- ✓ Automating of the wastewater treatment plants operation, with beneficial implications for their optimal functioning, i.e. avoiding methane emission;
- ✓ Collection of waste sludge by geographical areas, their processing by anaerobic fermentation in modern plants, safe for producing biogas.

I.4 PROJECTIONS AND THE TOTAL EFFECTS OF POLICIES AND MEASURES, AND SUPPLEMENTARY RELATING TO KYOTO PROTOCOL MECHANISM

In the figure I_5 are presented the GHG emissions projections for three scenarios (without measures, with measures and with additional measures). From this figure result that Romania attained the target imposed in the Kyoto Protocol for the period 2008-2012.

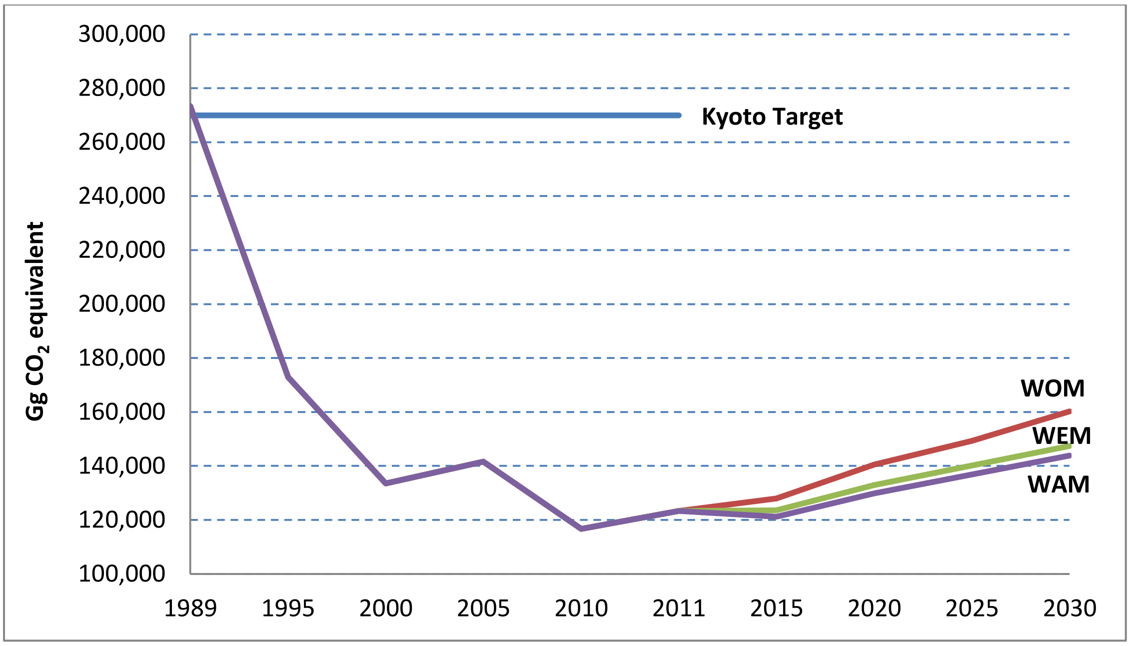


***Figure I_ 5** Evolution of GHG emissions in the period 1989-2030*

I.5 VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES

Scenarios on the future climate change

The climate in Romania is expected to undergo significant changes over the coming decades. In near future term (2011-2040), the most pressing consequences are those related to mean annual increase of temperature up to 1.3 °C in the Eastern and Southern regions of country (e.g. hotter summers with more frequent and persistent heat waves) and to reduction in mean precipitation in Southern part of Romania (up to 10%) under A1B IPCC scenario (Figure I_6).

The scenario-related differences are relatively small for the first decades of the 21st century. Higher differences in climate are expected towards the end of the 21st century. The mean temperature increases are larger for the A2 SRES scenario and smaller for the B1 one. However, even for the moderate emission scenario A1B, the mean temperature increase for Romania is about 3°C to 4 °C for summer months in the interval 2061-2090 compared with the interval 1961-1990.

As for precipitation, climate change signal revealed by CMIP3 data averaged over the Romanian territory indicates, in general, a reduction of mean rainfall in summer months, more pronounced for higher emission scenarios and stronger as we approach the end of the 21st century. A2 and A1B SRES scenarios show reduction in summer months up to 24%, respectively 20% for the interval 2061-2090 compared with the reference interval 1961-1990. In the case of B1 SRES scenario, no significant changes in precipitation are identified in the model results for Romania during the 21st century. Changes in winter precipitation are much smaller for all SRES scenarios and associated uncertainties are higher.

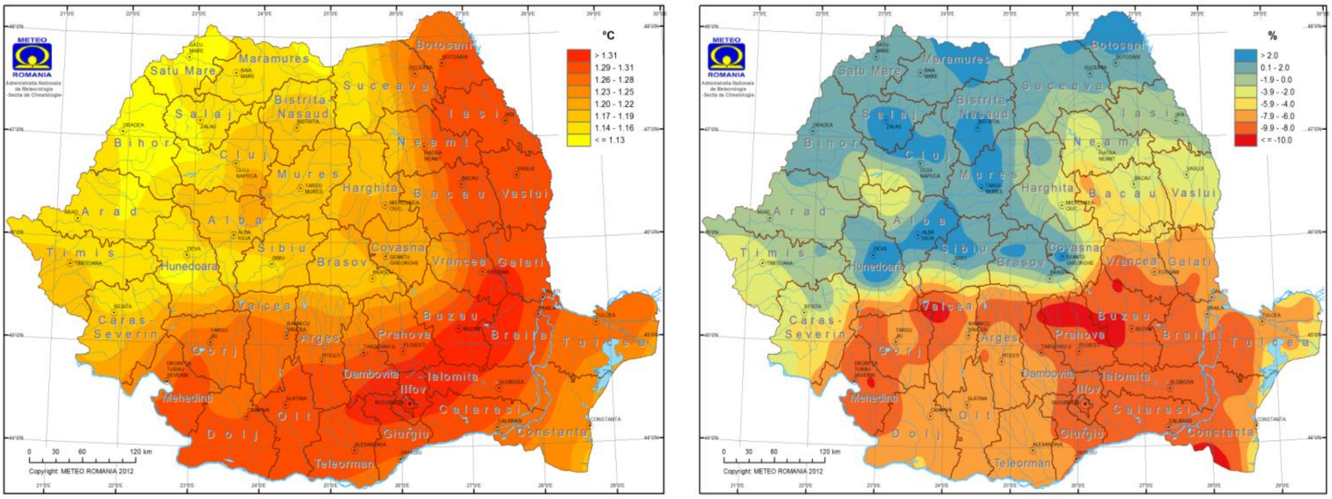


Figure I_ 6 *Multiannual mean changes (2011-2040 vs. 1961-1990) in air temperatrure (in °C, left panel) and precipitation (in %, right panel)*[1]

Also, projections show that changes in mean temperature and precipitation occur along with changes in extreme phenomena statistics.

Vulnerability and adaptation

Over the last years, adaptation to climate change impacts has reached an important position on the Romanian political agenda. The National Strategy for Climate Change in Romania, which has an important adaptation section, was approved in July 2013. This strategy refers to the effects of climate change on water safety, agriculture, energy, transport, industry, insurance, biodiversity, health, tourism, forestry, infrastructure, and recreational activities.

The National Strategy for Climate Change in Romania builds technical knowledge upon the background of the Guide on Adaptation to Climate Change issued in 2008. The strategy adds more information on implementation/application aspects of adaptation relative to the Guide.

[1] *The changes are computed using 9 runs with 9 regional climate models. Climate model results are taken from the FP6 Ensembles project*

Most important sector-related findings regarding vulnerability which have been identified in recent studies, from the last reporting period are illustrated in table I_3.

Table I_ 3 *Sectoral-related vulnerabilities of adaptation to projected change in temperature and precipitation*

Sector	**Vulnerability**		
	demography	**economy**	**society**
Agriculture	decline of local population; ageing of local population	lack of infrastructure for irrigation; low productivity for small farmers	propriety fragmentation; youth migration from rural areas
Health	ageing of local population; concentration of population in urban areas	land use changes	increasing rate of diseases prone to thermal impact among people
Tourism	decline of local population; ageing of local population	fluctuations in local economic activity; strong dependence of local economy on tourism; low productivity of non-touristic activities	a large proportion of local population working in tourism sector which has a strong seasonality; a high rate of jobless people from the local population

Table I_ 4 *Sectoral adaptation measures*

Sector	Adaptation measures
Agriculture	elaboration of drought risk maps based on climate change related hazards under present and future conditions; elaboration of associated management plans for climate adaptation based on studies of regional and local changes in behavior of genotypes; implementation of planned actions and monitoring (including disaster management community) according to the National Strategy for Climate Change in Romania
Health	elaboration of risk maps for heat wave in urban areas under present and climate change conditions; elaboration of associated management plans for climate adaptation to heat waves on central and local levels of administrations; implementation of planned actions with disaster management community and monitoring according to the National Strategy for Climate Change in Romania
Tourism	elaboration of risk maps based on climate change related hazards under present and future conditions; elaboration of associated management plans for climate adaptation based on winter and summer tourism activities (e.g. in mountain locations, alternative activities to traditional winter sports could taken into account; at seaside locations, touristic season could be extended beyond the traditional interval from May to September); implementation of planned actions and monitoring according to the National Strategy for Climate Change in Romania

Most important sector-related findings regarding measures of adaptation to climate change which have been identified in recent studies, from the last reporting period are illustrated in table I_4.

I.6 FINANCIAL RESOURCES AND TRANSFER OF TECHNOLOGY

Romania's approach to climate change financing cooperation recognises that early mitigation and adaptation actions will reduce global costs and the costs to individual countries.

Since the Fifth National Communication Romania provided only public financial support for climate change programs in developing countries, distributed through multilateral organisations.

I.7 RESEARCH AND SYSTEMATIC OBSERVATIONS

Research activities in Romania consist of themes related to climate system, impact and adaptation for policy support. However, up to now, the number of studies dedicated to climate change impact and adaptation is significantly smaller than those dedicated to physical basis of climate system.

National research activities are carried out along with participations in international and European programmes. The main coordinator of Romanian research is the Ministry of Education and Research which financially supports research projects selected from national competitions which are organized by its Executive Unit for Scientific Research (UEFISCU). Also, The Ministry for Education and Research financially supports a part of the contributions to the European and international research area.

The Ministry of Environment and Climate Change coordinates and financially supports applicative research on water management, climate related environmental risks and sustainable adaptation planning. The Ministry of Regional Developing and Tourism is the focal point on the SEE Transnational programme which partially supports projects on adaptation to climate change and climate-related risk assessment in relation to disaster management.

As for the systematic observation, Romania has actively participated in various fields of climate-related monitoring, both nationally and within European and global programmes (such as GCOS). Romania has internationally exchanged data and contributed to European and global databases.

I.8. EDUCATION, TRAINING AND PUBLIC AWARENESS

Europe 2020 strategy seeks to turn the EU into a smart, sustainable and inclusive economy capable of delivering high level of employment, productivity and social cohesion taking into consideration that education, training and public awareness have a major contribution.

Romania is committed to reduce regional disparities in terms of income, wealth and opportunities by promoting R&D activities via information, best practices and know-how transfer practices through innovation, knowledge economy and environmental protection.

Our national objective, for the 2013-2020 horizon, is to develop human capital and increase competitiveness by linking education and lifelong learning programs to the labour market and ensuring better opportunities to participate in a modern, inclusive and flexible labour market.

In Romania the responsible authorities for the initial and continuing vocational **education and training** systems (IVET and CVET) are both Ministry of National Education and Ministry for Labour, Family, Social Protection and Elderly, together with the National Authority for Qualifications (NAQ). IVET is the professional education and training set out within the national education system.

By Labour Code, in Romania there are covered the procedures regarding the CVET, respectively getting new competences and skills, including the assessment of knowledge level and certification according to occupational standards.

Climate change issues are present into the curricular activities both in the secondary (gymnasium cycle) and high school.

Most of the technical state and private Universities prepare the future specialists in the fields of environmental protection and climate change through bachelor, master and doctoral degrees.

The subject of climate change was also debated in numerous **knowledge sharing and best practices events, training sessions, workshops, conferences and** developed within **dedicated projects**.

Thus, a number of interesting projects aiming at capacity building, policy influencing, increasing the education level and the public awareness (specific target groups / stakeholders and/or the general public) have been developed during the last years.

Related to **training and education projects** developed by Romania in European consortiums the important role of the National Agency for EU Programs in the field of Education and Vocational Training responsible for managing several UE dedicated programs must be underlined. Thus during 2011-2013 several projects were developed in the field of sustainable development, GHG emission reduction and climate change impact mitigation, by Romanian consortium's leaders or partners, in programs such as: Comenius, Erasmus, Leonardo da Vinci and Grundtvig.

As referring to the **public information, engagement and awareness process** we underline the increasing role of the civil society representatives through different NGOs projects.

The National Administration of the Environmental Fund had and has a major role in promoting and supporting **education and public awareness activities** strongly related to climate change mitigation and GHG emissions reduction.

Further climate change mitigation dedicated **education – training – public awareness actions** are envisaged considering the future launch of Horizon 2020 in December 2013, LIFE 2014-2020, RDI National Programs, and the current EEA and Norwegian Financial Mechanism implementation (2009-2014).

II. NATIONAL CIRCUMSTANCES

II.A. Government Structure

Romania is a Republic organized based on the principle of the separation and balance of powers – legislative, executive, and judicial - within the framework of constitutional democracy.

The President of Romania is elected by universal, equal, direct, secret and free suffrage for a term of office of 5 years, not more than two consecutive offices. The President is Commander-in-Chief of the Armed Forces and presides over the Supreme Council of National Defence. The President of Romania designates a candidate to the office of Prime Minister and appoints the Government on the basis of the vote of confidence of Parliament.

Parliament, *legislative power*, is the supreme representative body of the Romanian people and the sole legislative authority of the country. Parliament consists of the Chamber of Deputies and the Senate, members of which are elected by universal, equal, direct, secret and free suffrage, in accordance with the electoral law for a term of office of 4 years. Parliament passes constitutional, organic, and ordinary laws.

The Government, *executive power*, consisting of the Prime Minister, Ministers, and other members as established by an organic law, ensure the implementation of the domestic and foreign policy of the country, and exercise the general management of public administration. The Government adopts decisions and ordinances that are signed by the Prime Minister, countersigned by the Ministers who are bound to carry them into execution, and shall be published in the Official Gazette of Romania. The Prime Minister directs Government actions and co-ordinates activities of its members, with the observance of the powers and duties incumbent on them. The Government is politically responsible for its entire activity only before Parliament.

Justice, *judicial power*, is administered by the High Court of Cassation and Justice, and the other courts of law set up by the law. The High Court of Cassation and Justice provides a unitary interpretation and implementation of the law by the other courts of law, according to its competence.

The Superior Council of Magistracy guarantees the independence of justice and consists of 19 members with a term of office of 6 years. The Superior Council of Magistracy performs the role of a court of law as regards the disciplinary liability of judges and public prosecutors.

The Public Ministry represents the general interests of the society, defend legal order, as well as the citizens' rights and freedoms and discharges its powers through public prosecutors, constituted into public prosecutor's offices.

From administrative point of view, the Romanian territory is organized into communes, towns and counties. Counties are administrative units in which Romania is divided into (41 plus Bucharest Figure II_A_1). The 41 counties are further structured into 2686 communes (for rural areas) and 265 cities and municipalities (for urban areas). Communes are divided into villages (which have no individual administration and hence not being an administrative division). There are 13092 villages. Bucharest is an exception to this structure having a secondary official division into six sectors, each sector having a local government and council.

The public administration authorities are the Local Councils and Mayors that are elected for 4 years in accordance with the law, act as autonomous administrative authorities and manage public affairs in communes and towns, in accordance with the law.

The County Council coordinates the activity of commune and town councils, with a view to carrying out the public services of county interest.

The Prefect, appointed by the Government in each county and in the Bucharest Municipality, is the representative of the Government at a local level and directs the decentralized public services of ministries and other bodies of the central public administration in the territorial-administrative units.

Figure II_A_1 *Administrative map of Romania*

According to the Law no 315/2004 on regional development in Romania were constituted four macroregions. They are not administrative territorial units and have no legal entity; they are constituted to assure the collection, compilation and transmission of harmonised regional statistics at European Union level.

In order to apply the regional development policy, in Romania were established 8 development regions as a result of an agreement between the county and local level counsels corresponding to NTUS 2 level (Nomenclature of Territorial Units for Statistics) of EU divisions, but without regional administrative responsibilities (Figure II_A_2). Development regions refer to the regional subdivisions of Romania created in 1998 and works in particular for the coordination of regional development projects. Developing regions are not administrative units; do not have legal personality, being the result of an agreement between the county and local councils.

Those regions of development are presented in the table II_1.

Table II_ 1 *Counties grouping, by macroregion and development region*

Macroregion	Development region
MACROREGION ONE	North - West
	Center
MACROREGION TWO	North - East
	South - East
MACROREGION THREE	South - Muntenia
	Bucharest - Ilfov
MACROREGION FOUR	South - West Oltenia
	West

Figure II_A_2 *Development regions map of Romania*

Romania's development regions are named after the geographical position occupied within the country as follow:

- ***Northeast Region 1***, consisting of the following counties: Iaşi, Bacău, Botoşani, Neamţ, Suceava, Vaslui totals 3,148,577 inhabitants and an area of 36,850 km².
- ***Southeast Region 2***, consisting of the following counties: Brăila, Buzău, Constanţa, Galaţi, Tulcea, Vrancea totals 2,399,604 inhabitants and an area of 35,762km².

- ***Southeast Muntenia Region 3***, consisting of the following counties: Prahova, Dâmboviţa, Argeş, Ialomiţa, Călăraşi, Giurgiu, Teleorman totals 2,998,679 inhabitants, an area of 34,450 km².
- ***Southwest Oltenia Region 4***, consisting of the following counties: Mehedinţi, Gorj, Vâlcea, Olt, Dolj totals 1,977,986 inhabitants and an area of 29,212km².
- ***West Region 5***, consisting of the following counties: Arad, Caraş-Severin, Timiş and Hunedoara totals a population of 1,730,146 inhabitants and an area of 32,034km².
- ***Northwest Region 6***, consisting of the following counties: Bihor, Bistriţa-Năsăud, Cluj, Maramureş, Satu-Mare and Sălaj totals 2,495,247 inhabitants and an area of 34,159 km².
- ***Centre Region 7***, consisting of the following counties: Alba, Sibiu, Mureş, Harghita, Covasna, and Braşov totals 2.251.302 inhabitants and an area of 34.100km².
- ***Bucharest-Ilfov Region 8***, composed of Municipality of Bucharest and Ilfov County totals 2,042,226 inhabitants and an area of 1,821km².

Romania's administration is relatively centralized and administrative subdivisions are therefore fairly simplified.

II.B. Population Profile

According to the final results of the Population and Dwellings Census from 2011, Romania has a population of 20,121,641 people out of which 10,333,064 women (51.4%). Compared to previous census situation (from 2002), the resident population decreased by 1559.3 thousand (of which 779 200 women). Out of the total number of population, 54% live in towns and the rest of 46% live in rural areas.

The first six counties, except Bucharest (1,883.4 thousand), considering the number of resident population are the following: Iaşi (772,300), Prahova (762,900), Cluj (691,100), Constanţa (684,000), Timiş (683,500) and Dolj (660,500 people).

Covasna (210,200), Tulcea (213,100), Sălaj (224,400), Mehedinţi (265,400), Ialomiţa (274,100) and Giurgiu (281,400) are the counties with the lowest number of people who are part of the resident population.

Main cities and towns in Romania account for more than half of the total population, 25 of them have over 100 thousands inhabitants each; this represent in total 54% of the urban population. Among the cities with the largest population, Bucharest ranks first (with 1883.4 thousand inhabitants), followed by Iaşi, Cluj-Napoca, Timişoara, Constanţa and Craiova (each with more than 300 thousand inhabitants). These 6 cities concentrate over 30% of the urban population.

The evolution of Romania's population shows a slight decrease of about 7% between 2005 and 2011:

Table II_ 2 *Evolution of Romania's population 2005-2011*

Year	1990	2005	2006	2007	2008	2009	2010	2011*
Population (mill. people)	23.211	21.624	21.584	21.538	21.504	21.470	21.431	20.122

*Source: National Institute of Statistics - Romanian Statistical Yearbook – 2012, *Final results of the Population and Dwellings Census*

Reasons leading to the decrease of the Romanian population by 13.3% during 1990 - 2011 were the external migration (particularly labour migration), the increase of the mortality rate and the decrease of the birth rate in this period.

The number of Romanians that are go for long periods abroad (12 months and over) is 727,540 (about 4.6% from adult population) and the number of temporarily absent persons abroad is 385,729 (about 2.44% from adult population).

Population migration has a negative influence on the development of Romania economic activity itself as most part of the persons leaving abroad for a job are young and active persons.

In terms of GHG emissions, changes in the quality of living (improvement of quality of living) will naturally drive towards higher emissions.

II.C. Geographical profile

II.C.1. Geographical position

On the Globe, Romania is situated in the northern hemisphere; at the intersection of 45° parallel Northern latitude with the 25° meridian Eastern longitude.

In Europe, Romania is situated in the South-Eastern Central Europe (Figure II_C_1), half the distance between the coast of the Atlantic Ocean and the Ural Mountains, inside and outside the Carpathians arch, within the lower basin of the Danube, having a gateway to the Black Sea.

The Romanian territory is between parallels 43 0 37'07" and 48 0 15'06'' Northern latitude and between meridians 20^{0}15'44'' and 29^{0}41'24'' Eastern longitude. Having an area of 238.391km^{2}, plus 23.700km ² represented by the Black Sea platform, it is the 13th largest country in Europe.

Figure II_C_ 1 *Physical map of Europe*

Romania's neighbours are: Ukraine to the North, Republic of Moldova to the East (the complete border being represented by the Prut River), Bulgaria to the South (mainly being a fluvial border, the Danube River), Serbia to the South-West, and Hungary to the West.

The Romanian borders stretch on a distance of 3 149.9 km, out of which, in 2007, 1876 km became EU borders (towards Serbia, Moldova and Ukraine).

The Black Sea border measures 194 km along the continental platform and 245 km on shore, the Romanian Black Sea coast stretching out between the border with Ukraine (Musura) and the border with Bulgaria (Vama Veche). The exit to the sea enables water way connections with the countries in the Black Sea basin and the rest of the world.

Romania's geographical position:

Extreme Point		**County**	**Eastern latitude**	**Northern latitude**
North	Horodiştea Village	Botoșani	$26^0$42'05"	$48^0$15'06"
South	Zimnicea City	Teleorman	$25^0$23'32"	$43^0$37'07"
East	Sulina City	Tulcea	$29^0$41'24"	$45^0$09'36"
West	Baba Veche Commune	Timiş	$20^0$15'44"	$46^0$07'27"

According to Greenwich

Figure II_C_ 2 *Political map of Europe*

Romania has an ellipse shape, with a territory length, in a straight line, of approximately 735 km from East to West and of approx. 530 km, from North to South. The total length of Romania's frontiers is 3,149.9km, out of which 1,085.5 km land and 2,064.3 km rivers and sea.

II.C.2. Relief

The relief of Romania has three major morphologic steps, proportionately distributed in the form of an amphitheatre. The high step, of the Carpathians (the highest peak Moldoveanu 2,544 m), the medium step, corresponding to the Sub-Carpathians, hills and plateaus and the low step, of the plains, river meadows and Danube Delta (the youngest relief unit, continuously developing and with an average altitude of 0.52 m). The main characteristic of these relief components is their proportional distribution in form of an amphitheatre, characterized by four elements: variety, proportionality, complementary and symmetrical layout, with approximately equal distribution of the main relief units (35% mountains, 35% hills and plateaus and 30% plains) Figure II_C_3.

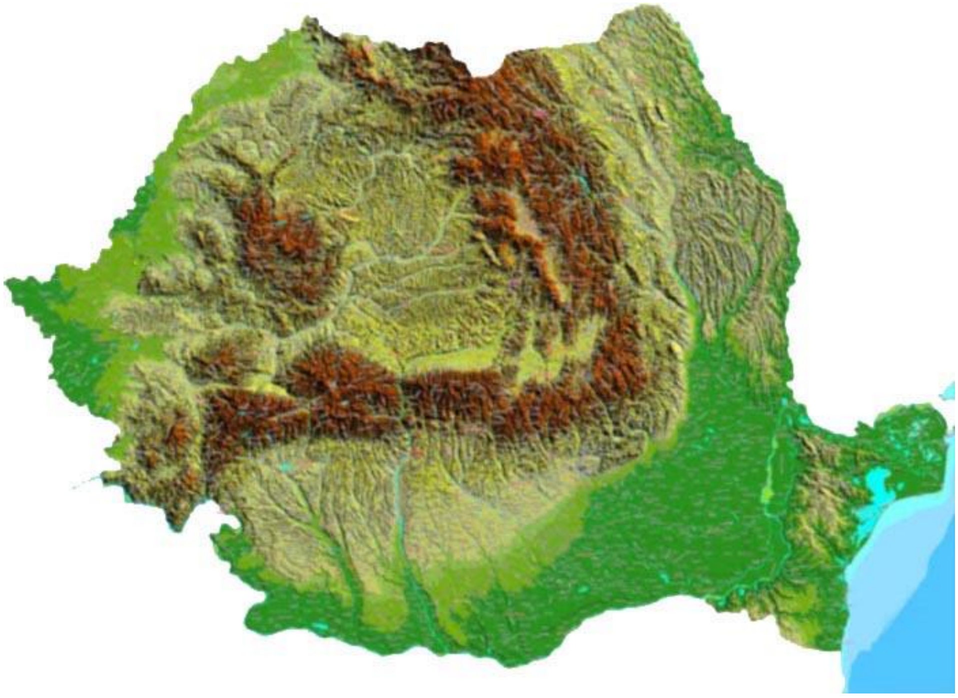


***Figure II_C_ 3** Physical map of Romania*

The Carpathians have an area of 66.303 km^2, which represents approx. 27.9% of the total area of the country, on a length of 910 km.

Inside the Carpathian arch lays the Plateau of Transylvania, with an area of approx. 25.000 km^2 and an altitude of 400 m to 600 m. Outside the Carpathian Mountains (the relief descends by steps, almost concentrically disposed), is a ring of hills – Sub Carpathians and Western Hills – the most densely populated areas, due to rich underground resources (oil, gas, coal, salt) and favourable conditions for cultivating vine and fruit trees.

In eastern and southern regions there are three large plateaus (Moldova, Dobrogea and Getic) and Mehedinti Plateau, while two great plains lay in the south and west, the Romanian Plain (narrowed towards East) and the Western Plain.

The inter-mountain depressions are represented by the depressions in the area of the Oriental Carpathians (Comăneşti, Bârsei, Gheorghieni, Ciucului, Borsec-Bilbor, Jolotea), depressions from the area of the Middle Carpathians (Loviştei, Petroşani, Caransebeş-Mehadia), depressions within the Western Carpathians (among which the depression of Bozovici or Almajului) and depressions in the area of Apuseni Mountains (Brad-Săcărâmb, Zlatna-Almaş, Roşia Montană). There are also internal depressions – Transilvaniei depression, Panonic depression and Şimleul Silvaniei depression, (Figure 2_C_4).

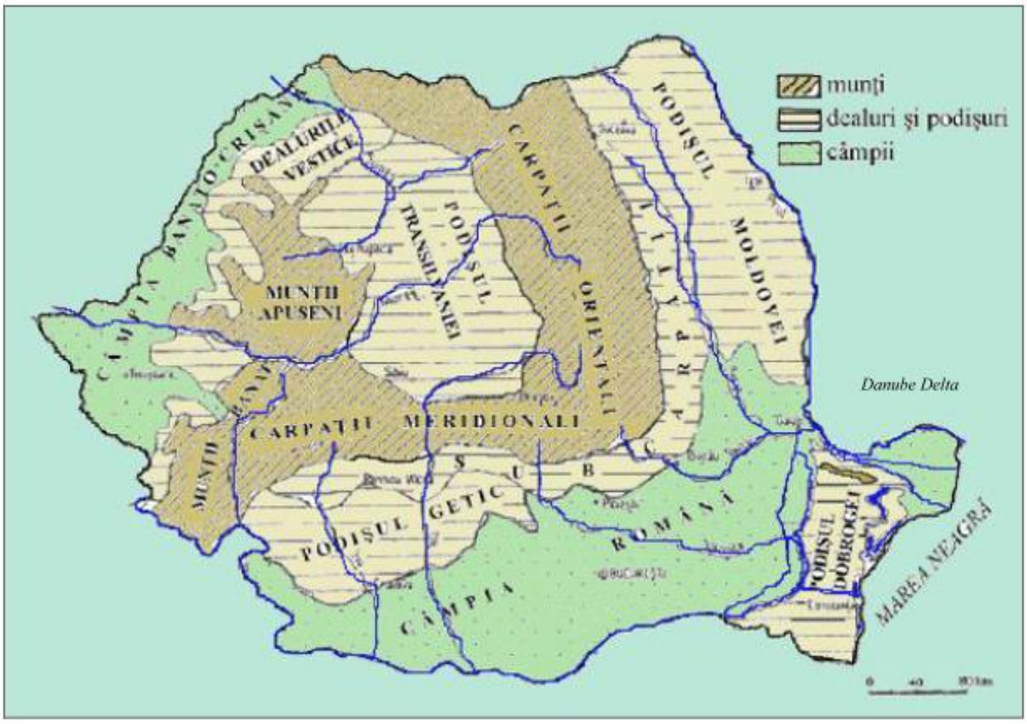


Figure II_C_ 4 *The main relief units of Romania*

II.C.3. Black Sea

The Black Sea is a sea in south-eastern Europe. It is bounded by Europe, Anatolia and the Caucasus and is ultimately connected to the Atlantic Ocean via the Mediterranean and the Aegean Seas and various straits. The Bosphorus Strait connects it to the Sea of Marmara, and the Strait of the Dardanelles connects that sea to the Aegean Sea region of the Mediterranean. These waters separate Eastern Europe and western Asia. The Black Sea is also connected to the Sea of Azov by the Strait of Kerch.

The Black Sea has an area of 436,400 km^2 (not including the Sea of Azov), a maximum depth of 2,212 m and a volume of 547,000 km^3.

The Black Sea is Romania's gate towards seas and oceans, and Black Sea seaside and coast area offers a variety of conditions for harnessing the underground (petroleum, natural gas), aquatic (the fish fauna) and land riches (tourism and leisure). The Black Sea exit gives Romania the possibility of developing the waterways transport.

II.C.4. Danube and Danube Delta

The Danube River is the second longest river in the European Union after the Volga. It rises in the Black Forest Mountains of western Germany and flows for some 2,850 km to its mouth on the Black Sea. Along its course, it passes through nine countries: Germany, Austria, Slovakia, Hungary, Croatia, Serbia, Bulgaria, Romania, and Ukraine.

The Danube flows into the Black Sea within Romania's territory forming the Danube Delta, a region with a medium-low altitude (31 cm), the biggest part of this area being under water.

The Danube Delta is the second largest (total surface of 4,178 km^2) and best preserved delta in Europe, and also a biosphere reserve and a biodiversity World Heritage Site. The Danube delta hosts over 300 species of birds as well as 45 freshwater fish species in its numerous lakes and marshes.

Lakes are interconnected by narrow channels featuring huge expanses of aquatic vegetation. This is the largest continuous marshland on Europe and the second-largest delta (the Volga being the largest), which includes the greatest stretch of reedbeds in the world. The marsh vegetation is dominated by reeds which form floating or fixed islands of decaying vegetation Reeds cover some 1,700 km^2 and the floating reed islands (*plaur*) 1,000 km^2, whereas the total area not inundated is only 148 km^2.

The Danube Delta has been included in the UNESCO World Heritage List in 1991 as being a natural reserve of the biosphere.

II.C.5. Natural mineral resources

Given the variety and complexity of the geologic structures, the Romanian territory has optimum conditions to accumulate useful mineral substances: gold and silver deposits, bauxite ore deposits, mineral combustible deposits, salt deposits and salts, useful rocks, mineral waters, geothermal waters, etc. Important reserves of hydrocarbons, gases and coals are quartered within the platform areas and in the intermountain depressions (Transylvania, Pannonian).

A special category of subsoil riches consist in more than 2000 mineral water springs, with consumption and medical treatments characteristics.

The mineral water is a renewable resource, but insufficiently capitalized, even though some of the mineral water springs received world appreciation for their quality. From the total mineral water reserve of 122 thousands m^3/day, which can be bottled, about 40% is capitalized.

II.C.6. Biodiversity

The vegetation varies, with a high tendency of originality. The following three areas of vegetation may be distinguished: alpine, forest and steppe. The alpine vegetation from mountain areas is very vulnerable to the environmental factors and anthropogenesis ones, as they regenerate in an extremely difficult manner. This is why some species are represented by little exemplars and easily disappear as result of the activity of the interfering factors. The main dangers are the uncontrolled pasturage and tourism.

The steppe and silvosteppe vegetation spreading in areas short on humidity on Dobrogea's Plateau, the Romanian Plain, Moldova's Plateau and West Plain, were mostly replaced by agricultural cultures.

The significant variety of the flora and fauna in Romania derives from the complexity of the relief. Romania's flora and fauna are harmoniously divided and form a highly valuable wealth, based on controlled and rational exploitation. Romania is a country with a great biological variety and a high percentage of natural ecosystems. The fauna is rich in species, some protected, as the black goat, bear, rock aquila, lynx, blackcock, birch cock and other species that present hunting interest.

Romanian forests preserve a genofund of great diversity. In order to preserve this valuable natural capital and to ensure a favourable conservation status for natural habitats of great natural and community importance, Romania has taken important steps, by implementing the legislative elements specific to the European Union, as well as of some programs and projects dedicated to preserving the biodiversity.

In Romania there are protected areas comprising of 79 scientific reservations, 13 national parks, with the largest one named Domogled - Valea Cernei, 190 natural monuments, 671 natural reservations, 15 natural parks (including Danube Delta) 3 biosphere reservations (Danube Delta, Retezat and Rodna) and 273 sites of communitarian importance.

II.C.7. Rivers

Romania benefits from all types of aquatic facilities: rivers and streams, lakes, groundwaters, marine waters. Romania's hydrographical and hydrological peculiarities are determined mainly by its geographic position within the temperate continental climate and the presence of the Carpathian arch.

A large part of Romania's border with Serbia and Bulgaria is formed by the Danube. The Prut River, one of its major tributaries, forms the border with the Republic of Moldova. Other major rivers are the Siret (596 km), the Olt (614 km), the Someș (388 km), and the Mureș (761 km).[114]

Lakes and lake complexes have a low share throughout Romania, occupying only 1.1% of total land area. The largest lake complex in size is Razelm-Sinoe (731 km²), located on the Black Sea seaside. Glacial lakes exist in the Făgăraș Mountains, a result of quaternary glaciation, of which the largest are: Lake Avrig (14,700 m²), Bâlea Lake (46,500 m²), Capra Lake (18,000 m²), etc. Other notable lakes are Lake Sfânta Ana, the only volcanic lake in Romania, and Red Lake, a natural dam lake, both situated in Harghita County.

II.D. Climate profile

II.D.1. Temperature

Romania's climate is a transitional temperate-continental one with oceanic influences from the West, Mediterranean modulations from the South-West and excessive continental effects from the North-East. Climatic variations are modulated by geographical elements, the position of the main mountain chain, elevation, the location of the Black Sea, etc (see Figure II_D_1 and II_D_2). The average annual temperature varies with latitude, from 8°C in the North to 11°C in the South, with around 2.6°C in the mountains and 11.7°C in the plains (see Figure II_D_1). Annual average amounts of precipitations vary between less than 300 mm/sqm*yr and 1200 mm/sqm*yr (see Figure II_D_2).

During the period 1901-2012, the mean annual air temperature increased by 0.8°C.

In the last 112 years, the warmest year was 2007 (with an average temperature of 11.5°C) and the coldest one, 1940 (with an average temperature of 8°C) (Figure II_D_3).). An absolute minimum temperature of - 38.5°C was recorded at Bod in Brasov County and an absolute maximum temperature of 44.5°C at Ion Sion in the Baragan Plain.

In Romania, the mean annual air temperature rose by 0,6°C in the last 100 years. The evolution by decades of the mean multiannual air temperature over the 1961-2010 period show that the air temperature rose by 0,4...0,6°C in the 2001-2010 interval in comparison with every decade. The increasing trend is obvious especialy begining with 1971.

As for the precipitation, the analysis of the data recorded during the interval 1901-2012 revealed a slightly decrease in the annual amount of precipitation (23.6 mm) (Figure 3). The highest annual rainfall amount recorded in Romania was 2401.5 mm in 1941, Omu weather station. The largest monthly amount of rainfall, 588.4 mm was recorded in June 2011 at the Balea Lac. Absolute maximum amount of rainfall in 24 hours was recorded at the meteorological station Deva, on 07/19/1934.

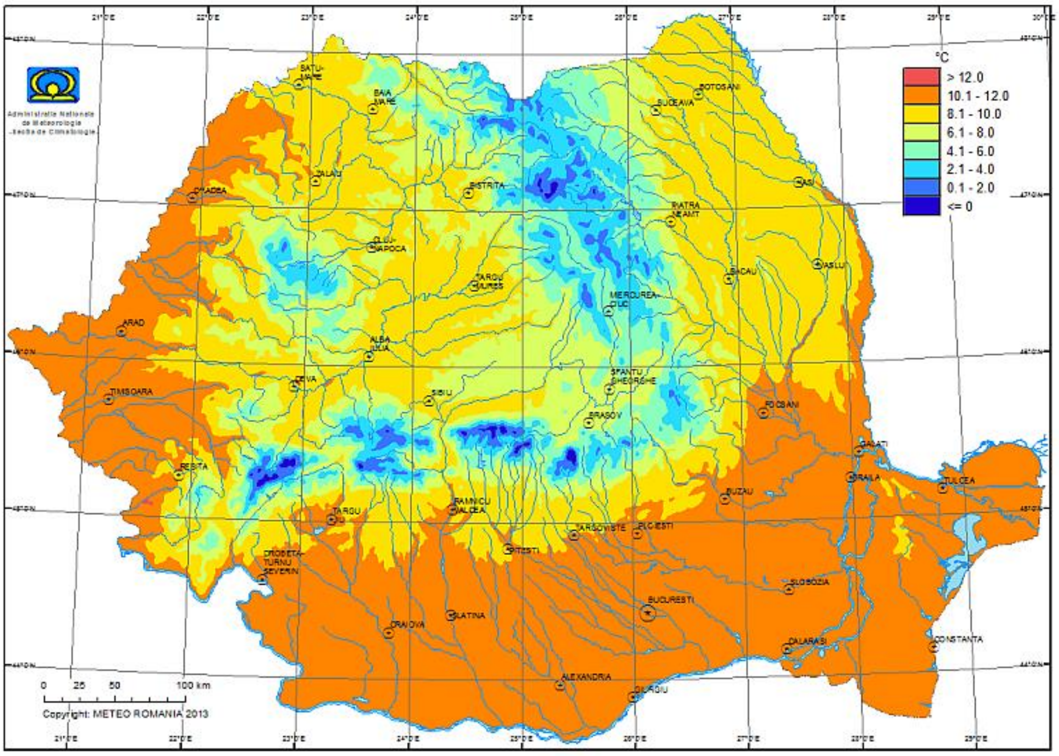


***Figure II_D_ 1** Multiannual mean of air temperature (in ^{0}C) for the interval 1961-2012*

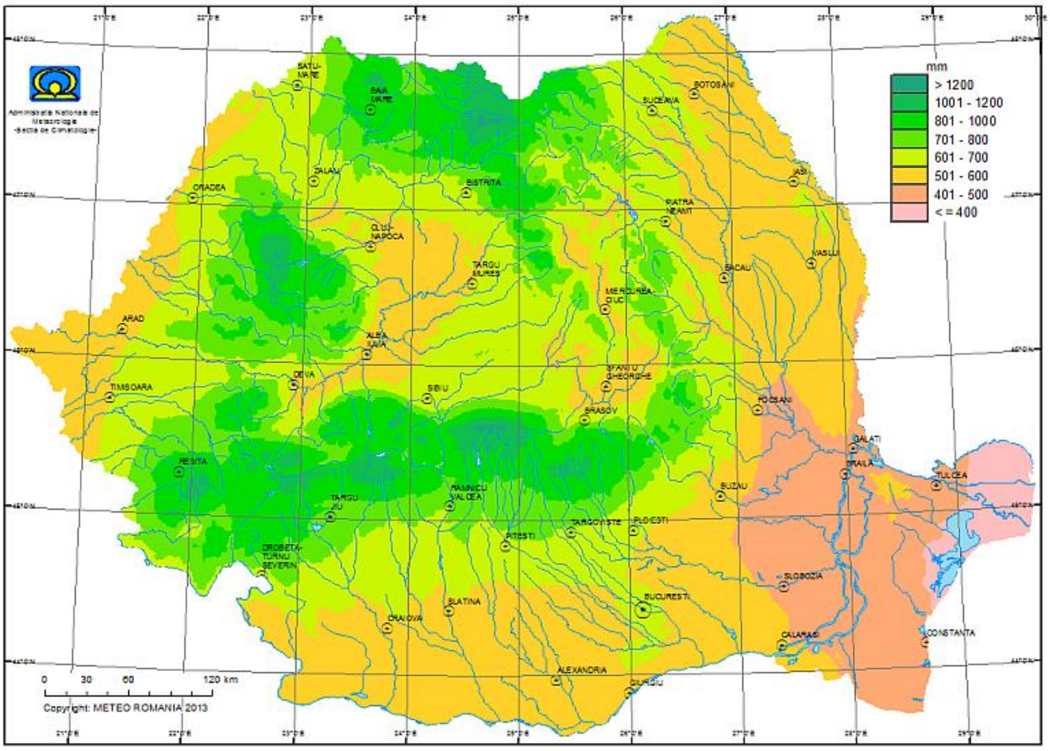


***Figure II_D_ 2** Multiannual mean of precipitation amount (in mm) for the interval 1961-2012*

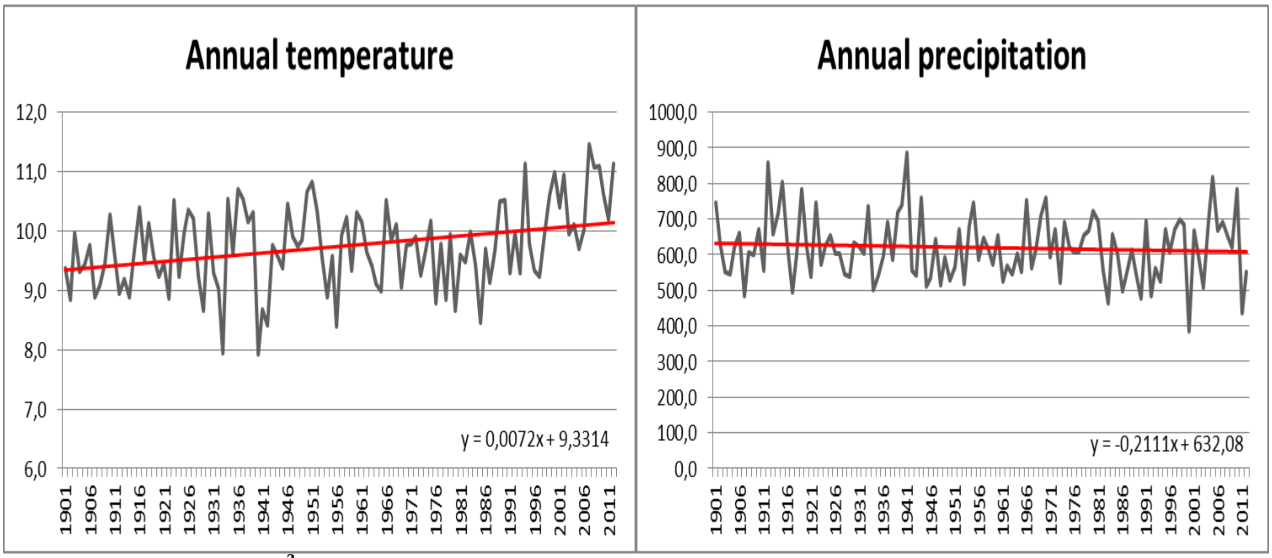


Figure II_D_ 3[2] *Evolutions of annual temperatures (in °C) and precipitation amounts (in mm)*

II.D.2. Precipitation

The highest annual rainfall amount recorded in Romania was 2401.5 mm in 1941, Omu weather station. The largest monthly amount of rainfall, 588.4 mm was recorded in June 2011 at the Balea Lac. Absolute maximum amount of rainfall in 24 hours was recorded at the meteorological station Deva, on 07/19/1934.

The hottest annual record in the last 112 years in Romania was observed in 2007. The mean temperature in January was 6°C higher than the multiannual average of the interval 1961-1990. In July 2007, 53 meteorological stations registered their highest temperature records. In 2007, the highest temperature for July in Romania - 44.3 °C - was recorded in Calafat. In terms of precipitation, the 2005 convective season had a record of unusual severe weather events in Romania: flash floods, hail, intense cloud to ground strokes and many severe wind related events like tornadoes, downbursts, waterspouts and funnel clouds. 13 tornado events were reported across the country many of them being recorded and documented. The majority of these occurred in the south-eastern part of Romania.

II.D.3. Other observed phenomena

The evolution of scorching heat intensity in Romania from 1961 to 2010 shows an increasing trend especially after 1981 (Figure II_D_4). Given the multi-annual means of scorching heat intensity, phenomenon quantified by sums of air temperature highs equal to or above 32°C recorded during the summer months, it has become apparent a significantly higher thermal stress over the critical interval for crops (June-August), an increase from 13 units of scorching heat between 1961 and 1990 to 28 units over 1981-2010 (Figure II_D_5).

[2] ***Averaged using data from 14 meteorological stations with long time series which cover the Romanian territory***

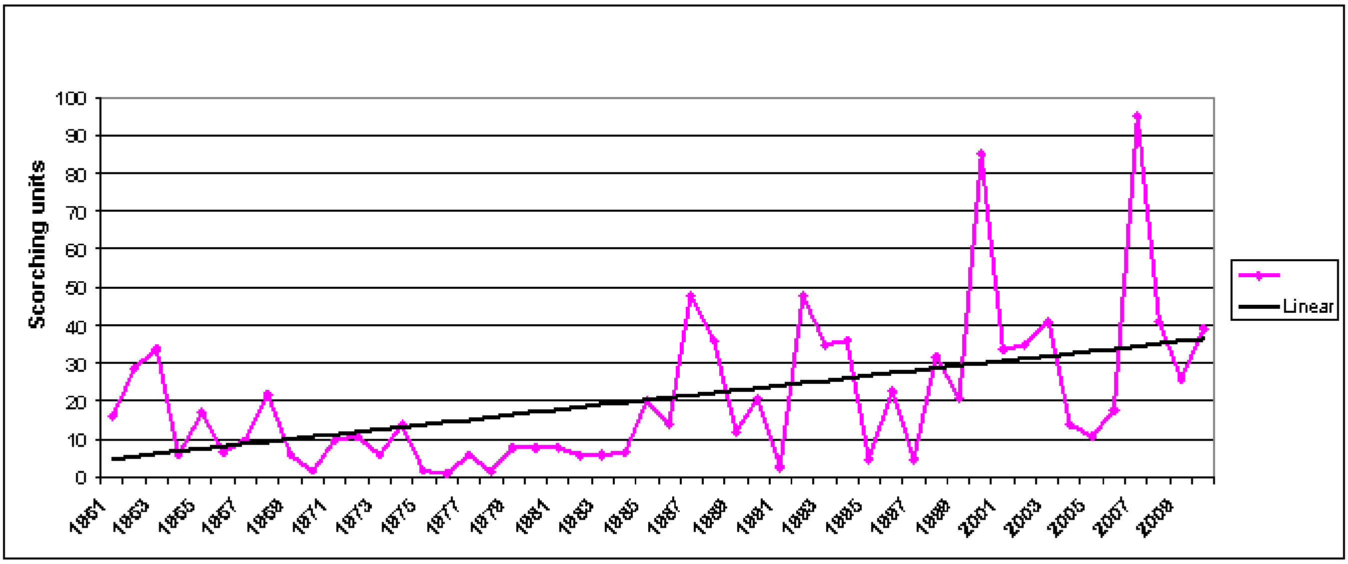
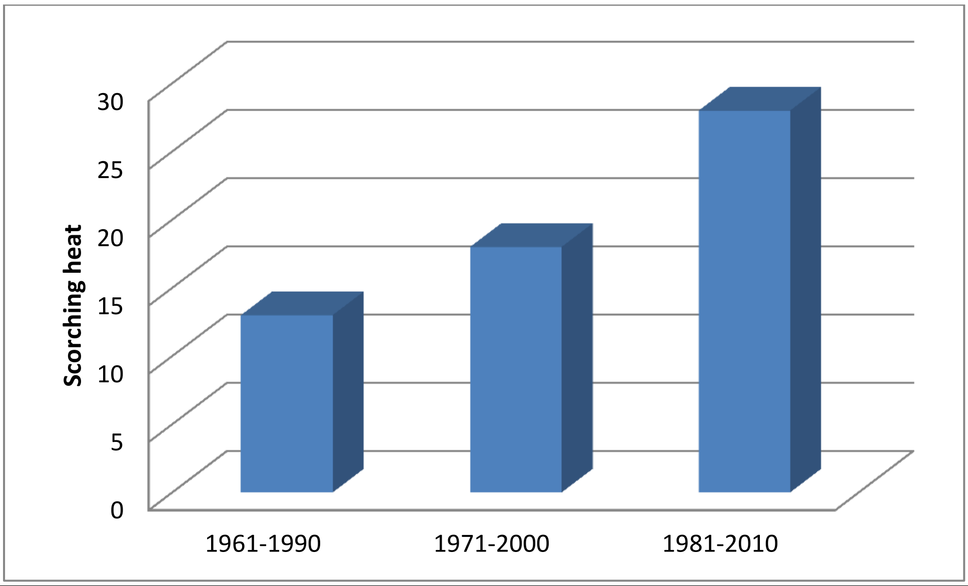


Figure II_D_ 4 The evolution of scorching heat intensity in Romania, 1961-2010



	Units of scorching heat (∑Tmax≥32°C, VI-VIII)
1961-1990	13
1971-2000	18
1981-2010	28
	2007 / 95 units **2012 / 123 units**

Figure II_D_ 5 Intensity of scorching heat intensity in Romania, 1961-2010

Focusing now on the decade 2001-2010, it was during the summer of 2007 that a scorching heat reached the highest intensity (95 units), in nine years out of decade's ten the records showing figures that top the multi-annual mean of 1961-1990. Here are some data: 2007/95 units, 2003 and 2008/41 units, 2010/38 units, 2002/35 units, 2001/34 units, 2009/26 units, 2006/18 units, 2004/14 units and 2005/11 units.

In summer 2007, the most severe scorching heat (∑Tmax≥32°C) was seen between 14 and 24 of July, when air temperature highs frequently topped 35...40°C across large areas from south, south-east and west Romania. 44.3°C was recorded at Calafat on July 27, 2007, exceeding the highest air temperature on record for July in Romania, namely 43.5°C on July 5, 2000, at Giurgiu. During the same summer, the maximum intensity of scorching heat reached 223 units over a total of 61 days with Tmax≥32°C at Giurgiu, as follows: 46 units/17 scorching heat days in June, 127 units/27 days in July and 50 units/17 scorching heat days in August.

The most frequent, the agricultural surfaces in Romania are affected by drought (cca. 7 mil. ha), erosion by water and landslides (cca. 6.4 mil. ha), temporary water excess (cca. 4 mil. ha.), compaction (cca. 2.8 mil. ha) etc. It can be seen that drought is the limiting factor affecting the widest surface as regards the crops.

The area subjected to desertification, characterized by an arid, semiarid or subhumid-dry climate is cca 30% of the total surface of Romania, being mostly situated in Dobrudja, Moldavia, the south of the Romanian Plain and the Western Plain (Figure II_D_6). This area is prevailingly used for agriculture (cca. 80% of the total, 60% of which is arable land), sylviculture (cca. 8%) and waters (source: National Strategy for the mitigation of the drought effect, preventing and combating land degradation and desertification in the short, mean and long range, Ministry of Agriculture and Rural Development, 2008).

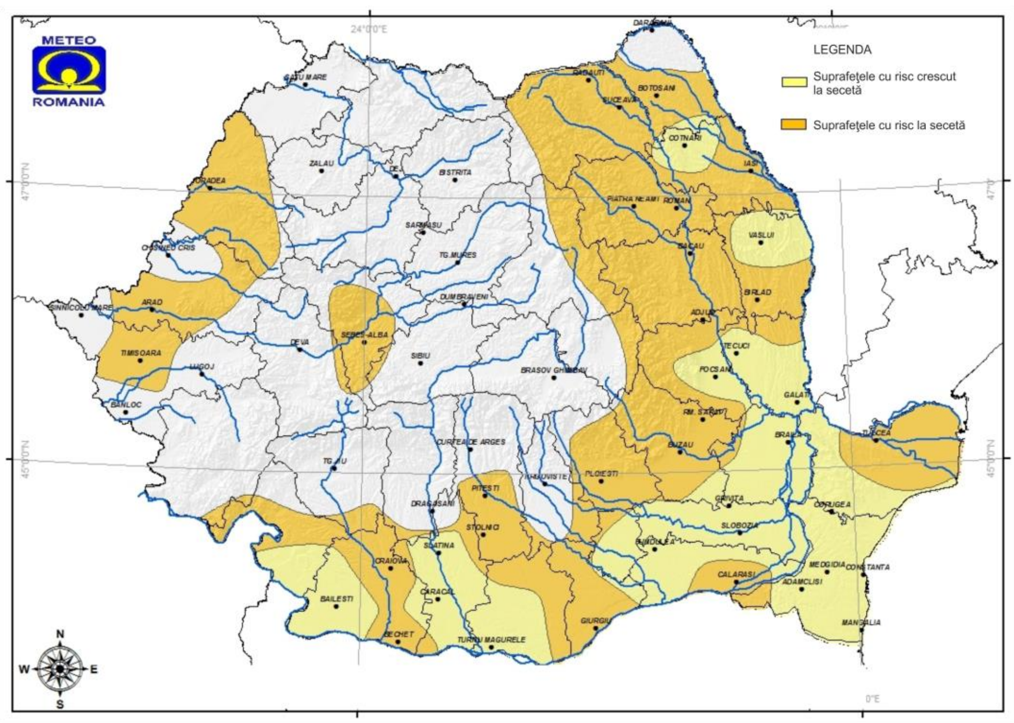


Figure II_D_ 6 *Agricultural surfaces in Romania affected by drought*

Since 1901 until now, Romania has seen in every decade one to four extremely droughty/rainy years, an increasing number of droughts being more and more apparent after 1981 (table II_3).

Table II_ 3 *Droughty/rainy years in Romania, 1901-2010*

DECADE	**XX-TH CENTURY**	
	EXTREMELY DROUGHTY YEARS	**EXTREMELY RAINY YEARS**
1901-1910	1907-1908	1910
1911-1920	1917-1918	1911, 1912, 1915, 1919
1921-1930	1923-1924, 1927-1928	1929
1931-1940	1934-1935	1937, 1939, 1940
1941-1950	1945-1946, 1947-1948, 1949-1950	1941, 1944, 1947
1951-1960	1952-1953	1954, 1955, 1957, 1960
1961-1970	1962-1963, 1964-1965	1969, 1970
1971-1980	1973-1974, 1975-1976	1972, 1974, 1975, 1976
1981-1990	1982-1983, 1985-1986, 1987-1988	1981, 1990
1991-2000	1992-1993, 1997-1998, 1999-2000	1991, 1997
	XXI-ST CENTURY	
2001-2010	2000-2001, 2001-2002, 2002-2003, 2006-2007, 2008-2009	2005, 2006, 2010

An analysis of the 1961-1990 annual precipitation amounts (September-August) provided a mean of 583.0 mm (Figure II_D_7) across the agricultural areas in Romania, 569.8 mm over 1971-2000, and 575.1 mm over 1981-2010, which makes the precipitation regime in Romania a moderately droughty one (less than 600 mm/year) as regards crop growth and development. Dobrogea agricultural territory is the most agricultural droughty region, with the following multi-annual precipitation means recorded over September 1 – August 31 (agricultural year): 400.9 mm for 1961-1990, 397.7 mm over 1971-2000 and 410.2 mm for 1981-2010.

Within each agricultural region, the frequency of the years with scanty annual precipitation varies from 37.4% in Banat - Crisana to 91.2% in Dobrogea region.

As regards the precipitation regime, in the 2001-2010 decade, the 2006-2007 agricultural year was excessively droughty at the scale of the whole country's agricultural territory, with precipitation deficits even more severe than in the landmark droughty year of the previous century, 1945-1946.

Figure II_D_7 comparatively exemplifies the precipitation amounts' territorial distribution in the 1945-1946 and 2006-2007 agricultural years respectively, proving that, countrywide, precipitation deficits were more enhanced in the 1 September 2006 31 July 2007 interval, when precipitation totaled on the average no more than 379.0 mm, against 396.0 mm in 1945-1946.

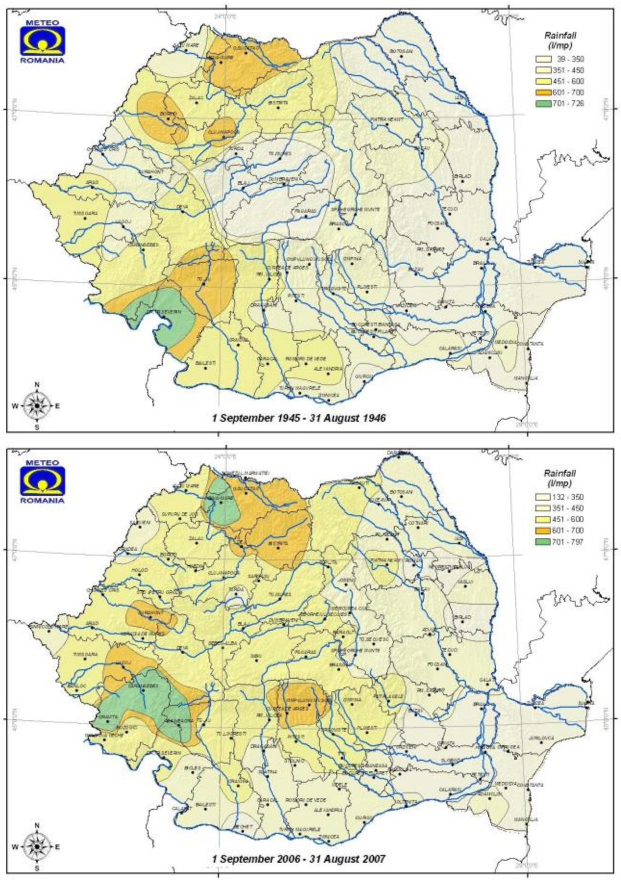


Figure II_D_ 7 *Precipitation amounts fallen in the 1946-1946 and 2006-2007 agricultural years*

The years 1945 and 1946 marked the most violent drought of the 20-th Century, with peak intensity especially in the south and south- east of the country, where the harvest was totally compromised. In the 21-th Century, the 2006 - 2007 agricultural year can be considered excessively droughty, both through the intensity of the in-soil water deficits and through the duration of the scanty intervals and wideness of the surfaces affected by pedological drought (extreme, severe and moderate) in the south, south- east, east, west and centre of the country.

In Romania, the territory highly exposed to the pedological drought hazard, tending to become arid and even desert comprises large surfaces in Dobrudja, southern and eastern Wallachia, southern Oltenia and southern Moldavia. These areas may be framed in the category of the areas the most vulnerable to excessive, prolonged pedological drought.

As a conclusion, the vulnerability degree of the cultivated species to the materialization of the thermal and hydric stress respectively is established on the grounds of the specific reference limits / hazard levels and classes, so as to assess the agroclimatic favourability degree of the agricultural surfaces for agricultural sorts and species with a different resilience to the occurrence of those hazards. Thus, the analysis of the agroclimatic phenomena implying thermal and hydric stress involves identifying the critical parameters and thresholds over specific calendar intervals, corresponding to the undergoing of the growth and development processes in plants, as well as over the whole vegetation period, so that the favourability degree for agriculture from the agrometeorological standpoint is also established.

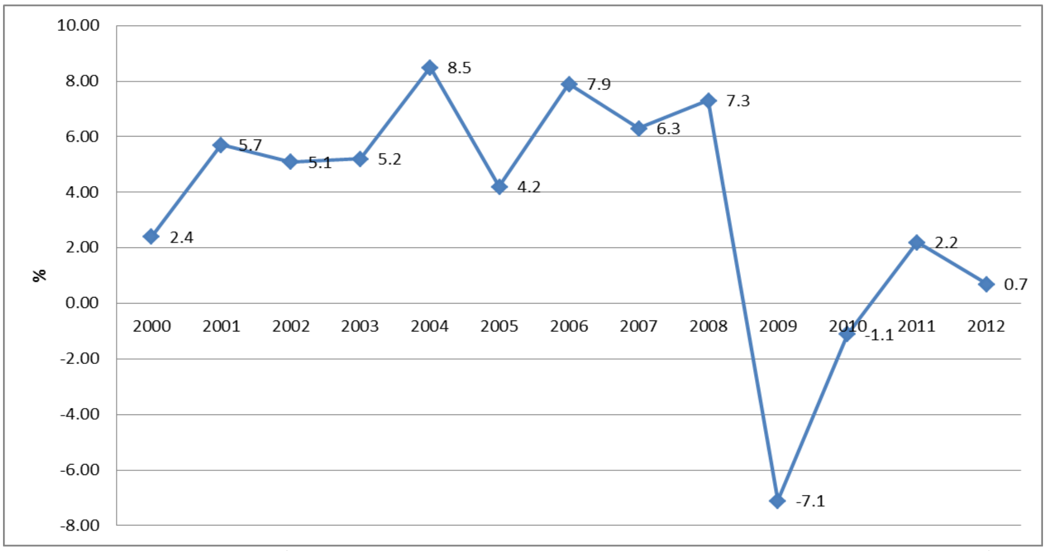
II.E. Economic profile

Romania joined the European Union in January 2007. The Romanian economy is a market based economy, promoting freedom of trade, protection against unfair competition, stimulation of domestic and foreign investments and protection of private property.

The economic development of Romania is strongly linked to the worldwide economic development and to that of the European Union one, as it occurs in special complex international environment affected by the global economic-financial crisis.

The analysis of the Gross Domestic Product (GDP) evolution during 2000 – 2012, revealed that the Romania economy experienced three separate periods and respectively: the period 2000 – 2008 of development when the annual average percentage of growth of the GDP was 6.27%, the period 2009 - 2010 of recession and the period 2011 – 2012 of coming out from recession (the Figure II_E_1, Table II_4).

During 2000 – 2010 the annual average percentage of growth was 4.074%, a value around 2.7 times higher than that one of the European Union of 1.5%.



Source: National Institute of Statistics – Romanian Statistical Yearbook – collections, National Commission of Prognosis - Projection of the main macroeconomic indicators for the period 2013 – 2016, May 2013

***Figure II_E_ 1** The GDP growth rate - 2000 – 2012*

***Table II_ 4** Romanian GDP evolution within the 2000 – 2012 period*

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012*
GDP bill. Euro	40.58	45.32	48.64	52.57	61.03	79.75	97.79	124.65	139.76	118.27	124.40	131.36	132.28
GDP bill. Euro 2010	83.45	88.19	92.67	97.52	105.80	110.19	118.87	126.38	135.67	126.03	124.40	127.13	128.02

*Source: National Institute of Statistics – Romanian Statistical Yearbook – collections *Estimation based on real GDP growth rate*

This evolution does not comply with the provisions of the National Strategy for Sustainable Growth of Romania, which provisioned yearly average rhythms of GDP in order to meet the convergence criteria for adopting the unique European currency. According to this strategy, the average yearly rhythms of GDP had to be:

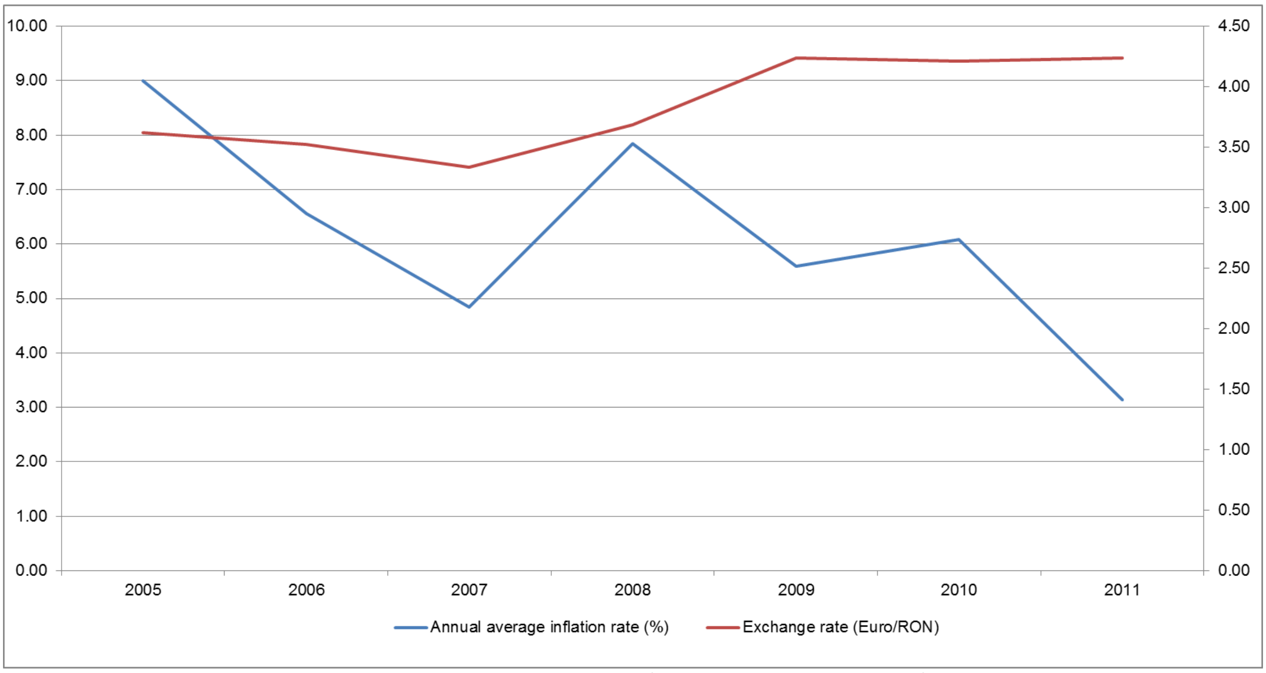
- 5.6 – 5.8% within the 2008 – 2013 period;
- 4.8 - 5% within the 2014 – 2020 period;
- 3.8 – 4.2% within the 2021 – 2030 period.

Romania's main export goods are: machinery and equipment, metals and metal products, textiles and footwear, chemicals, agricultural products, minerals and fuels. The exports value rose with about 12% in 2011 against 2010 figures. In the structure of exports the main categories in 2011 includes: machinery and transport equipment 41.1%, 17.9% manufactured goods classified mainly by the raw material, 15.3% miscellaneous manufactured articles, 6.2% chemicals and related products, 5.7% mineral fuels, lubricants and related materials and 13.8% other goods (source: National Institute of Statistics – Romanian Statistical Yearbook – 2012).

Romania's imports rose with 14.7% in 2011, compared to 2010. Sectors accounting for 81.1% in the total imports are: transport machinery and equipment (34.7%), manufactured goods classified mainly by the raw material (21.9%), mineral fuels, lubricants and related materials (11.3%) and chemicals and related products (13.2%) (source: National Institute of Statistics – Romanian Statistical Yearbook – 2012).

Romania's currency is the "leu" (lei). 1 leu (RON) = 100 bani (ban).

Inflation rate decreased from about 9% in 2005 to about 4.85% in 2007, rising again in 2008 at 7.85% and reaching at 3.14% in 2011, while the exchange rate against Euro offered the image of a constantly stronger RON in the same period; though the National Bank of Romania is continuously monitoring and adjusting it, through the market mechanisms (Figure II_E_2).



Source: National Institute of Statistics and National Bank of Romania web site: www.bnro.ro

Figure II_E_ 2 *Romanian Annual Average Inflation Ratio and Exchange Rate for the period 2005 – 2011*

According to the data provided by the National Agency for Employment, the number of registered unemployed persons at the end of December 2011 was about 461,013 compared to about 548,000, in January 2006. High unemployment rates were registered in 2011 in the counties: Mehedinţi (9.74%), Vaslui (9.61%), Teleorman (8.87%), Covasna (8.57%), Dolj (8.55%), Buzău (7.77%), Gorj (7.68%) and Galaţi (7.65%). The lowest unemployment rates were registered in the counties: Timiş (1.27%), Ilfov (1.43%), and Bucharest (1.98%).

GHG emissions per unit of GDP are continuing to decrease, due to the technical improvements, applications of different policies and due to the structural change of the GDP.

We notice a general decreasing trend for the GHG emissions per capita between 1989 and 2011, although there was a small increase after the year 2010. All trends may be seen in the Figure II_E_3:

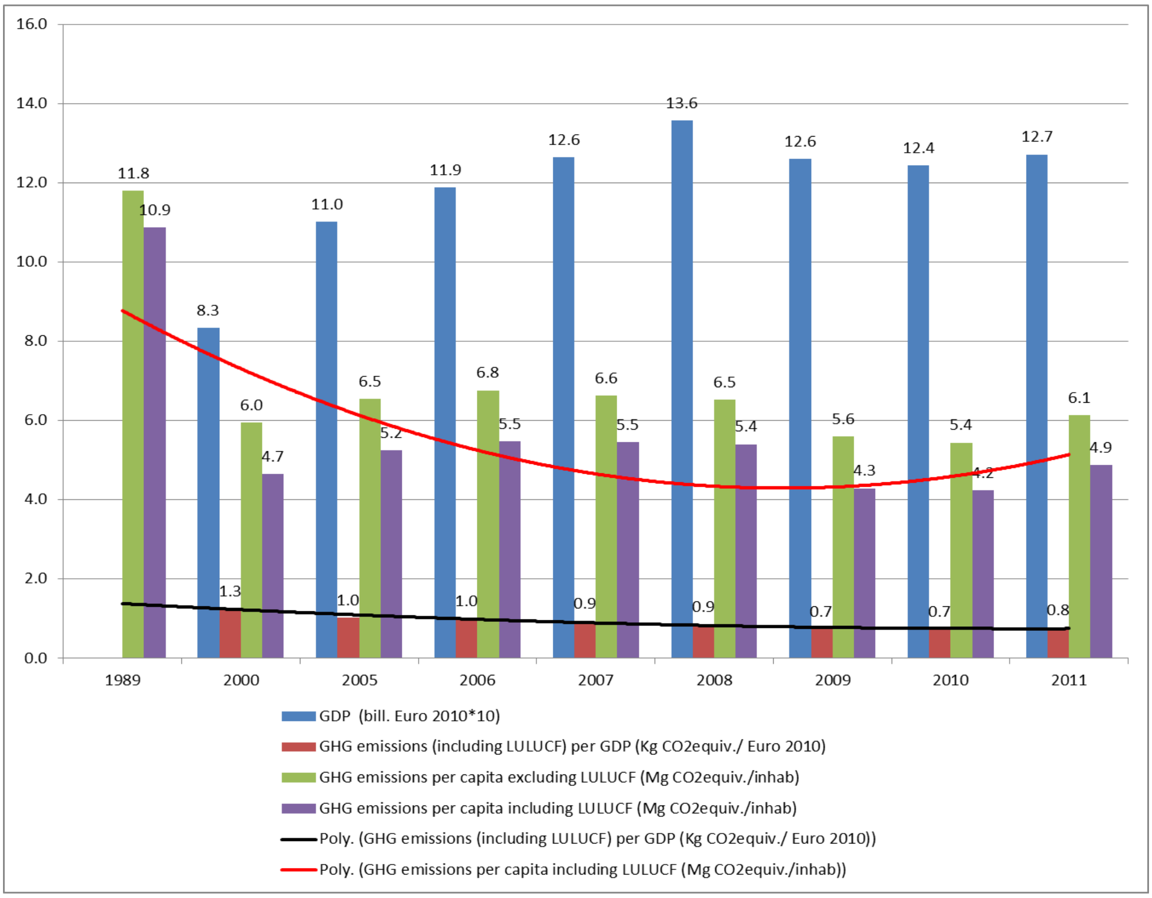


Figure II_E_ 3 *GHG data and national circumstances*

II.F. Energy profile

In Romania, the State is the main owner of the energy industry. The Romanian energy system is going on a long way from the vertically integrated model to a decentralized system consisting in the unbundling electricity production and transport as well as the distribution activities. The evolution of the power market structure, determined by the subsequent energy sector restructuring, imposed the adaptation of the regulatory framework according to the European Union practices. Successive actions for industry reorganization and decentralization led up to competitiveness improvements of some companies. The oil processing industry is almost entirely privately owned and in most cases the owners started to invest in new technology. On the contrary, the combined heat and power facilities delivering heat for district heating are owned by the municipalities. Those are in a very bad condition due to lack of investment and inappropriate price regulation and subsidy policy.

The electricity sector in Romania consists of the following operators and companies:

- Transmission network and system operator (Transelectrica);
- Electricity market operator (OPCOM is a subsidiary of Transelectrica);
- Electricity generators operating dispatching units (16);

- Electricity generators operating dispatching units and acting also as suppliers on the competitive market (10);
- Distribution network operators (8)
- Incumbent suppliers (5)
- Electricity suppliers acting exclusively on the wholesale market (37)
- Electricity suppliers (40).

The main characteristics of the sector are:

- Excess installed capacity;
- Poor management and prioritization of the sector development;
- Absence of a competitive environment, and inadequate regulatory systems;
- Low efficiency of energy use and energy conversion due to old and inefficient technologies;
- Poor consideration of the economic criteria in planning and investment selection;
- High operation expenses;
- Environmental pollution.

The Romanian Government established the strategic scope for the energy sector. The target consist of meeting both the current and the medium and long term energy demand, for the lowest possible price, adequate to a modern market economy and to a civilized living standard, under quality and safety in supply conditions, in observance of the sustainable development principles.

Romanian Energy Strategy for the period 2007 - 2020 has the following objectives:

- Energy security, by:
  - ✓ Lower dependence of imported energy through the use of national resources of lignite and hard coal, hydropower and wind power;
  - ✓ Import diversification of resources and the use of both nuclear fuel and natural gas;
- Sustainable development through:
  - ✓ Energy efficiency using modern technologies in the years 2015
  - ✓ Promotion of electricity in hydroelectric and wind power;
  - ✓ Promotion of electricity and heat production in cogeneration plants using high-efficiency technologies for natural gas;

  - ✓ Rehabilitation of transmission and distribution system correlated to buildings rehabilitation actions for reducing energy losses and the development of new intelligent buildings;
  - ✓ Reducing negative environmental impacts by promoting modern technologies with zero emissions.

- ➢ Competitiveness:
  - ✓ Development of markets for electricity, natural gas, uranium, green certificates, certification of greenhouse gas emissions;
  - ✓ Continuing restructuring the electricity and natural gas sectors;
  - ✓ Continuing restructuring coal sector to increase profitability and access to capital markets.

The government's most recent strategy in the sector highlights the need for enhancing the security of supply, utilization of locally available primary resources and enhancing the use of renewable energy. Reforms regarding the electricity market allowed a 100% opening of this market, both for industrial and for domestic users.

II.F.1 Energy resources

Romania has a wide but quantitatively reduced range of fossil and mineral energy resources as: oil, natural gas, coal, uranium ore, and a great potential of renewable energy resources.

A fair assessment of the possibilities for covering the primary energy needs in the future should start from the current situation of proven reserves combined with realistic estimates of potential resources in close correlation with resource consumption forecasts determined by the final energy demand.

In the tables II_5 and II_6 are presented the evolution of the primary energy production and domestic primary energy consumption in the period 2002 - 2011.

Based on the exploitation of fossil energy reserves, coal and oil as well as those of uranium ore, primary energy production in Romania, in the most optimistic case, will not grow in the next 2 - 3 decades.

***Table II_ 5** Domestic Primary Energy Production*

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total (thousand toe) of which (%)	27,668	28,192	28,094	28,050	20,769	20,584	20,612	19,801	18,794	19,514
✓ Coal	22.1	23.2	22.0	22.1	31.2	33.3	34.0	32.6	31.4	34.1
✓ Crude oil	21.5	20.5	19.9	18.0	23.6	22.6	22.4	22.2	22.3	21.2
✓ Natural gas	37.5	37.4	36.3	37.2	45.2	44.1	43.6	45.3	46.3	44.7

Source: National Institute of Statistics, Energy Banlance - Collections 2002- 2012

***Table II_ 6** Domestic primary energy consumption*

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total (thousand toe) of which (%)	36,480	39,032	39,018	31,725	33,432	32,584	31,844	26,409	25,663	27,804
✓ Coal and coke	24.2	24.4	23.5	27.5	28.5	30.9	30.3	28.2	26.9	29.3
✓ Crude oil and oil products	25.7	23.3	25.9	28.9	28.1	29.6	30.5	31.5	30.6	30.5
✓ Natural gas	36.5	39.5	35.3	43.6	43.4	39.5	39.2	40.3	42.5	40.2

Source: National Institute of Statistics, Energy Banlance - Collections 2002- 2012

Oil

The Romanian oil industry history begins in 1857 when the first well was drilled in Ploiesti. In 1938 "The Science of Petroleum" publication certifies the fact that Romania was the first country in the world with an oil production of 275 tones officially registered in the international statistics. Since then, Romania has proved to be an important oil producer in the region over the last 150 years.

The major oil market player is Petrom which also explores the international crude reserves located in Kazakhstan, India, Hungary, former Yugoslavia countries and the Republic of Moldova through its subsidiaries, joint ventures concluded with other companies.

The second private player is Rompetrol whose main activities are in the refining and oil product marketing/sale fields with adjacent interests in oil exploration and production. In August 2007, Kazakhstan's state-controlled oil and gas company KazMunayGas took over 75% of the company shares. The acquisition has been approved by the European Commission in November 2007.

Petrotel – LukOil is another big private player, a subsidiary of the Russian group Lukoil, which owns over 90% of the company since 1998.

In terms of oil reserves, Romania ranks no. 4 in Europe after Norway, Great Britain and Denmark. The actual oil reserves stands at around 0.6 billion boe (barrel oil equivalent) at the beginning of 2009 (EIA, 2009). In February 2009, after its dispute with Ukraine on maritime delimitation in the Black Sea, the International Court of Justice in The Hague awarded around 80% of the disputed sea floor to Romania. It is estimated that this area contains about 70 billion cubic meters of gas and 12 million tons of oil (Media, 2009). Foreign oil major companies have expressed interest in more fully exploring the area and potentially investing in extraction.

The refining sector of Romania consists of ten refineries, with a total refining capacity of 34.0 mill. tons (the biggest capacity from Central and Eastern Europe).

The most important are Petrobrazi Ploieşti, Petrotel Lukoil Ploieşti and Petromidia Rompetrol having a capacity use rate over 60%.

All seven others refineries from Romania, including Arpechim Pitesti, owned by OMV Petrom and RAFO Onesti owned by British company Balkan Petroleum, are small and many of them have faced closure due to poor financial situation.

Coal

Romania has important reserves of coal, although the coal quality is rather poor. The largest coal reserves are those of bituminous coal. Half of Romania's bulk coal production comes from Petroşani Depression alone. The large lignite field Motru Valley (Gorj) supplies two of the largest power stations in the country Rovinari and Turceni.

In the lignite extraction sector intervention level is "low" being summarized in subsidies just to operate underground; those mining are going to be closed in the near future. Lignite surface mining is unsubsidized.

Lignite resources in Romania with calorific value between 1650-1950 kcal/kg are estimated at 3.297 billion tons of which operated in leased perimeters, 356 million tons. In terms of reaching an annual production of about 30 million tons/year concession perimeters reserves currently provide continuity extraction for about 10 years. Exploitable lignite reserves can ensure their effective economic exploitation still about 40 years at a production level of 30 million tons/year.

Resources of coal with calorific value of 3650 kcal/kg from the Jiu Valley Basin are estimated at 602 million tonnes, of which 95 million tonnes are industrial reserves (exploitable) located in those areas leased by CNH - SA Petrosani.

Given the characteristics of coal extracted in Romania (hard coal with calorific value of 3650 kcal/kg; lignite with calorific value between 1650-1950 kcal / kg) can only use in power plants equipped for this type of fuel and located as close coal suppliers. In the table II_7 is presented the evolution of coal production during 2002-2011 that underlines the share of lignite production about 89% of total coal production in 2011.

As of national primary energy resources it is obvious that unless renewable energy sources, lignite is the only domestic primary energy carrier in terms of resources and it might significantly contribute to fulfil consumers demand for electricity in the next 2 - 3 decades.

Table II_ 7 *Coal Production (thousand toe)*

Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Coal, out of which	6,117	6536	6192	5793	6477	6410	7011	6477	5903	6661
Lignite and brown coal	4942	5499	5120	4698	5628	5985	6032	5726	5173	5932

Source: National Institute of Statistics, Energy Banlance - Collections 2002- 2012

Nuclear

The Nuclear Power Plant in Cernavodă is the only nuclear power plant in Romania so far. The Cernavodă NPP is located in the Dobrogea region of South-East Romania, near the Danube River - Black Sea river canal. The site is designed for five CANDU 6 reactors. Initial constructions on the site commenced in 1982, with the intention of completing all five units.

Nowadays Romania has two nuclear reactors: Cernavodă NPP Units 1 and 2, with an installed capacity generating about 18% of the country's electricity. Unit 1 is in operation since December 1996 and Unit 2, is in operation since October 2007.

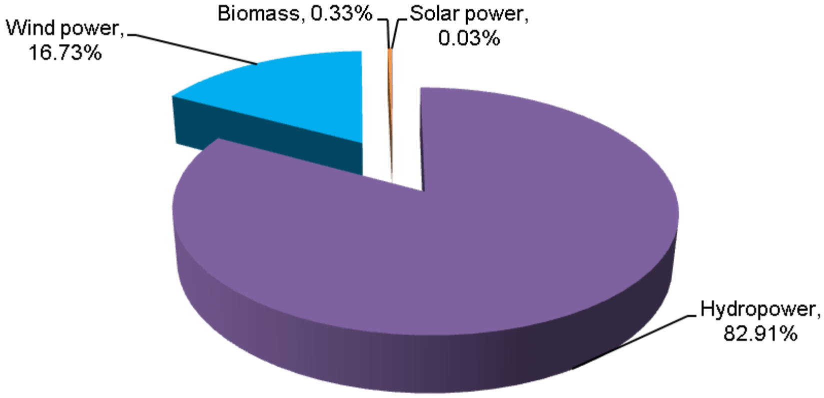
The owner of Cernavodă NPP Site is Societatea Naţională Nuclearelectrica S.A., a Romanian state owned company, established in 1998. Both operating Units have 706.5 MW installed capacity, with CANDU 6 reactors using natural Uranium as fuel and heavy water as moderator and cooling agent.

In 2011, Cernavodă NPP, with both units in operation, produced a total of 10.9 TWh, out of which, 10.1 TWh delivered to the National Power Grid.

Renewable energy resources

Hydropower generation and wind power generation accounted for almost the entire amount of the total electricity generated by renewable energy sources in Romania. According to CN Transelectrica SA, the Romanian Transmission and System Operator, the breakdown of renewable energies by 1 June 2012 (7,853 MW) was hydropower (6,511 MW), wind power (1,314 MW) and biomass (26 MW) with little solar power (Figure II_F_1)

The goal of the Romanian government is to increase the share of renewable energy in the final energy consumption from 19% as of the end of 2010 to 24% by 2020.



Source: Data from Transelectrica

Figure II_F_ 1 *Renewable energy resources (1 June 2012)*

Energy companies from abroad are launching business in wind power generation sector due to Romania wind power generation high potential and the governmental incentives increment.

In terms of renewable energy Romania has the highest wind potential in South Eastern Europe and investors already have connection requests of over 23,000 MW at the end of 2012, according to CN Transelectrica SA web site.

At the end of 2012 the installed capacity of wind power plants in Romania was 1738 MW, compared with 14.1 MW installed capacity in 2009.

The largest projects implemented are the wind farms Fântânele and Cogealac, developed by the CEZ Group (one of the biggest investors in wind energy in Romania) with a combined capacity of about 600 MW.

The installed capacity of the wind power plants from Romania varies between 347.5 MW at Fântânele wind farm and 13.8 MW at Mihai Viteazu wind farm.

The following companies have installed wind farms in Romania: EDP, CEZ AS, EON, Iberdrola SA and ENEL SA.

Romania's operational wind farms are mainly located in Dobrogea, on the Black Sea coast, where average wind speeds can reach 7 m/s at 100 m altitude. The region is flat and sparsely populated, which makes it possible to install a large number of wind turbines. There are also two other regions with a high wind power potential in Romania, namely: Moldova and Banat.

The wind potential is estimated at approximately 8400 GWh/year, with 4000 MW of installed capacity in 2020,

The Romanian Transmission and System Operator, CN Transelectrica SA plans to invest 782 million lei ($219 million) in 2012 - 2013 to expand and upgrade its grid to accommodate the rising wind-farm output.

II.F.2 Energy transmission infrastructure

National oil Pipelines

Romania's 3,800 km network of oil pipelines is under the control of CONPET, a natural monopoly on the crude oil pipeline transport national market, being the only company carrying out such activities in Romania (figure II_F_2).

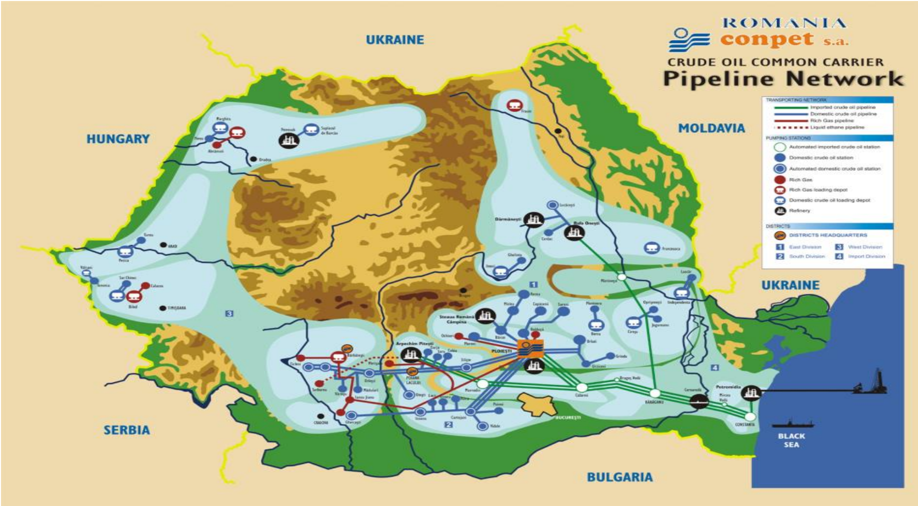


Figure II_F_ 2 *Crude oil national pipeline system*

Crude oil national pipeline system has a transport capacity of about 30 million tons / year. The transport capacity has been used in a proportion of not more than 60%. The national pipeline system was fully rehabilitated during 1995 - 2005. It consists of four large sub-systems for:

- Domestic oil transportation with a total length of 1450 km and 10 mill. tons/year capacity;
- Imported oil transportation with a total length of 1200 km and 18 mill. tons/year capacity;
- Rich gas and ethane transportation with a total length of 1150 km and 314 thou. tons/year capacity for rich gas and 72 thou. tons/year capacity for liquid ethane;
- Transportation on railways.

The Constanta Port, connected to the national pipeline network, has the biggest oil terminal in South-Eastern Europe (operated by Oil Terminal company), specialized for the import of crude oil and other oil products and for the export of refined oil products. The oil terminal can operate vessels with capacities up to 165,000 dwt (deadweight tons) and has a maximum capacity of 24 mill. tons/year and a crude oil storage capacity of 550,000 tons.

Between 2007-2008 Rompetrol invested over USD 175 millions for building an offshore sea terminal in the Black Sea and expanding by 350% its end product transit capacity by Midia port (from 90,000 tons/month to 310,000 tons/month). The oil terminal is located 8.6 kilometers offshore the Black Sea, has an annual transit capacity of maximum 24 mill. tons of crude oil and can receive ships of up to 160,000 dwt (Rompetrol, 2009).

National gas Pipelines

The National Gas Transmission Company, Transgaz S.A. is the technical operator of the national gas transmission system and it is responsible for its operation under quality, safety, efficiency and environmental conditions.

Established based on Governmental Decision no. 334/28 April 2000, it is Romanian legal person operating as a trading joint-stock company, under the Romanian legislation and its By-laws. In order to support Transgaz S.A main object of activity it might complementary perform other related activities, in compliance with the legislation in effect and with its own By-laws, except for the purchasing and trading of natural gas from domestic production or import.

The company is state owned, through the Ministry of Economy that holds 58.5% of the shares while Property Fund holds 15% of the shares. Considering Romania's history in natural gas exploitation, the National Transmission System (NTS) is well developed.

The main components of the existing infrastructure of the NTS are:

- 13,366 km pipelines, of which 553 km are transit pipelines;
- 5 compressor stations, having a total installed power of 32 MW;
- 51 valve control stations/ technological nodes;
- 966 cathodic protection stations;
- 772 gas odorization units;
- 9 physical interconnection points;
- 8 physical entry/exit points connected to storage facilities;
- 151 physical entry points;
- 857physical exit points / 39 operators of distribution systems;
- 249 physical entry points;
- 76 physical entry/exit points for natural gas direct deliveries;

The NTS for natural gas is graphically illustrated in Figure II_F_3.

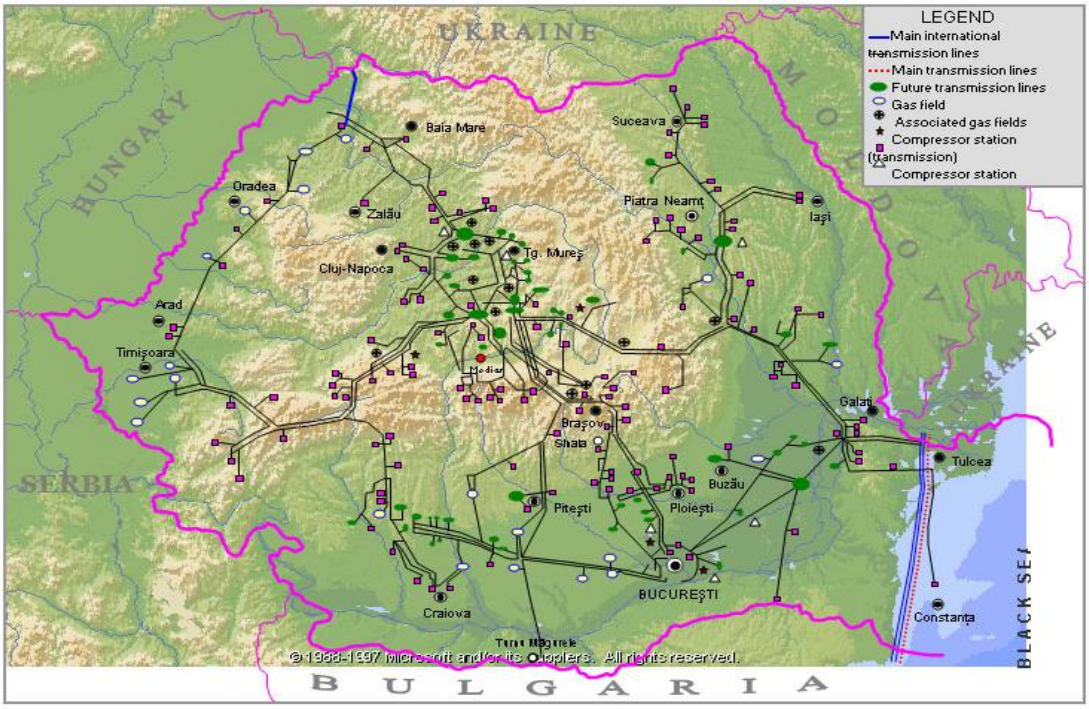


***Figure II_F_ 3** National Gas Transportation System*

The NTS has a maximum technical capacity of 51,316.800000 MWh/day and a reserved capacity of 27,060.410334 MWh/day, which highly exceeds the current consumption; therefore there are no network congestions so far.

The transmission system operator maintains a sustained activity to improve the technical condition of the transport system by constant rehabilitation development and modernization of the system, expansion to new areas of consumption, and interconnection with similar systems of neighbouring countries, to diversify sources of supply for natural gas import.

Romania participates or had declared interest for a series of interconnection projects, construction and development of cross-border gas transmission capacities by NTS interconnection with similar neighbouring systems in order to secure the safety of gas supply and demand balance:

Electricity network and interconnections

Romania has an extensive power transmission network with an overall length of about 10,000 km, of which 425.8 km are interconnection lines. The HV power transmission network of Romania is owned by the TSO – CNTranselectrica SA, which achieved full UCTE membership in 2003.

The National Power Grid Company Transelectrica SA is transmitting the electricity by means of the power transmission grid (PTG), consisting of electric substations and lines. The PTG is the electricity network of national and strategic interest, with nominal voltage higher than 110 kV.

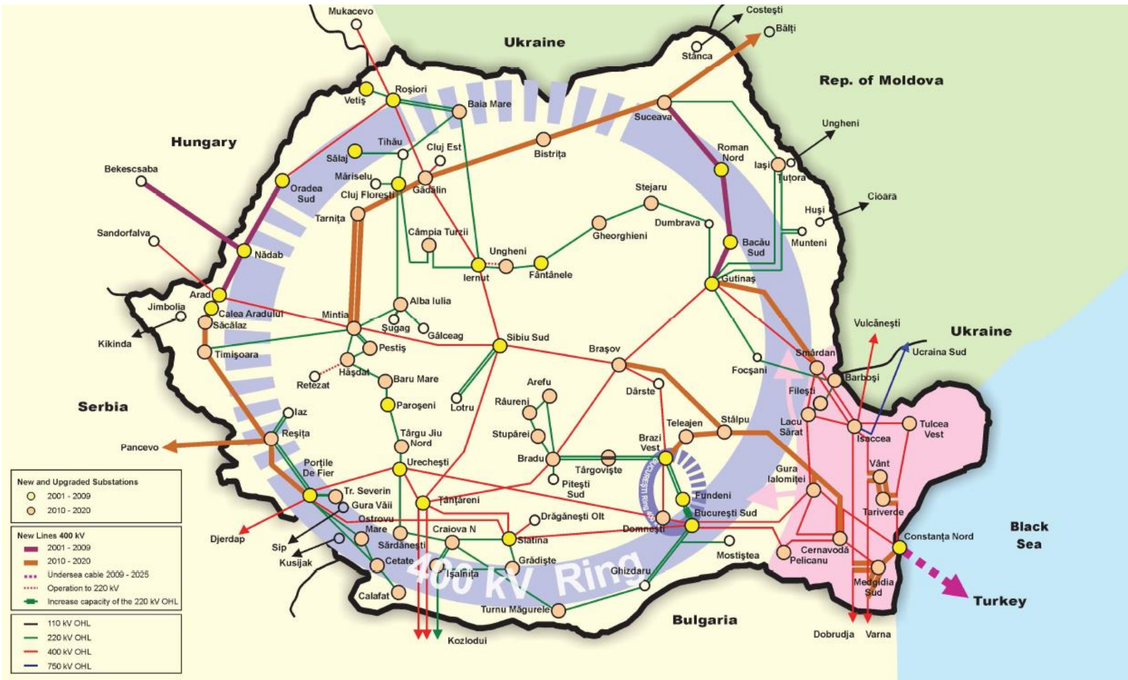
The amount of installations managed by CNTranselectrica SA consists of:

- 81 electric substations, of which:
  - ✓ One 750 kV substations
  - ✓ 38 substations at 400 kV
  - ✓ 42 substations at 220 kV
- 8759.4 km overhead electric lines (OHL), of which:
  - ✓ 155.62 km at 750 kV
  - ✓ 4706.8 km at 400 kV
  - ✓ 3059.4 km at 220 kV
  - ✓ 38 km at 110 kV

of which interconnection lines: 425.8 km

- 216 main transformer units amounting to 37,794 MVA, as follows:

At present the Romanian Power System is interconnected to the neighbouring power system by means of the following lines (Figure II_F_4):



Source: Transelectrica

Figure II_F_ 4 *Romanian electricity Transmission Network*

Section Romania – Bulgaria includes:

- OHL 400 kV Isaccea – Dobrudja;
- OHL 400 kV d.c Ţânţăreni – Kozlodui.

Section 400 kV Romania – Serbia includes:

- ➢ OHL 400 kV Porţile de Fier – Djerdap.

Section 110 kV Romania – Serbia includes:

- ➢ OHL 110 kV Ostrovul Mare – Kusjak;
- ➢ OHL 110 kV Gura Văii – Şip;
- ➢ OHL 110 kV Jimbolia – Kikinda.

Section Romania – Hungary includes:

- ➢ OHL 400 kV Arad – Sandorfalva;
- ➢ OHL 400 kV Nadab-Bekescsaba.

Section Romania – Ukraine includes:

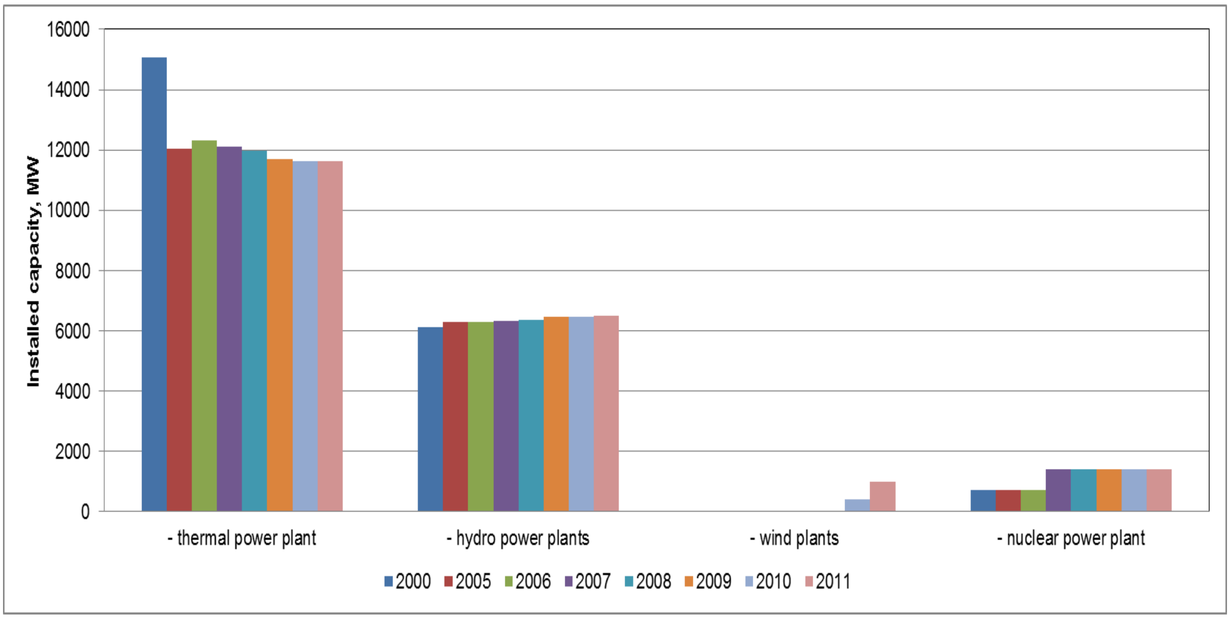
- ➢ OHL 400 kV Roşiori – Mukacevo.

Section Romania – Moldavia Republic with island function includes:

- ➢ OHL 400 kV Isaccea – Vulcăneşti (line only for National Power System imports);
- ➢ OHL 110 kV Stânca – Costeşti;
- ➢ OHL 110 kV Cioara – Huşi;
- ➢ OHL 110 kV Ţuţora – Ungheni.

II.F.3 Electricity, generation and consumption

In 2011, the National Power System (NPS) had an installed power of 20,498 MW. The installed power evolution during 2000 – 2011 periods registered a decrease by 6.4 % due to the fact that there were put in operation only the second unit of Cernavodă Nuclear Power Plant and hydroenergetic groups with a total installed power of 240 MW, thermoenergetic units at the end of the normal lifetime being decommissioned. (Figure II_F_5).



Source: National Institute for Statistics – Energetic balance and Structure of energetic equipment – collections

Figure II_F_ 5 *Installed power capacity in Romania within 2000 – 2011 [MW]*

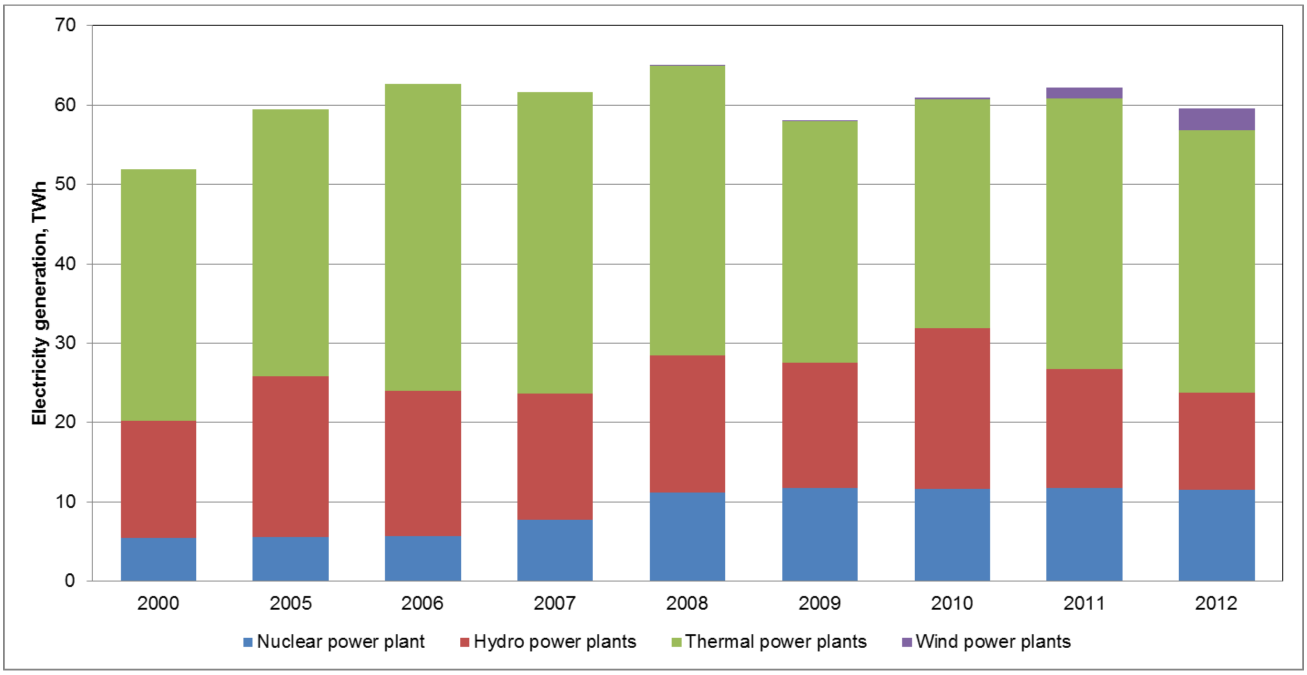
Table II_8 and Figure II_F_6 illustrates the main features of NPS within the 2000 – 2011 period as well as the electricity generation evolution per types of power plants.

***Table II_ 8** Main features of NPS*

Year	Gross electricity generation [GWh]	Net electricity generation [GWh]	Gross peak of electricity demand [MW]
2000	51,935	47,066	8265
2001	53,866	48,766	8569
2002	54,935	50,400	8410
2003	56,645	51,525	8356
2004	56,482	51,934	8761
2005	59,413	54,804	8970
2006	62,696	56,835	9650
2007	61,673	56,450	9526
2008	64,956	59,770	9373
2009	58,016	53,272	8825
2010	60,979	56,546	9349
2011	62,216	56,968	9509

Source: *National Institute for Statistics – Energetic balance and Structure of energetic equipment - collections, CN TranselectricaSA*

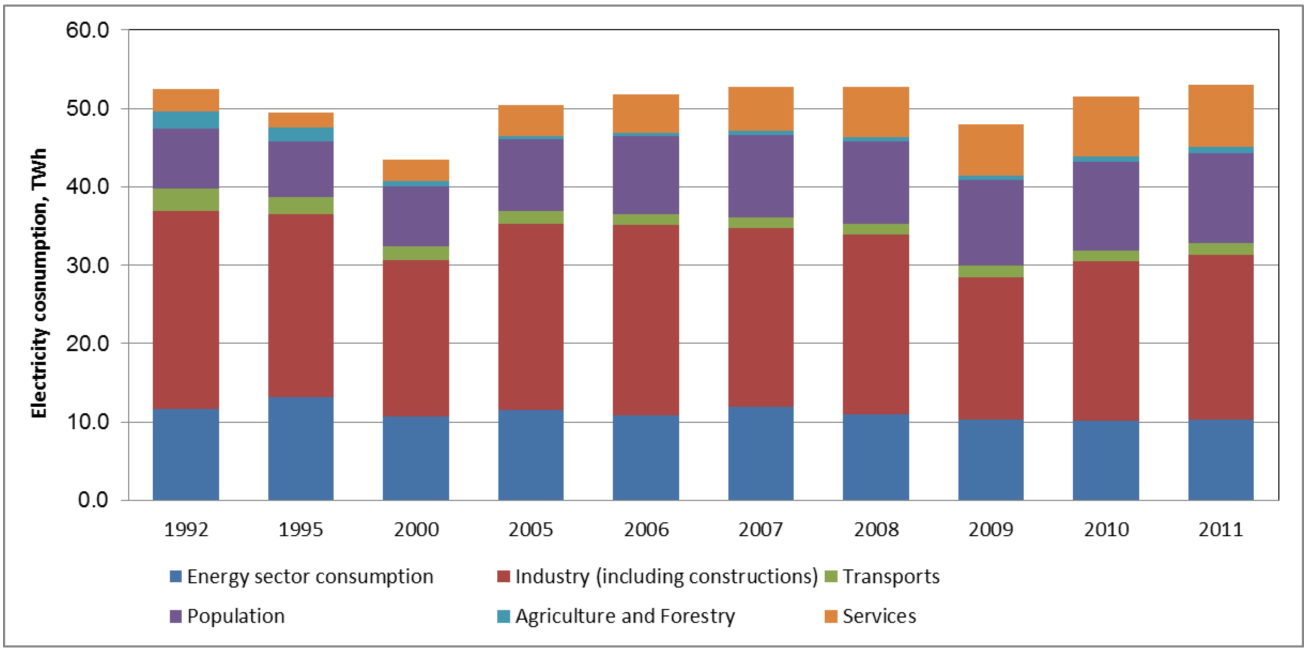
NPP Cernavoda outputs accounted for about 9% (until the 2006 year) of generated electricity and for about 19% in 2011. The share of electricity generated in the hydropower plants is between 23% and 33%, according to the hydrologic conditions.



Source: National Institute for Statistics – Energy balance and Structure of energy equipment - collections
**NIS- PRESS RELEAS NO. 31 of 7 February 2013 - Energy resources in 2012 - provisional data*

***Figure II_F_ 6** Evolution of electricity generation per types of power plants*

The evolution of electricity consumption on economy main sector is presented in the Figure II_F_7:



Source: National Institute for Statistics – Energy balance and Structure of energy equipment - collections

Figure II_F_ 7 *Evolution of electricity consumption per consumer's types*

The industry final electricity consumption decreased during the period 1992 – 2011 as a result of economic restructuring, of the transition to free market economy as well as of the crisis effects.

The entire economic and technical operation and development of the electricity sector is regulated, supervised and monitored by the National Electricity and Heat Regulatory Authority (ANRE), set up in October 1998 as a public institution, independent and autonomous.

The GHG emissions related to electricity sector might vary broadly, depending on the intensity of hydro power use, fossil fuels prices, availability factors etc. From National GHG Inventory data it is obvious that in 2011, there was a decrease of GHG emissions, due to decrease of electricity consumption and also due to the increasing share of the renewable electricity generation.

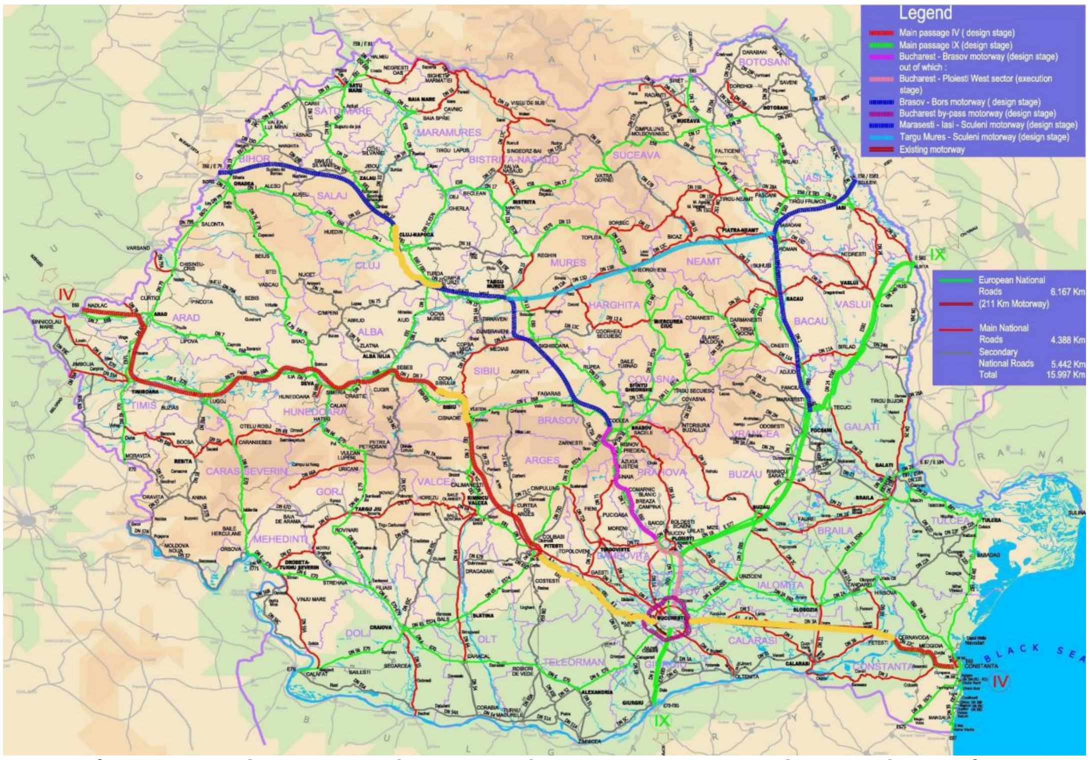
II.G. Transport profile

Romania has a national transportation system (infrastructure, transport equipment, etc.) largely at the same level with the average standards of conventional transport systems in Europe from the point of view of both the functional structure and services rendered.

Strategic framework for sustainable transport policy in Romania has aligned European policy defined in the White Paper of transport.

In the Transport sector, Romania holds a key position at the eastern border of the EU as a transit area both on the east-west direction (link to Asia via the Black Sea) and north-south (from the Baltic Sea to the Mediterranean Sea). Three of the TEN-T priority axes cross Romania.

According to data from NIS at 31 December 2011 road transport performed on public roads has totalling 83,703 km out of which 16,690 km (19.9%) were national roads, 35,374 km (42.3%) were county roads and 31,639 km (37.4%) were village roads. In 2012, Romania had only 504 km of highway; the road network is in very poor condition only 25,791 kilometres (32%) were upgraded by the end of 2011 and 34,963 km (41.8%) are still gravel and earth covered roads. Status of road infrastructure and low density of public roads of 33.3 km per 100 km^2 in 2009 compared to the EU 25 average of 101.1 km to 100 km^2 in 2003 lead to enhanced distance, traveling time and excessive fuel consumption, with harmful effects on the environment. In 2012, the European road length was 6188 km.



Source: Ministry of Environment and Forests National Environmental Protection Agency - National report on the state of environment in 2011, Bucharest 2012

Figure II_G_ 1 *Roads map of Romania*

Local public transport of passengers is steadily declining since 1990. Number of urban settlements with public passenger transport declined steadily from 115 in 2000 to 95 in 2007.

At the same time, the length of the simple line for public transport infrastructure (tram and trolleybus) recorded the same downward trend in the last decade, simple line length decreasing during 2000-2010 by 10% for trams and by 51% for trolleybuses.

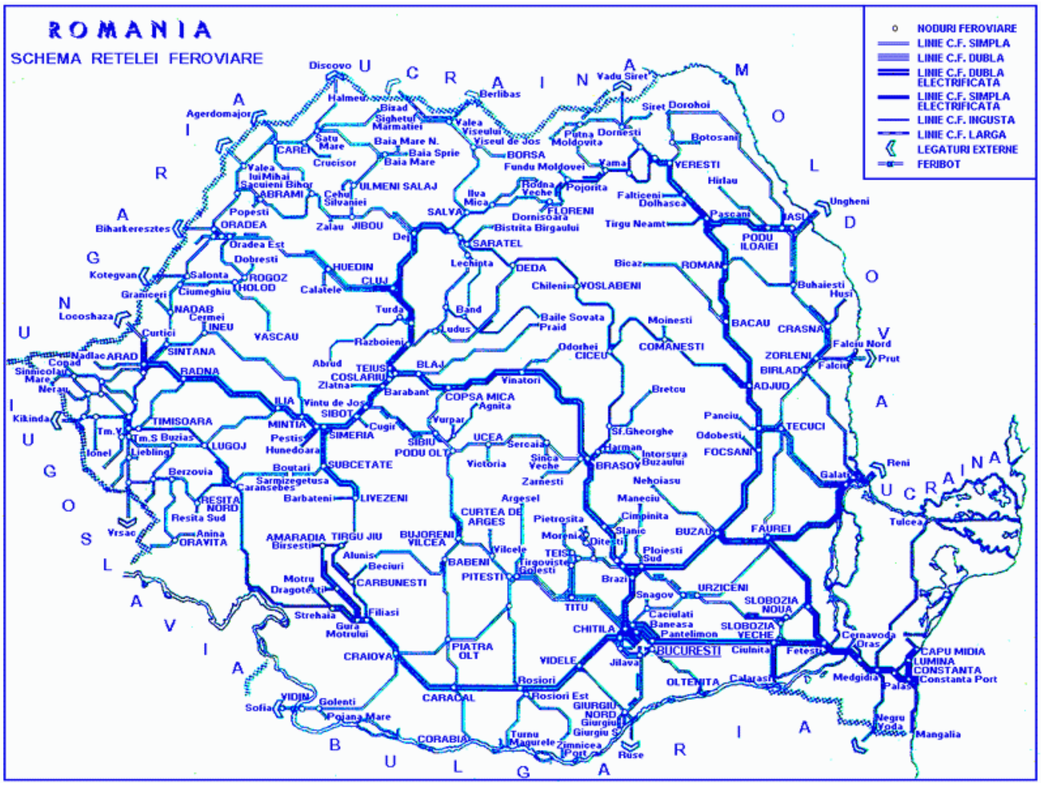
Number of vehicles had different evolutions, trams and trolleybuses number has been steadily declining (25% decline for trams during 2000-2009), the number of buses and minibuses increased by approximately 10% during 2000-2009.

The subway, transportation facility specific to Romanian capital, Bucharest, has registered limited positive evolution during 2000-2009, both in terms of length of railways (about 6%) and vehicles in inventory (about 21%). However it is necessary to transport a number of increasingly larger passenger and building new subway lines for surface traffic decongestion and development of a sustainable transport.

There are discrepancies between rural and urban areas in terms of public transportation services that are provided 33% of villages in rural areas, compared to 67% in urban areas.

At the end of 2011, according to NIS, public railways line in operation, amounted 10,777 km. Length of electrified railway lines in operation summarised 4,020 km representing 37.3% of the rail network in operation.

The rail network is relatively equal distributed, the average density of lines per 1000 km^2 being 45.2 ‰. The highest densities were recorded in following order, in the Bucharest-Ilfov Region (153.2 ‰), Western Region (59.1 ‰), North-West Region and South-East Region (48.8 ‰).



Source: Ministry of Environment and Forests National Environmental Protection Agency - National report on the state of environment in 2011, Bucharest 2012

***Figure II_G_ 2** Railways network map*

Infrastructure has experienced a continuous decline in the last two decades. In addition to the decommissioning of rail lines and reduction of trains it has been noticed a worrying increase of the traveling times. All these factors have contributed to the considerable decrease in the trains use in the favour of the other modes of transport, especially road transport.

During 2009-2011, being performed upgrades works mainly targeted on sectors "Hungarian border - Curtici - Arad" and "Simeria - Coslariu - Sighisoara" the maximum running speed has increased of 160 km /h for passenger trains and 120 km/h for the goods transport trains.

Water transport is performed on the Danube and the channel Danube-Black Sea / Poarta Albă - Midia Năvodari and in the main river and maritime ports (Braila, Galati, Tulcea, Cernavoda, Giurgiu, Calafat, Drobeta Turnu Severin, Constanta).

Constanta Port has a favourable geographical position, being located on the TEN-T core network, on the route linking the North Sea to the Black Sea through the Rhine-Main-Danube corridor. Constanta Port has a major role in European intermodal transport network, located at the intersection of trade routes connecting the markets of Central and Eastern Transcaucasus region, Central Asia and the Far East.

River shipping market share decreased from 6.8% in 2001 to 3.3% in 2007, even thought it has increased by 32%. The volume of goods transported by inland waterways in 2008 was 30,295 thousands of tons representing 37.5% of total goods loaded / unloaded in ports. In 2008, the port container transportation on inland waterways was 11,555 TEUs, representing 51% of total port transportation.

A significant decrease was recorded in the market share of cargo shipping from 55.6% in 2000 to 14.3% in 2001 and below 0.1% in 2007. During 2008, the ports that developed the most intense activity are Constanta, with a share of 90.7%, Midia, with a share of 4.6% and Galati with a share of 3.4%.

Air transport remains at a low level, accounting only 3% of human traffic and 1% of the transport of goods. Air transport is currently dominated by Bucharest Henri Coanda Airport, the main international airport in the country. TEN-T core network covers on the territory of Romania the airports Henri Coandă in Bucharest and Traian Vuia in Timişoara and TEN-T extended network includes airports Constanta, Tulcea, Craiova, Braşov, Sibiu, Cluj Napoca, Oradea, Baia Mare, Bacău, Suceava and Iaşi.

The number of air passengers in Romania increased from 3.633 million to 9 million during 2005 ÷ 2010. Of the approximately 10 million passengers, about 5 million passengers transited the Henri Coanda International Airport in Bucharest. The volume of goods transported increased from 18,000 tonnes to 24,000 tonnes in the same period. Although advantageous, the share of total air cargo freight to / from Romania is not significant.

The transport sector is one of the most important sectors both from the point of view of energy consumption and environmental implications. Transport sector development is done in tightly correlation with socio-economic development of Romania.

II.H. Industry

Romanian industry was severely affected by the transition from planned economy to market economy and the loss of existing market within Comecon. In the period 1990 - 2005 were carried out actions of restructuring and privatization of industrial enterprises. Undertakings that hadn't any market or couldn't handle economic competition had ceased their business. After

2008 due to the global economic crisis, some undertakings had ceased their business because of marketplace lack (metallurgical enterprises, heavy machinery businesses, etc.).

After 1989 year, the Romania economy had experienced a structural adjustment. Thus, in 2000 the industry, agriculture and constructions have contributed by 46.43% to the formation of Gross Value Added against 67.8% which was the contribution thereof in 1990. We remark a relative continuous course of increase of contribution of the services sector as against the other economic branches until the 2005 year. In Table II_9 the evolution of the GVA per activities sectors in the 2000 - 2011period is presented. We remark that in the economic-development period of 2000 - 2007 the industry and agriculture sectors reduced their contribution to Gross value added as against the construction and services sectors. This direction is not kept in the crisis period. Taking into account the macroeconomic structures of the EU countries, which suffered a long restructuring process, we can conclude that, after the crisis, the direction of decrease of industry and agriculture contribution and GVA formation will be kept, but in lower measure.

Table II_ 9 *Contribution of different activities to GPD growth within 2000-2010 [%]*

Indicator	**2000**	**2005**	**2010**	**2011**
TOTAL GVA out of which:	100	100	100	100
Industry	29.02	28.10	31.85	33.02
Agriculture	12.06	9.52	6.4	7.48
Constructions	5.35	7.39	10.24	9.76
Services	53.57	54.99	51.51	49.74

The main sectors of the Romanian economy are: industry, energy, construction, agriculture, tourism, communications (internet, mobile and landline phone), commerce, trade and public sector.

Romania's main industries are: textiles and footwear, metallurgy, light machinery and assembly of machinery, mining, wood processing, building materials, chemical, food and oil extraction and refining. Pharmaceutical industry, heavy machinery and household appliances have a steady annual growth. Currently, the car industry is very wide and oriented towards the market. Romania's economic power is focused primarily on the production of goods by small and medium enterprises, in industries such as precision machinery, motor vehicles, chemicals, pharmaceuticals, household appliances and clothing.

The evolution of Romania different industrial branched depends on the economic development of entire country and the area policies adopted within EU, as well as on the socio-economic context at world level. In the Table II_10 the evolution of the industrial contribution to GVA formation during 2000 - 2010 is presented and one should mention that the procession industry has the main share (approx. 80%). Important contributors to the GVA formation are the food industry, the industry of beverages and tobacco products (approx. 20%), industry of transportation (approx. 11%), energy industry (approx. 13%), and metallurgy industry (approx. 8%).

Table II_ 10 *Evolution of the contribution of different industrial branched to GVA formation*

Indicator	**2000**	**2005**	**2008**	**2009**	**2010**
TOTAL GVA, of which:	100%	100%	100%	100%	100%
Extractive industry	7.98	5.28	4.38	4.90	5.84
Manufacturing industry	80.68	85.39	85.41	82.2	76.17
Food industry, industry of beverages and tobacco products	24.57	24.35	23.17	22.10	19.48
Manufacture of textiles, clothes and leather goods	8.15	9.10	7.30	6.40	7.46
Manufacture of wood and of the paper and polygraph goods	9.44	7.01	6.36	6.30	5.44
Manufacture of coke oven products	3.78	5.00	3.98	2.87	1.11
Manufacture of chemical substances and products	6.08	6.24	2.53	2.07	1.13
Manufacture of basic pharmaceutical products	0.00	0.00	0.83	1.19	0.19
Manufacture of rubber and plastic products and of other non-metallic mineral products	0.00	3.81	8.18	7.11	3.41
Metallurgical and metal products industry	7.48	7.42	8.57	6.55	8.04
Manufacture of computers and electronic and optical products	12.26	5.59	3.21	3.59	5.75
Manufacture of electric equipment	0.00	0.00	3.56	3.42	3.73
Manufacture of machinery and equipment n.e.c.	0.00	4.32	3.07	3.06	3.00
Transportation means industry	4.21	8.46	10.57	13.62	11.23
Other industrial activities n.e.c.	4.73	4.09	4.09	3.93	6.20
Generation and supply of electricity heating, gas, warm water and air conditioning	10.00	8.52	8.21	10.16	13.06
Distribution of water, salubrity, management of waste and decontamination activities	1.35	0.81	2.00	2.71	4.92

II.I. Waste

Waste management is one of Romania's current issues. The integrated approach in waste management concerns waste collection, transport, treatment, capitalization and disposal activities and it includes the construction of waste disposal subsystems, together with measures on the prevention of their generation and recycling, in accordance with the hierarchy of principles: preventing waste generation and the negative impact thereof, waste recovery through recycling, reuse and the safe disposal of waste, when recovery is no longer possible.

The responsibility for the waste management activities shall fall with the generators thereof, in accordance with the "polluter pays" principle, or, as appropriate, with the producers, in accordance with the "producer responsibility" principle.

Each type of waste generated on the country's territory shall be formally classified into one of the following categories:

- Municipal waste;
- Industrial waste;
- Waste generated from medical activities.

Municipal waste represents the totality of waste generated in the urban and rural environment by households, institutions, commercial units, businesses (household waste and similar), street waste collected from public spaces, streets, parks, green areas, building-demolition waste generated in households and collected by sanitation operators and sludge from the purification of municipal wastewater.

The table II_11 presents the evolution of the amount of municipal waste generated during 2006-2010.

***Table II_ 11** The amount of municipal waste generated during 2006-2010*

	2006	2007	2008	2009	2010
Total municipal waste generated, out of which:	8,866.42	8,895.19	9,251.00	8,440.00	7,073.42
1. waste generated and uncollected (estimated)*	2,057.58	1,973.53	1,879.83	1,501.29	1,250.10
2. municipal waste collected, out of which:	6,808.84	6,921.66	7,371.17	6,938.71	5,823.31
- Domestic and biodegradable waste	5,362.44	5,243.18	5,669.12	5,283.35	4,572.06
- From municipal services	972.05	944.76	889.23	981.42	753.75
- Construction-demolition (including other types of waste)	474.35	733.72	812.82	673.94	497.51

Source: Ministry of Environment and Forests National Environmental Protection Agency - National report on the state of environment in 2011, Bucharest 2012

** The amount of waste generated and uncollected (generated by population that is not serviced by sanitation services) adds to the amount of municipal waste collected, in the table above. The amount of waste generated and uncollected was calculated depending on generation indexes established in PRGD, namely: 0.9 kg/location/day in the urban area and 0.4 kg/location/day in the rural area (Source: Medius database 2010)*

Municipal waste management entails their collection, transportation, capitalization and disposal, including monitoring the storage facilities after closure.

The responsibility for managing municipal waste belongs to the local public authorities who, directly or by concession of the sanitation service to an authorized service provider must insure the collection, selective collection, transportation, treatment, capitalization and final disposal of the waste.

In Romania, storage represents the main municipal waste disposal option. Out of the total generated municipal waste, over 95% was stored in 2011. Following an assessment of waste storage facilities, in 2012, an inventory of 79 operating storage facilities, 49 non-conforming facilities and 30 facilities conforming to the directive's storage requirements has resulted. The evolution of the storage facilitates' in Romania is presented in the table II_12.

***Table II_ 12** Number of Storage Facilities in Romania in the year 2012*

Facilities – year	2006	2007	2008	2009	2010	2011	2012
Conforming facilities	20	20	20	26	27	30	30
Nonconforming depth storage facilities	90	92	87	87	40	70	49
Nonconforming surface storage facilities	130	109	96	14	35		

Source: National Environmental Protection Agency

Conforming waste storage facilities are built and operated based on the operational and technical requirements and measures for the storage of waste with the purpose of preventing or reducing to as great an extent as possible negative effects on the environment (surface water, groundwater, soil and air) and on population health based on G.D. no. 349/2005 on waste storage, the Order of the Ministry of the environment and water management no. 757/2004 to approve the Technical norm regarding the storage of waste and GEO no. 78/2000 concerning the status of waste, with subsequent changes and additions.

According to the data reported by NEPA, the quantity of wastes deposited in 2011 in the compliant wastes deposits was of approximately 3,357,300 t. and in non- compliant wastes deposits was of approximately 2,331,000 t.

Romania's capitalization by recycling objective was of 38% in 2009, 42% in 2010 and 46% in 2011. In 2010, paper recycling objectives were of 60%, plastic recycling objectives were of 14%, glass recycling objectives were of 44% and metals' recycling objectives were of 50%.

As concerns the depositing of municipal wastes, in 2010 106 non-compliant deposits for municipal wastes were operating, out of which 26 ceased their activity on July 16th 2010 according to the negotiated calendar (annex to the Government Decision 349/2005 concerning wastes' depositing – transposing the European Directive 99/31/EC concerning wastes' depositing). For the other non-compliant municipal wastes still in their transition period (until 2017), it is currently performed the improvement of operation and monitoring activities. According to the negotiations for Romania's adherence to the EU provided in the Adhesion Treaty, Romania is obliged to ensure the gradual decrease of wastes deposited in these municipal deposits of non-compliant wastes, by observing certain maximum annual quantities.

Biodegradable waste

Most part of the total amount of municipal waste, is represented by domestic and biodegradable waste (around 72%), and approximately 45% of it is represented by biodegradable waste. These come from both households and from economic agents, commercial areas, offices, public institutions, hospitals, as well as from public areas (parks, public gardens, markets, streets).

Table II_13 presents the data on amounts of municipal waste generated (including amounts of estimated waste generated but uncollected) and amounts of waste collected by means of special services of town halls or sanitation companies in 2010, compared to 2009. The table also shows data on biodegradable waste generated.

Table II_ 13 *Amounts of waste generated and collected (including biodegradable waste) in 2010 compared to 2009*

Types of waste	**Amount of waste** - *mil.tons/year*	
	2009	2010
Total municipal waste generated, out of which:	9.15	7.56
- Biodegradable waste	3.60	3.36
- Municipal waste collected	7.25	6.32

Analysing data in Table II_13 one should observe a decrease of the total amount of municipal and biodegradable waste generated on national level in 2010 compared to 2009, of about 17%, as well as a decrease of the amount of biodegradable waste.

In Romania, waste incineration is not a common practice for the treatment/ disposal of the municipal and assimilated waste. So far, in Romania there were not put into operation incineration installations for municipal waste.

Hazardous waste generated in 2010, in the amount of 514,325 tonnes, accounted for about 0.3% of the total waste generated (including waste from extractive industries). Most hazardous waste were disposed of in landfills, the rest being recovered or disposed of by co-incineration or incineration in the generator's own plants or specialized plants belonging to private operators.

During 2010, the following systems have been in operation for the incineration of hazardous industrial waste:

- 8 incineration/co-incineration plants belonging to 8 private operators in the industry, that incinerate/ co-incinerate their own hazardous waste;
- 10 existing plants for the incineration of hazardous waste belonging to private operators incinerating for others;
- 7 co-incineration plants in cement kilns – authorized for hazardous liquid and solid waste treatment.

Industrial waste

In 2010, the amount of waste generated by mining, energy and manufacturing industries was about 191 million tons, most of which (90%) resulted from mining activities.

Non-hazardous wastes generated during 2006 – 2010 by the main economic activities excluding waste from mining industry are shown in Table II_14.

Table II_ 14 *Non-hazardous waste generated by main economic activity, with the exception of the mining industry, during 2006 – 2010,*

Thousand tons

Economic Activity	2006	2007	2008	2009	2010
Manufacturing Industry	8,964.15	18,860.39	10,678.66	7,780.74	7,010.46
Production, transportation and distribution of thermal energy, electricity, gas and water	102,551.84	36,465.59	7,055.92	6,103.45	5,886.2
Collection, purification and distribution of water	220.82	10.96	20.58	12.85	17.62
Other	483.92	1.494.34	506.52	739.25	514.9
Total	112,220.73	56,831.28	18,261.68	14,636.29	13,429.18

Quantities of hazardous waste generated by the main industrial activities during 2006 - 2010 are presented in the table II_15.

Table II_ 15 *Hazardous waste generated by main economic activity during 2006 – 2010,*

Thousand tons

Economic Activity	2006	2007	2008	2009	2010
Mining	497.59	11.24	31.11	87.79	146.27
Crude Oil Processing Industry, Coal Coking	226.35	37.89	114.53	125.91	157.51
Chemicals and Chemical Products Manufacturing	47.11	53.33	54.02	24.55	22.01
Metallurgy Industry	168.76	121.62	150.78	99.64	71.53
Machinery and Equipment Industry	33.05	26.67	28.58	25.36	24.63
Transport Industry	26.19	31.06	13.33	12.11	9.59
Other	53.76	137.28	42.59	63.22	82.77
Total	1,052.81	419.08	434.94	438.58	514.32

Medical Waste

Every year, the Ministry of Health, through the National Institute of Public Health Bucharest, issues a National overview called "Monitoring and inspection of the management system for waste generated from medical activities" and updates the national database on waste generated from medical activities. This is part of the National program for monitoring determining factors in life and work environments, i.e. Objective 1 - Protecting health and preventing diseases associated with environmental risk factors.

In 2011, the total amount of waste generated from medical activities in all the health care units in Romania, was 34,511 tons/year, of which 25,663 tons/year hazardous household waste, 7,497 tons/year hazardous infectious waste and 1,351 tons/year hazardous sharps waste.

In conclusion, the amount of hazardous waste generated from medical activities for 2011 was 8,848 tons/year.

Compared to 2010, there was a 17% decrease in the quantity of hazardous waste generated from health care units fitted with beds. During 2010 and 2011, based on regulations issued by the Ministry of Health, some hospitals were decommissioned, merged or repurposed as nursing homes for the elderly. This could be a factor in the waste reduction in 2011 compared to 2010.

II.J. Building stock and urban structure

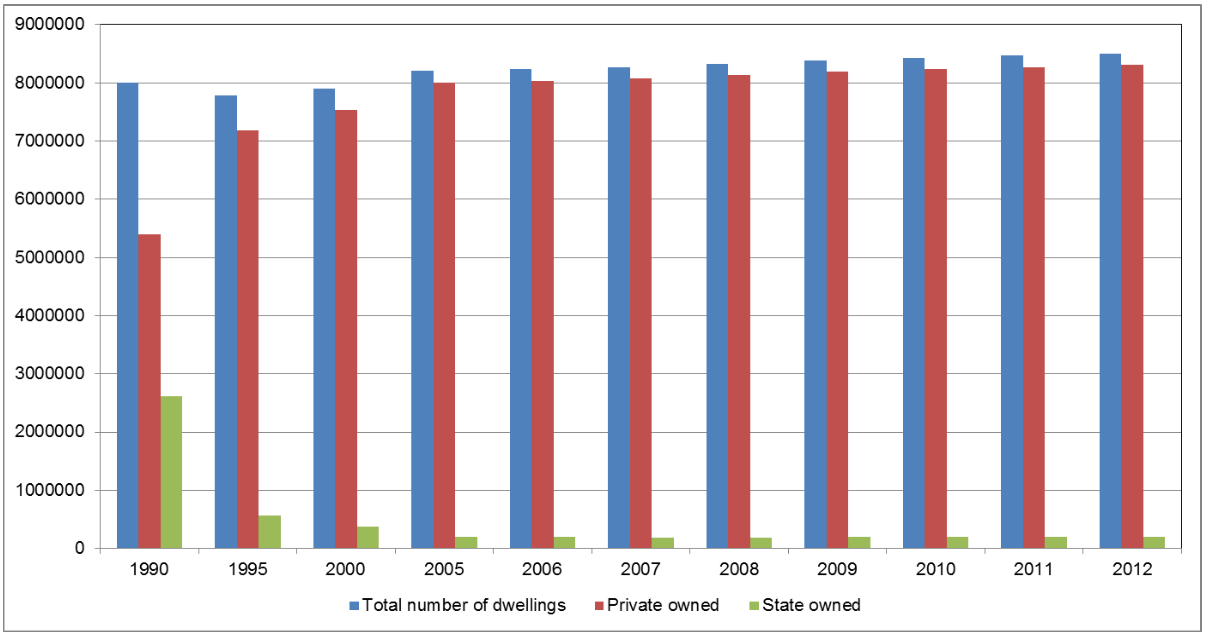
Construction may be considered one of the most dynamic sectors of national economy in the last 7-8 years, due mainly to the highest degree of private share (over 99.7% companies with major private capital in 2010). It is one of the engines 'pushing' the other sectors both by influencing the production of construction materials and other industrial and commercial activities, and by creating new residential and non-residential buildings and infrastructures.

The last Census of Population and Dwellings was done at the end of 2011 and preliminary results were:

- Households: 7,086,717 units;
- Dwellings: 8.5 million units, of which 8,450,607 conventional dwellings (54.2% in urban area) and 8,149 other living units;
- Buildings: 5,117,940 bldgs., of which 5,103,013 buildings with dwellings and 14,927 buildings with collective living spaces;
- Living area: 398,037 sq.m (55,4 % in urban area).

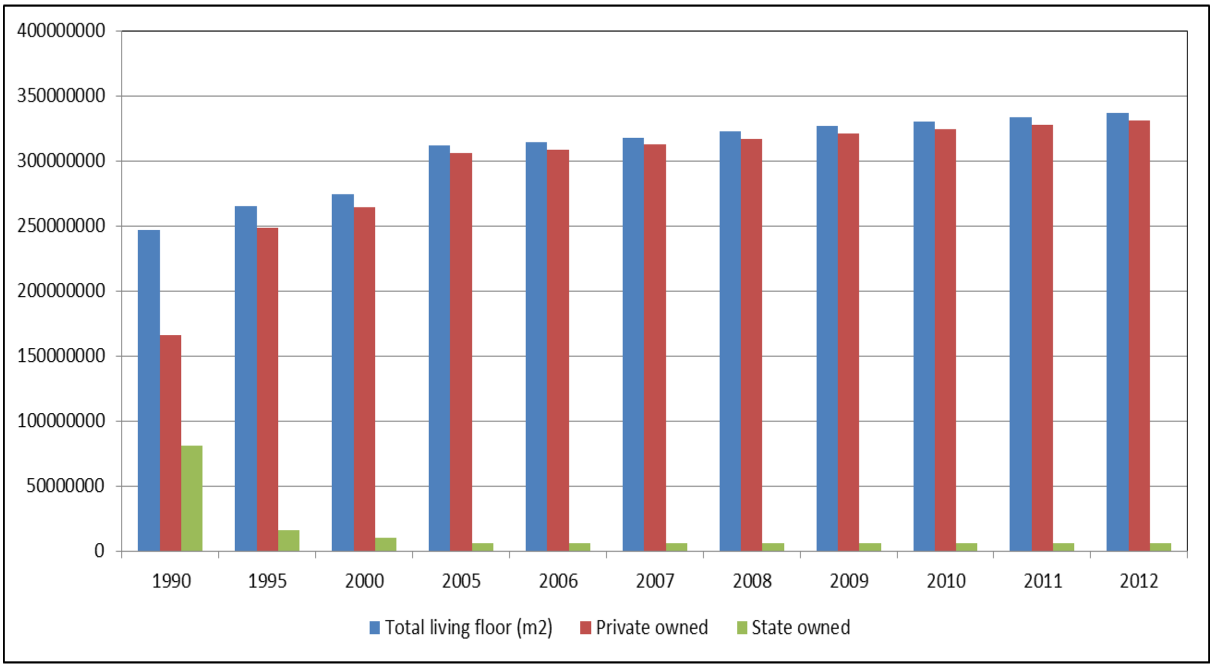
(Living area is the total useful area of living rooms, i.e. except the area of bathrooms, kitchens/kitchenettes, deposit areas and hallways).

In the figures II_J_1, II_J_2, II_J_3 are presented the evolution of the number of dwellings, living floor in the dwellings and finished dwellings, by areas in the period 1990-2012.



Source: National Institute of Statistics - Romanian Statistical Yearbook – collections

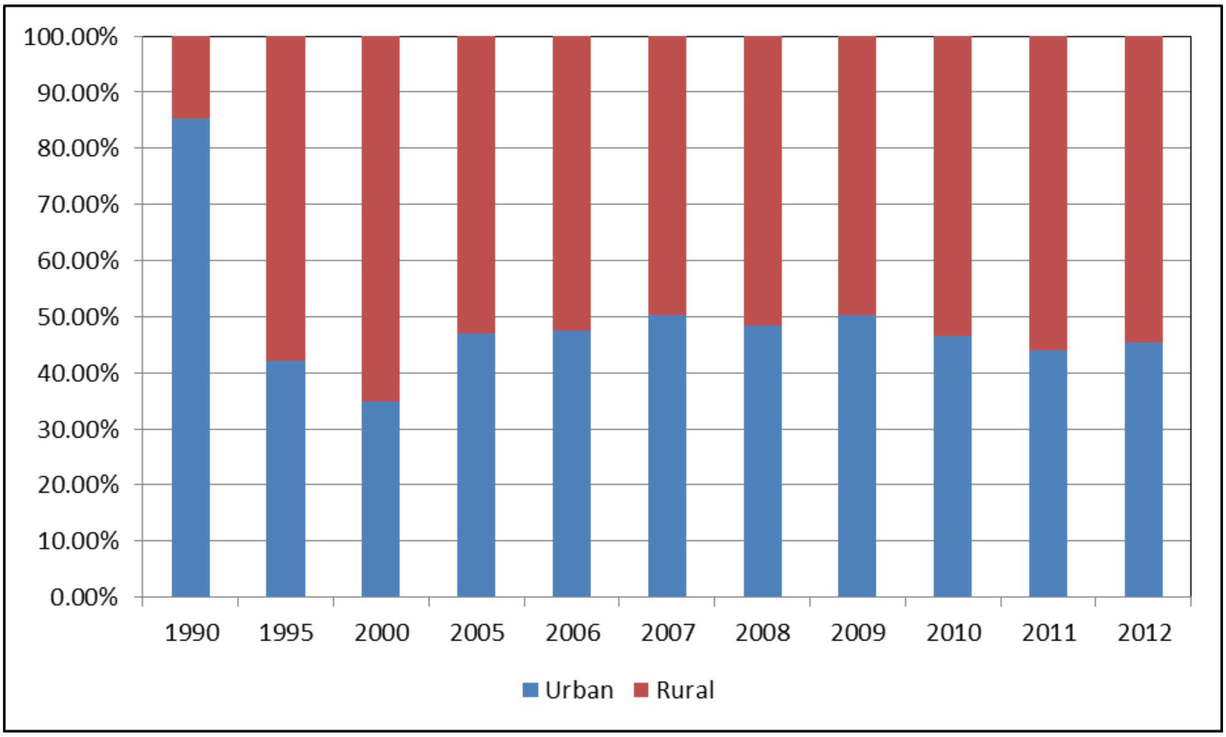
***Figure II_J_1** Number of dwellings*



Source: National Institute of Statistics - Romanian Statistical Yearbook – collections

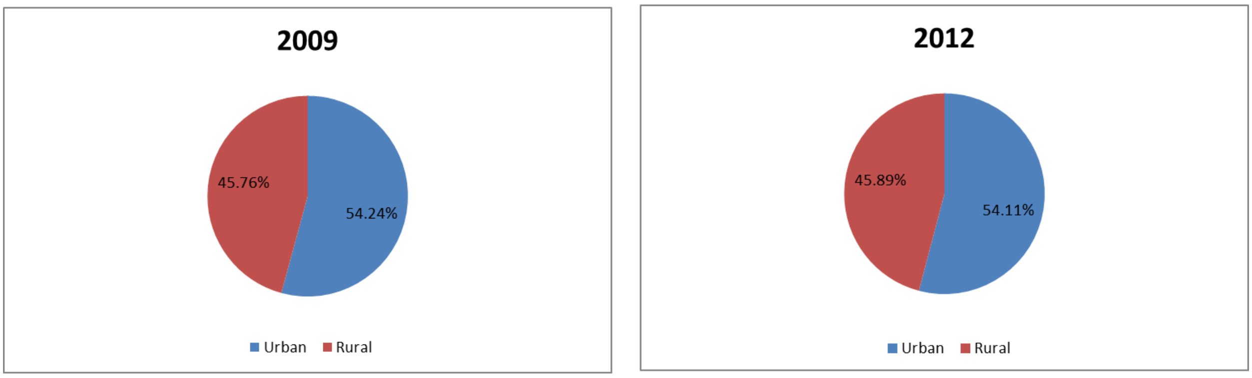
***Figure II_J_ 2** Living floor in the dwellings*

The average annual new build rate is less than 1% (Figure II_J_4) and is characterized by a major share of private funding.



Source: National Institute of Statistics - Romanian Statistical Yearbook – collections

Figure II_J_ 3 *Finished dwellings, by area*



Source: National Institute of Statistics - Romanian Statistical Yearbook – collections

Figure II_J_ 4 *Dwellings at the beginning of the year 2009 compared with year 2012, by area*

The insulation level of building envelope for residential building stock (built mainly before 1990) is very low, with the following reference average values (Source: INCD URBAN-INCERC):

- Block-of-flats (mainly urban area):
  - ✓ External walls: 1.35 – 1.90 W/m²K;
  - ✓ Terrace : 0.80 – 1.45 W/m²K;
  - ✓ Windows: 2.30 – 2.60 W/m²K.
- Individual house (urban and rural area):
  - ✓ External walls: 1.40 – 2.00 W/m²K;
  - ✓ Attic: 0.90 – 1.80 W/m²K;
  - ✓ Windows: 2.30 – 2.60 W/m²K.

The energy modernization of existing building stock is made both by private funding (owners) and public funding (national rehabilitation programs). For residential buildings two thermal rehabilitation programs are active: one established by Government Emergency Ordinance (GEO) no. 18/2009 applied block of flats built in the period 1950-1990 and the other one established by GEO no. 69/2010 for all residential buildings.

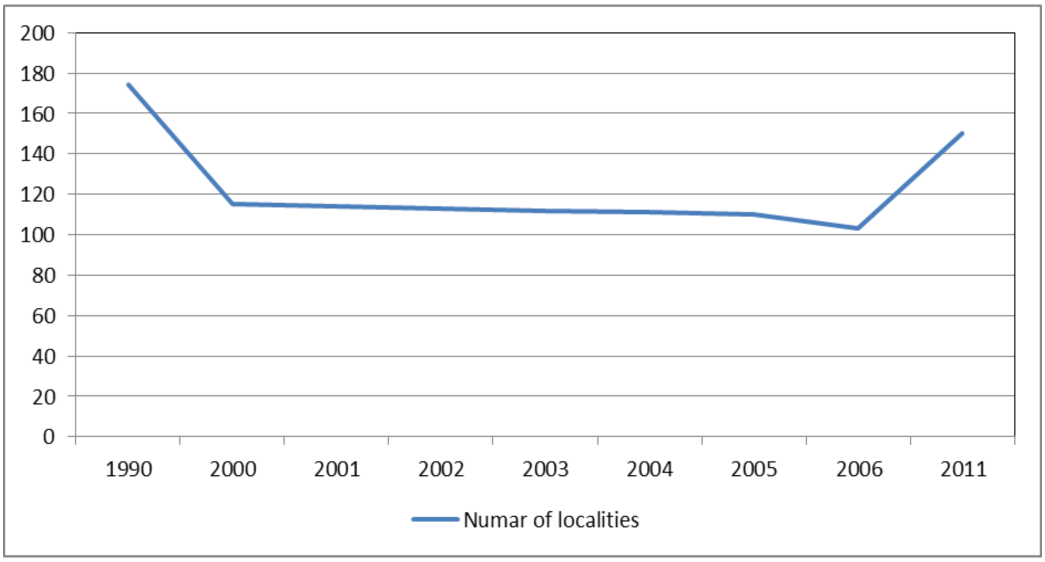
Houses were built both in the urban and rural areas; with a slight trend of accelerating the process in urban areas. In terms of utilities, almost all new houses benefit from all the required utilities.

Regarding the public utilities of dwellings in the following part is presented the situation of number of localities with:

- Public transportation systems;
- Drinking water supply installations;
- Public sewerage installations;
- Natural gas distribution network.

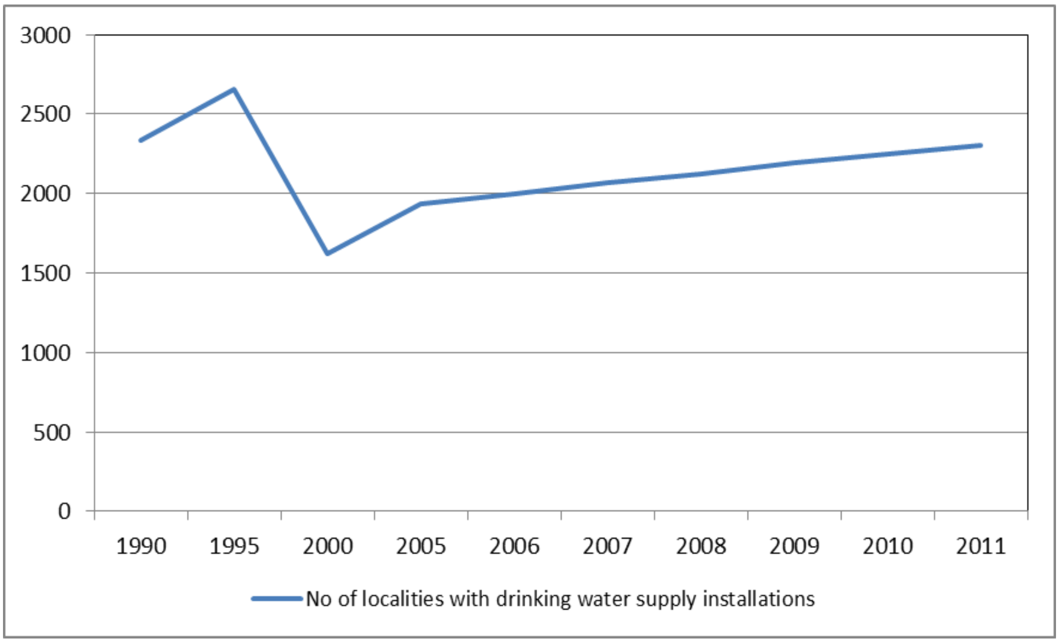
Regarding the public transportation systems, during the '90s, there was an accentuated trend of decreasing the number of localities organizing public transportation services. In the period 2000 – 2005, the number stabilized between 115 and 110, but in 2006 it decreased at 103, starting to increase again reaching at 150 in 2011 (in the urban area 101 localities and 49 localities in the rural area). (Figure II_J_5).

In the figures II_J_6, II_J_7, II_J_8 are presented the evolution of the number of localities with drinking water supply installations, with public sewerage installations, with natural gas distribution network in the period 1990-2011. On should remark the achieved investments or the increasing of level of life.



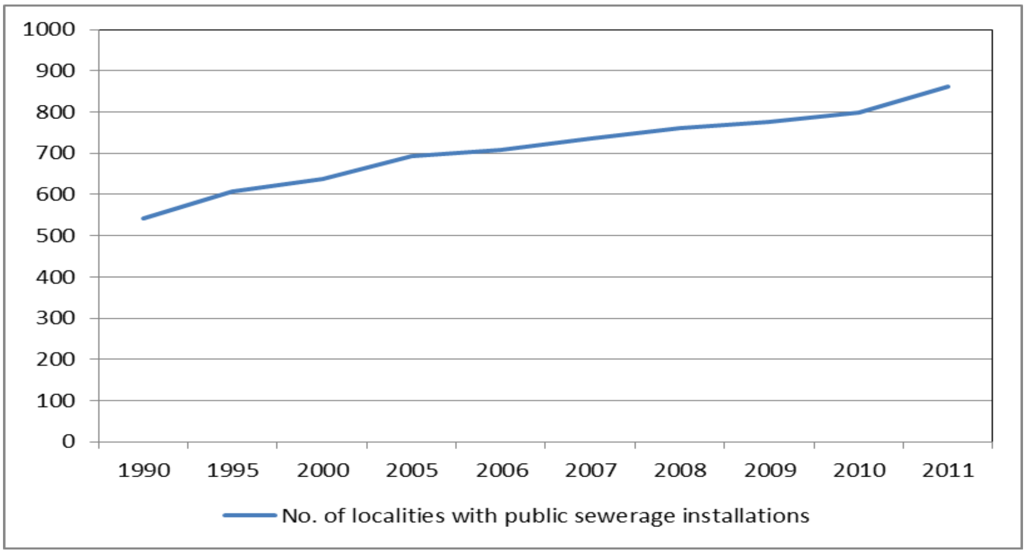
Source: National Institute of Statistics - Romanian Statistical Yearbook – collections

***Figure II_J_ 5** Number of localities with public transportation services*



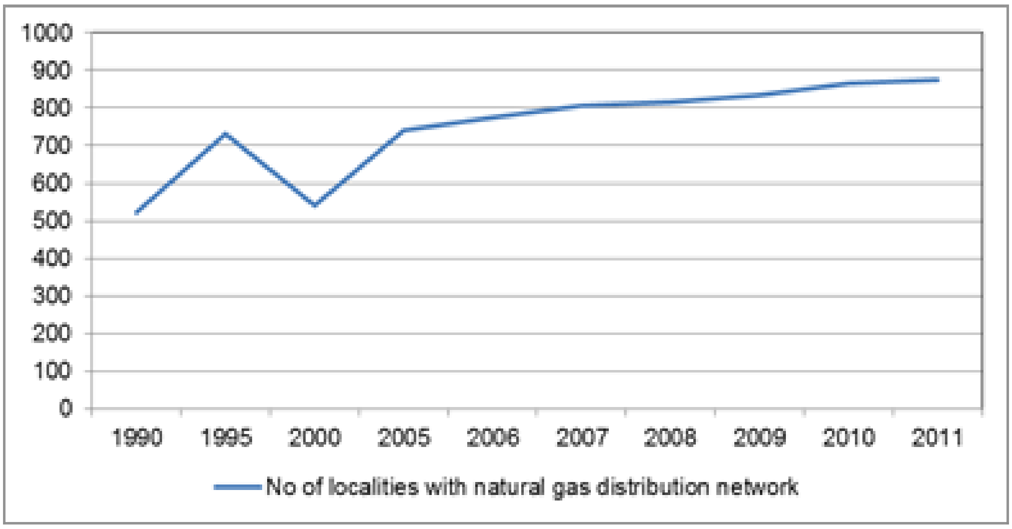
Source: National Institute of Statistics - Romanian Statistical Yearbook – collections

Figure II_J_ 6 *Number of localities with drinking water supply installations*



Source: National Institute of Statistics - Romanian Statistical Yearbook – collections

Figure II_J_ 7 *Number of localities with public sewerage installations*



Source: National Institute of Statistics - Romanian Statistical Yearbook – collections

Figure II_J_ 8 *Number of localities with natural gas distribution network*

II.K. Agriculture

Agriculture is an important sector in the Romanian economy contributing during 2005 - 2011 with 7 – 10 % of GDP, depending on the year and climatic conditions. Although agriculture was collectivized by the government in 1949, a land reform program instituted in 1991 returned more than 80 per cent of the country's agricultural land to nearly 5.5 million small farmers.

Romania had in 2011 a total agricultural surface of 14591 thousand ha on which 9,352 thou. ha surface was available for agriculture. Pastures and hayfields have also held important weights (22.5% respectively 10.7%). Vineyards and orchards, including nurseries accounted for the remaining 2.7% of agricultural surface.

The Romanian agricultural surface decreased slightly from year to year. Transfer of land to forestry and building sector was the main cause of reducing agricultural area in the past 20 years. Land area was reduced through its inclusion in urban areas was met in areas with higher productivity while in less-favoured areas the forests took place to agricultural land.

In Table II_16 it is presented the evolution of Romanian arable land by the usage type for the period 2005 – 2011.

Table II_ 16 *Agricultural area trend, 2005-2011 (thou. hectares)*

	2000	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
The total area of country	**23839.1**	**23839.1**	**23839.1**	**23839.1**	**23839.1**	**23839.1**	**23839.1**	**23839.1**
Agricultural land	14856.8	14741.2	14731.0	14709.3	14702.3	14684.9	14634.6	14590.9
Arable	9381.1	9420.2	9434.6	9423.3	9415.1	9422.5	9404.0	9352.3
Pastures	3441.7	3364.0	3334.4	3330.0	3333.0	3313.8	3288.8	3277.7
Meadows	1507.1	1514.7	1524.9	1531.4	1532.4	1528.0	1529.6	1553.5
Vineyards and vine nurseries	272.3	224.1	223.7	218.0	214.5	215.4	213.6	211.3
Orchards and fruit tree nurseries	254.6	218.2	213.4	206.6	207.3	205.2	198.6	196.1

Source: National Institute of Statistics – Romanian Statistical Yearbook – collections

Main crops in arable land are:

- Cereals for grains (wheat, rye, barley, maize etc.);
- Dried pulses (peas, dried beans);
- Roots crops (potatoes, sugar beet, fodder roots);
- Industrial crops (fiber crops, oilseed crops, etc.);
- Vegetables(tomatoes, dry onion, dry garlic, cabbage, green peppers, melons);
- Green fodder from arable land.

The production of fruit consists of: plums, apples, pears, peaches, cherries, apricots, nuts, strawberries, etc.

Table II_ 17 *Dynamics of vegetal agricultural production (thou. tones)*

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Cereal grains	14357	12964	24713	19346	15759	7815	16826	14873	16713	20842
Vegetables	2864	3358	3679	3625	4139	3117	3820	3902	3864	4176
Oil plants	1195	1760	2160	1803	2050	1047	1942	1764	2378	2687
Potatoes	4078	3947	4655	3739	4016	3712	3649	4004	3284	4077
Fruits	952	2098	1444	1647	1486	1086	1179	1323	1420	1480

Source: National Institute of Statistics – Romanian Statistical Yearbook – collections

Table II_ 18 *Number of animals in farms in the period 2002 - 2011 (thou. heads)*

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Cattle	2878	2897	2808	2862	2934	2819	2684	2512	2001	1989
Pigs	5058	5145	6495	6622	6815	6565	6174	5793	5428	5364
Sheep	7312	7447	7425	7611	7678	8469	8882	9141	8417	8533
Goats	633	678	661	687	727	865	898	917	1241	1236
Horses	879	897	840	834	805	862	820	764	611	596
Poultry	77379	76616	87014	86552	84991	82036	84373	83843	80845	79842

Source: National Institute of Statistics – Romanian Statistical Yearbook – collections

Table II_ 19 *Animal production in the period 2003 – 2011*

	M.U.	2003	2004	2005	2006	2007	2008	2009	2010	2011
Meat - total	thou tonnes live weight	1699	1666	1508	1401	1503	1426	1443	1305	1357
Milk - total	thou hl	57736	59837	60614	64607	61048	59006	56383	49129	50074
Eggs	mill. pcs.	6641	6927	7310	7133	6226	6438	5946	5951	6086
Wool	tonnes	16879	18049	18390	19378	21025	22075	22352	20457	19026
Extracted honey	tonnes	17409	19464	17704	18195	16767	20037	19937	22222	24127
Fish	tonnes	10050	10498	13352	12576	15106	16250	15202	15184	11593

Source: National Institute of Statistics – Romanian Statistical Yearbook – collections

The agricultural employment is large but ageing. In 2011 it represented about 39% of total employment, 33.6% of whom were aged over 55 years. Of total employment 2,780 thou persons there were the following status: 5.2% employee, 0.1% employer, 52.9% self-employed, 41.6% contributing family worker.

The gap between the contribution to GDP and the size of the agricultural employment reflects a rural environment devoted almost exclusively to agriculture, with a level of labour intensiveness in line with inadequacy of technical resources.

The export of products of agriculture represents only 4 - 5% of total Romanian export.

The net investments in agriculture represent only 3 - 4% of total net investments by activity of national economy.

GHG emissions related to agricultural sector are due to:

- Fuel combustion (CO_2);
- Enteric fermentation (CH_4);
- Manure management (CH_4 and N_2O);
- Rice cultivation (CH_4);
- Agricultural soils (N_2O);
- Field burning of agricultural residues (CH_4,N_2O, NO_x and CO).

Contribution of agriculture in total GHG emissions in the period 1989 - 2011 altered between 11% and 14.54%.

Structure of ownership and agricultural holdings

After 1990 the agricultural sector underwent significant changes as a result of Law No.18/1991, which concerns the distribution of agricultural area. So following the enforcement of the restitution laws in 2010 around of 94.3% of agricultural area was private ownership (includes: private ownership of state, of administrative territorial units, of legal persons and of natural persons).

Almost all of total agricultural surface was privatized. In the present Public Property fields account for only 0.5% of arable land, 0.7% of pastures total area and 0.2% of meadows total area.

In 2011 from the total 3,724,332 farms, 3,459,123 utilized arable lands between 0.1 and 10 ha, resulting that average arable land of farm was about 3 ha, situating Romania below average size of a European farm. In Romania existed only 13,657 farms with larger areas than 100 ha, 7,556 farms with areas between 50 and 100 ha, and 243,996 farms with areas between 10 and 50 ha.

Privatization process of arable land generated in Romanian agriculture two structural disadvantages: large area of fields and small farms, large area of field owned by farmers at retirement age.

Almost half of total surface and livestock exist in subsistence farms, fact which diminishes agriculture sector performance. To strengthen subsistence farms to become viable and competitive are required interventions for restructuring. Associative actions will play a major role.

II.L. Land use and forestry

II.L.1 Land use

Table II_20 presents the evolution of the land in the period 2000 - 2011 according to the National Institute of Statistics. It results that in 2011 arable areas represented 39.23%, forests 28.53%, pastures and hayfields 20.27%, vineyards and orchards 1.71%, buildings, roads and railroads 4.72%, waters and ponds 3.45% and other areas 2.09% of the total land of Romania.

Table II_ 20 *The evolution of the land fund area during 2000 – 2011 (thou. hectares)*

	2000	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
The total area of land fund	**23839.1**	**23839.1**	**23839.1**	**23839.1**	**23839.1**	**23839.1**	**23839.1**	**23839.1**
Agricultural land	14856.8	14741.2	14731.0	14709.3	14702.3	14684.9	14634.6	14590.9
Arable	9381.1	9420.2	9434.6	9423.3	9415.1	9422.5	9404.0	9352.3
Pastures	3441.7	3364.0	3334.4	3330.0	3333.0	3313.8	3288.8	3277.7
Meadows	1507.1	1514.7	1524.9	1531.4	1532.4	1528.0	1529.6	1553.5
Vineyards and vine nurseries	272.3	224.1	223.7	218.0	214.5	215.4	213.6	211.3
Orchards and fruit tree nurseries	254.6	218.2	213.4	206.6	207.3	205.2	198.6	196.1
Forests and other forest vegetation	6457.3	6742.8	6754.7	6740.9	6728.6	6752.9	6758.1	6800.9
Forests	6223.1	6233.0	6272.3	6314.9	6309.3	6334.0	6354.0	6362.5
Other areas with forest vegetation	234.2	509.8	482.4	426.0	419.3	418.9	404.1	438.4
Settlements	632.9	657.1	674.7	685.7	692.1	703.3	728.3	737
Roads and railways	388.2	391.1	389.4	390.1	390.4	389.8	388.9	388.8
Land covered with waters, ponds	867.8	841.4	841.8	849.9	849.3	833.3	833.6	822.7
Other areas	636.1	465.5	447.5	463.2	476.4	474.9	495.6	498.8

II.L.2 Forestry

Romania's national forestry real estate occupies at the end of 2011, an area of 6800.9 thousands hectares, representing 28.53% of the country surface. Forestry real estate area on 31st of December 2011, compared with the same date of 2010, increased with 0.1% due mainly to the inclusion of forest areas outside the forest in the national forest, according to the Law 46/2008 regarding the approval of the Forest Code. At European level, Romania ranks 13 in terms of percentage of afforestation, which is below the EU average of 43.24%.

With about 0.30 ha/capita in terms of forest area related to the number of inhabitants, Romania ranks 10 European level. The spread of forest over the country territory is uneven (10.9% at the plains, 37.2% at the hill, 51.9% at the mountain).

In the plains, successive deforestation linked to land improvement sector underfunding has led to more and more frequent and prolonged drought. Cutting forest in hill and mountain areas it correlates with torrential phenomena, of erosion and land degradation.

In accordance with Law 46/2008 of Forest Code there are 15 counties considered poor areas in forest in which the forest area is under 16% of the total. This per cent ranges from 4.0% in Calaraşi to 15.7% in Ilfov.

The main priority is the implementation of the National Programme of expanding forest areas, to reduce the impact of climate change and the risk of desertification, especially in areas with deficient in forests, to improve the surface leakage and diminish the risk of floods, landslides, erosion, lakes warping.

III. GREENHOUSE GAS INVENTORY INFORMATION, INCLUDING ON NATIONAL SYSTEM AND NATIONAL REGISTRY

This chapter presents information on 2013 (last) submission of Romania's National GHG Inventory (NGHGI) of anthropogenic greenhouse gas emissions, submission to the UNFCCC Secretariat. The national greenhouse gas emissions/removals estimates were calculated for the period 1989-2011. The results are presented for every year of the analysed period and include also information on: trend analysis, data sources, key categories, uncertainties, and quality assurance and quality control (QA/QC) activities. The 2013 submission comprise the CRF Reporter database, CRF Tables and the National Inventory Report (NIR). As a Party to the Convention, Romania is required to develop and regularly to update the National GHG Inventory. The last NGHGI for the period 1989–2011 was compiled according to the recommendations for GHG inventories set out in the Updated UNFCCC reporting guidelines on annual inventories following incorporation of the provisions of Decision 14/CP. 11 (FCCC/SBSTA/2006/9), using the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 1996) as well as the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC GPG 2000) and Good Practice Guidance for Land Use, Land-Use Change and Forestry (IPCC GPG 2003).

The last NGHGI submission covers the obligation of Romania under the UNFCCC. It also constitutes Romania's voluntary submission under the Kyoto Protocol. The inventories cover all sectors and the majority of the IPCC source categories. The direct GHG (including groups of gases) included in the national inventory are:

- Carbon dioxide (CO_2);
- Methane (CH_4);
- Nitrous oxide (N_2O);
- Hydrofluorocarbons (HFCs);
- Perfluorocarbons (PFCs);
- Sulphur hexafluoride (SF_6)

The report also contains data on calculations of emissions of the indirect GHGs: NO_x, NMVOC, CO and SO_2, which should be included according to the reporting guidelines. GHG emissions inventories have been reported since the 2005 submission using the CRF Reporter software, delivered by the UNFCCC Secretariat. The last NGHGI refers to figures generated using the 3.6.2 version of the CRF Reporter.

The GHG inventories submitted annually by Parties are subject to reviews by expert review teams (ERT), coordinated by the UNFCCC Secretariat. Up to now, the GHG inventories of Romania were reviewed as follows:

Table III_1 *Information on reviews of the Romanian NGHGIs coordinated by the UNFCCC Secretariat*

Year	Submission	Review process
2002	CRF tables and draft NIR submitted (late submission)	No Review
2003	CRF tables and NIR submitted	In - country Review
2004	CRF tables and NIR submitted	Desk Review
2005	CRF Reporter database, CRFs for LULUCF and NIR submitted	Centralized Review
2007	2nd version of the 2006 submission: CRF Reporter database, CRF Tables and NIR + Initial Report of Romania under the Kyoto Protocol	In - country Review
2008	2007 and 2008 submissions: CRF Reporter database, CRF Tables and NIR	Centralized Review
2009	2009 submission: CRF Reporter database, CRF Tables and NIR	Centralized Review
2010	2010 submission: CRF Reporter database, CRF Tables and NIR	Centralized Review
2011	3rd version of the 2011 submission	In - country Review
2012	2rd version of the 2012 submission	Centralized Review

The ERT's reports following these reviews can be found on the UNFCCC website.

III.A. Summary tables

Summary tables on emission trends by gases and by sectors are presented, using the common reporting format, for 1989-2011, in the Annex 3.1 and 3.2.

III.B. Descriptive Summary

III.B.1. Overall GHG emissions trends

The total GHG emissions in 2011, excluding removals by sinks, amounted to 123.359,15 Gg CO_2 equivalent.

According to the provisions of the Kyoto Protocol, Romania has committed itself to reduce the GHG emissions by 8% in the period 2008-2012 comparing to the base year 1989. The total GHGs emissions (without considering sinks) decreased with 54.87 % in the period 1989-2011, and the net GHG emissions (taking into account the CO_2 removals) decreased with 61.06 % in the same period (Figure III_B_1). Based on these observations, there is a great probability for Romania to meet the commitments to reduce the GHG emissions in the first commitment period 2008-2012.

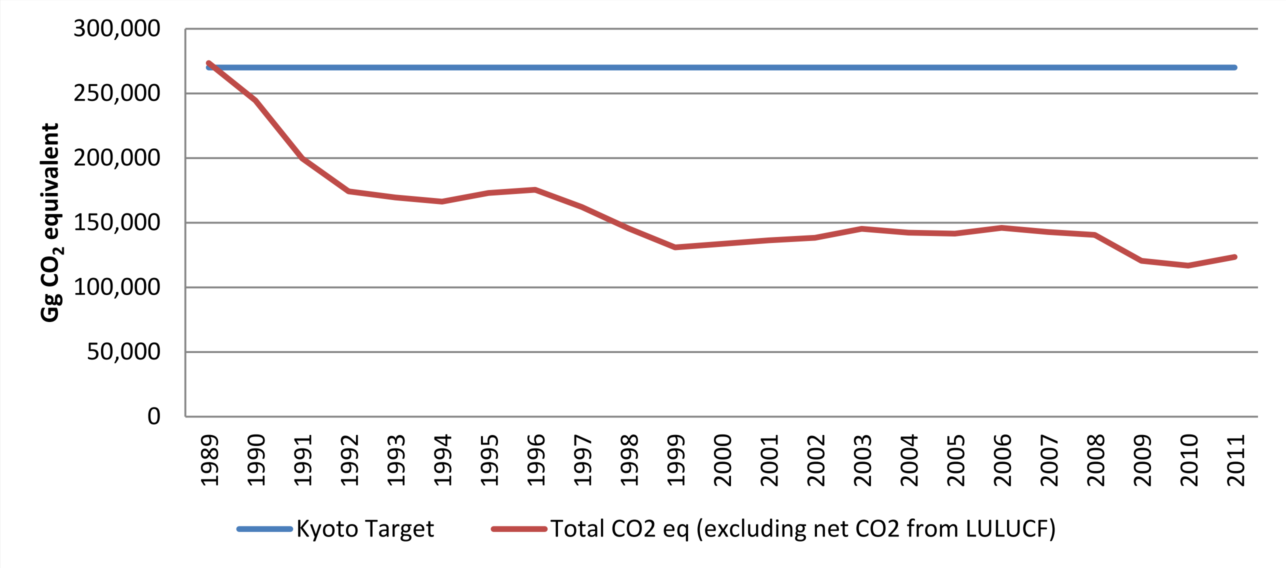


***Figure III_B_ 1** Total GHG emissions in CO_2 equivalent during 1989-2011 period*

The emissions trend reflects the changes in this period characterized by a process of transition to a market economy and by financial/economic crisis (Figure III.B.2).

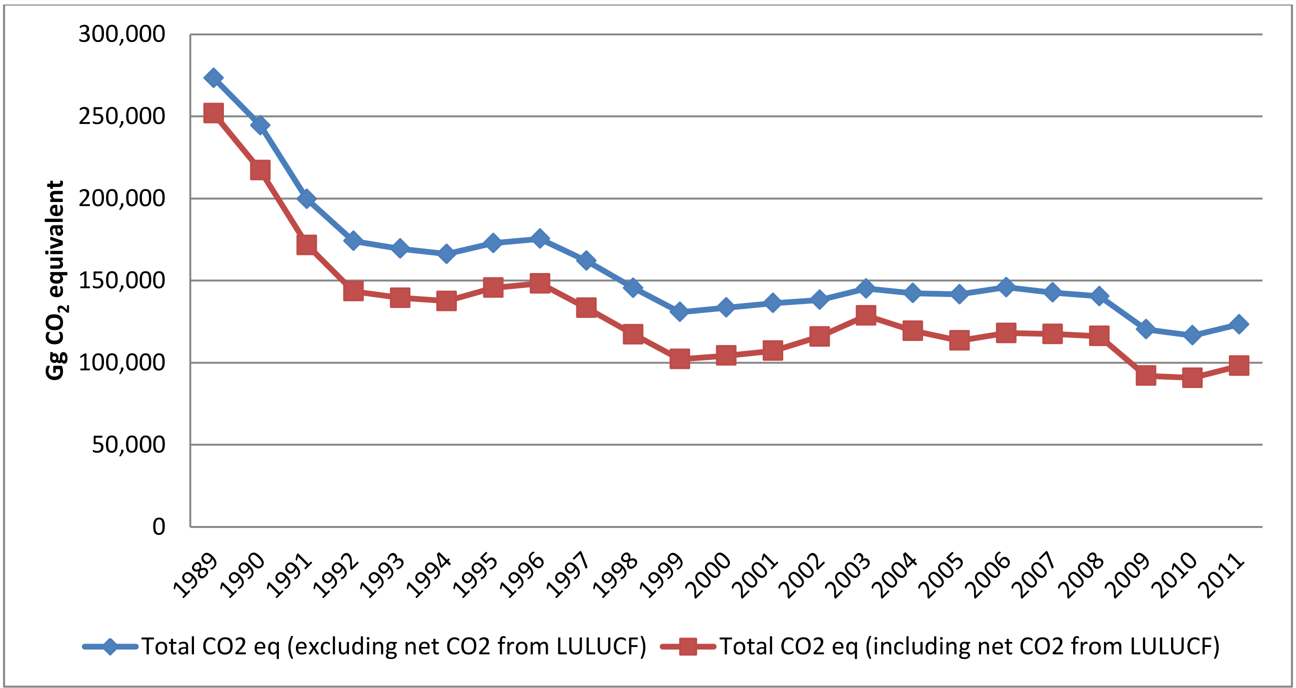


***Figure III_B_ 2** Trends of the aggregated GHG emissions*

The emissions trend reflects the changes in this period characterized by a process of transition to a market economy. The emissions trend can be split in three parts: the period 1989-1999, the period 2000-2007 and the period 2008-2011. The decline of economic activities and energy consumption in the period 1989-1992 had directly caused the decrease of the total emissions in that period. With the entire economy in transition, some energy intensive industries reduced their activities and this is reflected in the GHG emissions reduction. Emissions have started to increase until 1996, because of the economy revitalization.

Considering the starting of the operation of the first reactor at the Cernavoda nuclear power plant (1996), the emissions decreased again in 1997. The decrease continued until 1999. The increased trend after 1999 reflects the economic development in the period 2000-2007. The limited decrease of GHG emissions in 2005, compared with 2004 and 2006 levels was caused by the record-breaking hydrological year positively influencing the energy produced in hydropower plants. Due to the economic crisis, the emissions have significantly decreased in 2010 comparing with 2008. In 2011 it has been registered a slightly increase due to the small extent of economic revitalization.

III.B.2. Emissions/removals trends by gas

All GHG emissions, except HFCs and SF_6, decreased comparing with the base year. The shares of GHG emissions have not significantly changed during the period. The largest contributor to total GHG emissions is CO_2, followed by CH_4 and N_2O. In the base year, the shares of GHG emissions (excluding LULUCF) were: 71.54 % CO_2, 17.03 % CH_4, 10.2 % N_2O, 1.22 % PFCs. In 2011, the shares of GHG emissions (excluding LULUCF) were: 71.30% CO_2, 18.04% CH_4, 10.28% N_2O, 0.0088% PFCs. The F gases started to be used as substitutes for ODS in refrigerating and air conditioning systems since 1995. In 2011, the contribution of these gases to the total GHG emissions was negligible: 0.3571% HFCs and 0.00584% SF6. Next graphic presents the trend of the aggregated emissions, split by gas (Figure III-B-3 excluding/ including LULUCF).

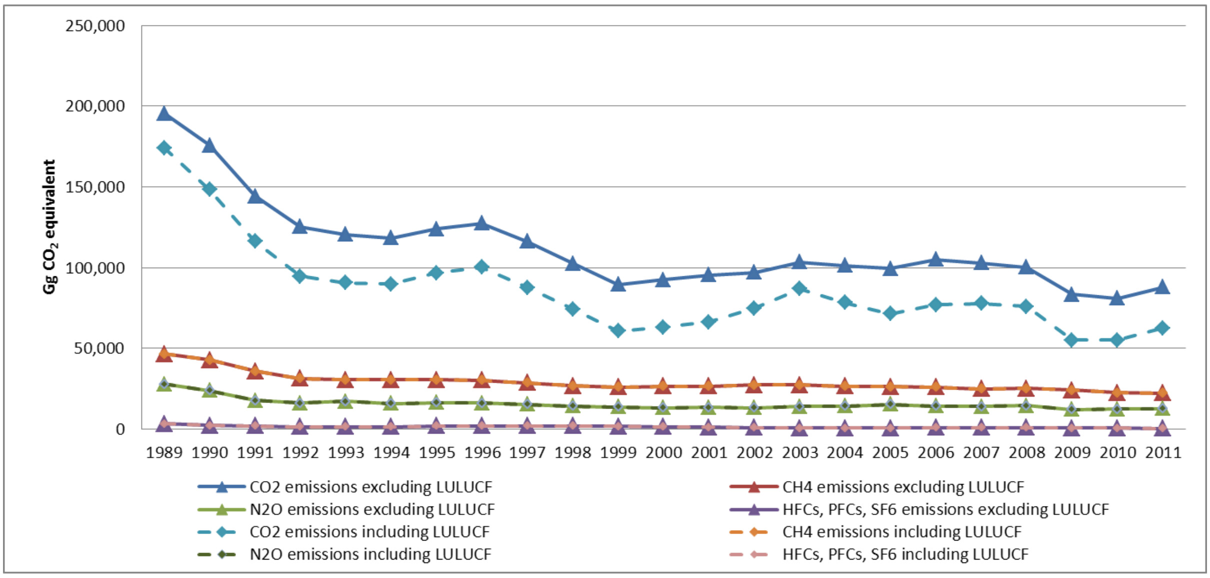


Figure III_B_ 3 *Trends by gas (GHG emissions excluding/ including LULUCF)*

Carbon dioxide (CO_2) – the most significant anthropogenic greenhouse gas is the carbon dioxide. The decrease of CO_2 emissions (from 195,449.25 Gg $CO_{2\ equiv}$ in 1989 to 87,962.88 Gg Gg $CO_{2\ equiv}$ in 2011) is caused by the decline of the amount of fossil fuels burnt in the energy sector (especially in the public electricity and heat production, and manufacturing industries and constructions sectors) as a consequence of activity decline.

Methane (CH_4) – the methane emissions, related mainly to the Fugitive emissions from fossil fuels extraction and distribution and to the livestock, decreased in 2011 by 52.17 % compared with the levels in 1989 (from 46,540.15 Gg $CO_{2\ equiv}$ in 1989 to 22,258.13 Gg $CO_{2\ equiv}$ in 2011). The decrease of CH_4 emissions in Agriculture is due to the decrease of the livestock level.

Nitrous oxide (N_2O) – the N_2O emissions are mainly generated within the Agricultural Soils activities in the Agriculture sector and within the Chemical industry activities in the Industrial Processes sector. The decline of these activities (decline of livestock, decline of N synthetic fertilizer applied on soils amounts, decrease of the crop productions level) is reflected in the N_2O emissions trend. The N_2O emissions in 2011 decreased with 54.54 % in comparison with the level in the base year.

Fluorocarbons and SF_6 (HFCs, PFCs, SF_6) – the F-gases started to be used as substitutes for ODS in refrigerating and air conditioning systems since 1995; therefore the emissions resulted as a consequence of the use of these substances and are estimated beginning with the same year. The PFCs emissions generated in the production of the primary aluminium are reported for the entire analysed period (1989-2011) and have decreased with 99.67 % (from 3,349.56 Gg $CO_{2\ equiv}$ in 1989 to 458.68 Gg $CO_{2\ equiv}$ in 2011) in 2011 comparing with the level in 1989).

III.B.3. Emissions/removals trends by sector

The figure below shows the GHG emissions/removals trends by each sector, expressed in Gg CO_2 equivalent.

According with Romania's most recent inventory submitted to the UNFCCC in 2013, the evolution of GHG emissions/removals by sectors during 1989-2011period, expressed in Gg CO_2 equivalent are presented in Figure 1.2.

In 2011, in term of GHG emissions, the Energy sector has the biggest share – 69.97%, followed by the Agriculture sector with 15.35% and Industrial Processes with 10.22%.

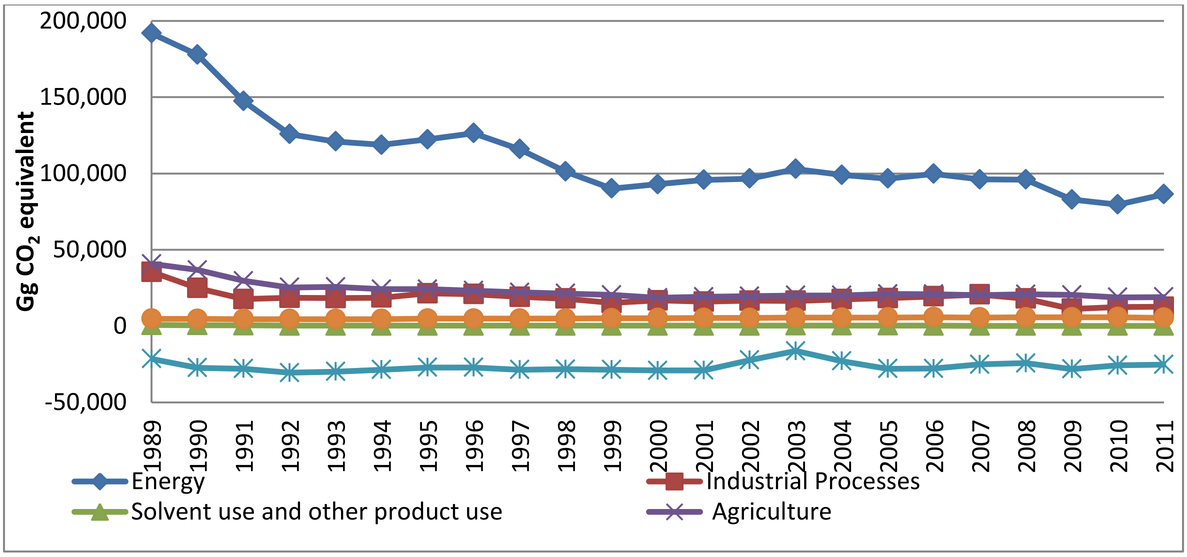


***Figure III_B_ 4** Trends by sector*

Energy represents the most important sector in Romania. In 2011, the GHG emissions (excluding LULUCF) from the Energy sector decreased by 55.00% compared to the base year; the main reason for decreasing the GHG emission trend in Energy sector is the transition to a market-based economy, which led to a sharp drop in electricity production demand from power plants.

Industrial Processes contributes to total GHG emissions (excluding LULUCF) with 10.22%. A significant decrease of GHG emissions was registered in this sector (64.46 % decreases in 2011 compared to the level in 1989) due to the decline or the termination of certain production activities.

For the *Solvent and Other Product Use* the trend of GHG emissions (excluding LULUCF) resulted from this sector follows the general trend: emissions have decreased seriously after 1989, then the emissions were relatively stable from 1992 to 2002; after 2002, emissions started to increase, and due to the revitalization of the relevant economic activities (automobile manufacture, construction and buildings).

The GHG emissions level (excluding LULUCF) decreased in 2011 by 80.55 % in comparison with the level recorded in 1989.

For the *Agriculture,* the GHG emissions have also decreased. The GHG emissions (excluding LULUCF) in 2011 are 53.50% lower in comparison with the 1989 emissions due to:

- the decline of livestock;
- the decrease of rice cultivated area;
- the decrease of crop productions level;
- the decline of N synthetic fertilizer applied amounts.

In 2011, 15.35 % of the total GHG emissions (excluding LULUCF) resulted from the agriculture sector.

For the *LULUCF,* the The net GHG removals/emissions level is 17.63 % higher in 2011 in comparison with the level in the base year. The Romanian land use sector acts as a net sink, at an average uptake of 26.560,6 Gg/year, being relatively stable over the last 23 years.

For the *Waste* sector, the total GHG emissions (excluding LULUCF) have significantly increased in 2011 with 14.91 % in comparison with the level in 1989, due to the increase of population consumption in parallel with the increase of living standards. The contribution of the waste sector to the total GHG emissions (excluding LULUCF) in 2011 is 4.35 %.

The participation of the sectors to GHG emissions (excluding LULUCF) is presented in the next figure.

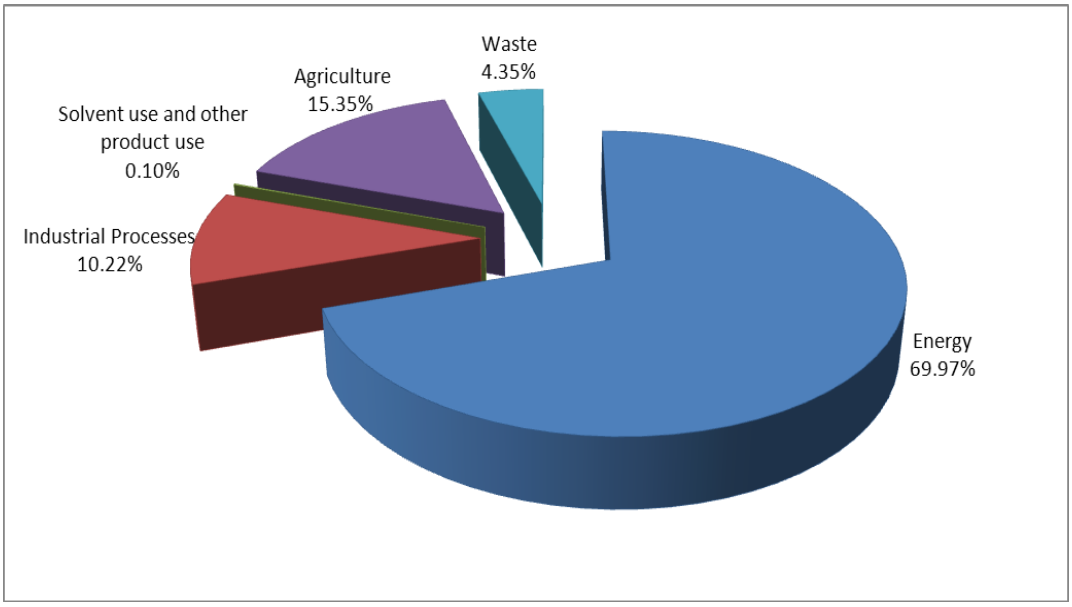


Figure III_B_ 5 *Sectoral GHG emissions in 2011*

III.B.4. Description and interpretation of emissions/ removals trends

Energy (CRF sector 1)

According to IPCC the following categories are included in the Energy Sector:

- 1.A.1. Energy industries;
- 1.A.2. Manufacturing Industries and Construction;
- 1.A.3. Transport;
- 1.A.4. Other sectors (commercial/institutional, residential, agriculture/ forestry/ fisheries);
- 1.A.5. Other (stationary, mobile);
- 1.B. Fugitive Emissions from Fuels.

Compared to the other GHG emissions sectors (Industrial Processes, Agriculture, LULUCF, Waste), the Energy sector represents the largest source of anthropogenic GHG emissions in Romania. In 2011, the Energy sector was responsible for about 69.97% of the total GHG emissions 123,345.54 Gg $CO_{2\ equiv}$ (excluding LULUCF) (Figure_III_B_5).

The emissions trend reflects the changes in this period characterized by a process of transition to a market economy (Figure_III_B_6 şi Figure_III_B_7).

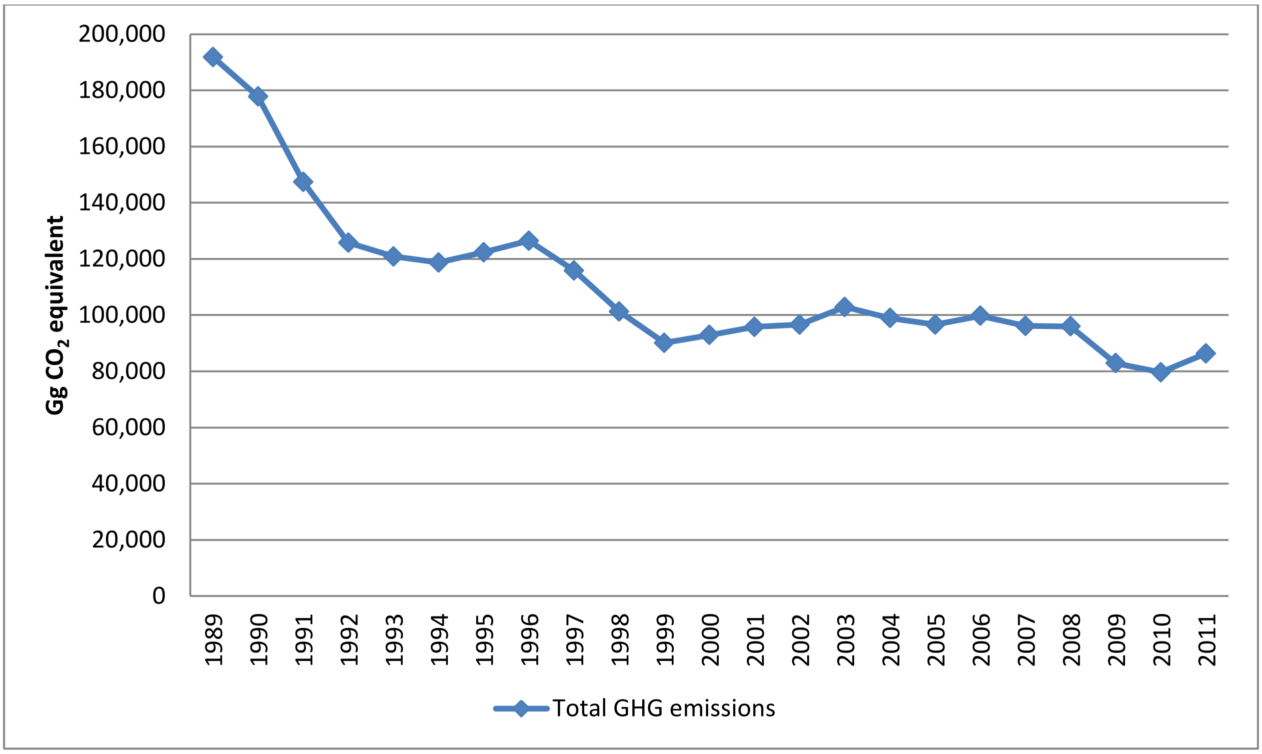


Figure III_B_ 6 *Overall emissions/ removals trend for Energy Sector*

The emissions trend can be split in two parts: the period 1989-1996 and the period 1996-2004. The decline of economic activities and energy consumption in the period 1989-1992 had directly caused the decline in total emissions in that period. With the entire economy in transition, some energy intensive industries reduced their activities and this is reflected in the GHG emissions reduction.

Emissions have started to increase until 1994, because of economy revitalization. Considering the starting of the operation at the first reactor at the Cernavoda nuclear power plant (1996), the emissions started to decrease again. The decrease continued until 1999. The increased trend after 1999 reflects the economic development in the period 1999-2004.

At the end of 2007, the second unit of the Cernavoda nuclear plant was functioning, therefore the decrease in emission trend is not very noticeable; for 2008-2010 it was noticed a slight tendency of decrease of emissions due to the economic crisis that had affected entire Europe.

In 2011, emissions from the Energy sector have decreased by 55% (86,320.46) Gg $CO_{2\ equiv}$ compared to 191,809.14 Gg $CO_{2\ equiv}$ in 1989, base year.

The trend of GHG emissions between 1989 and 2011, was defined by a substantial decrease of emissions from energy use in Manufacturing Industry and Construction (77.51%) followed by Other (72.37%) and by Fugitive Emissions from Fuels (63.19%), as well as a clear increase of emissions from Transport (92.47%) (Figure III_B_7).

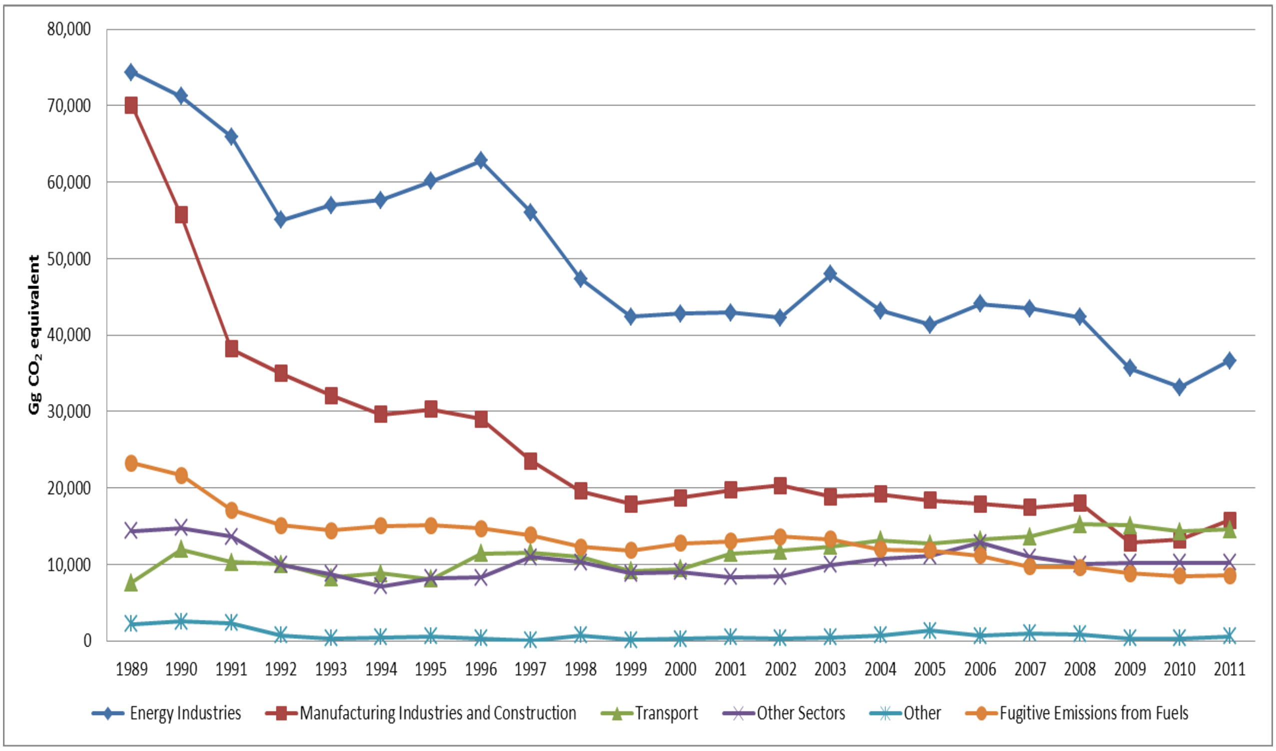


Figure III_B_ 7 *Energy sub-sectors emission/ removals trend for the period 1989-2011*

In 2011, GHG emissions from the Energy industries have decreased by 50.75%, 36,621.9 Gg CO_2 equiv compared to 74,355.62 Gg CO_2 equiv in 1989 (base year) as a result of transition to a market-based economy, which led to a sharp drop in electricity production demand from power plants.

GHG emissions from the Manufacturing Industries and Construction have decreased by 77.51 %, from 70,076.86 Gg CO_2 equiv in 1989 (base year) to 15,761.24 Gg CO_2 equiv due to the decrease of several productions levels.

Transport sub-sector have registered an increment of 92.47% of GHG emissions, 14,577.72 Gg CO_2 equiv compared to 7,574.06 Gg CO_2 equiv in 1989, base year.

GHG emissions from the Other Sectors sub-sector have decreased by 29.07 %, from 14,384.51 Gg CO_2 equiv in 1989, base year to 10,203.15 Gg CO_2 equiv while those from Other sub-sector have decreased by 72.37 %.

GHG emissions from the Fugitive Emissions from Fuels sub-sector have decreased by 63.19 %, 23,233.65 Gg CO_2 equiv compared to 8,552.966 Gg CO_2 equiv in 1989, base year.

Shares of GHG emission categories within the Energy sector, in 2011 are presented in the following figure:

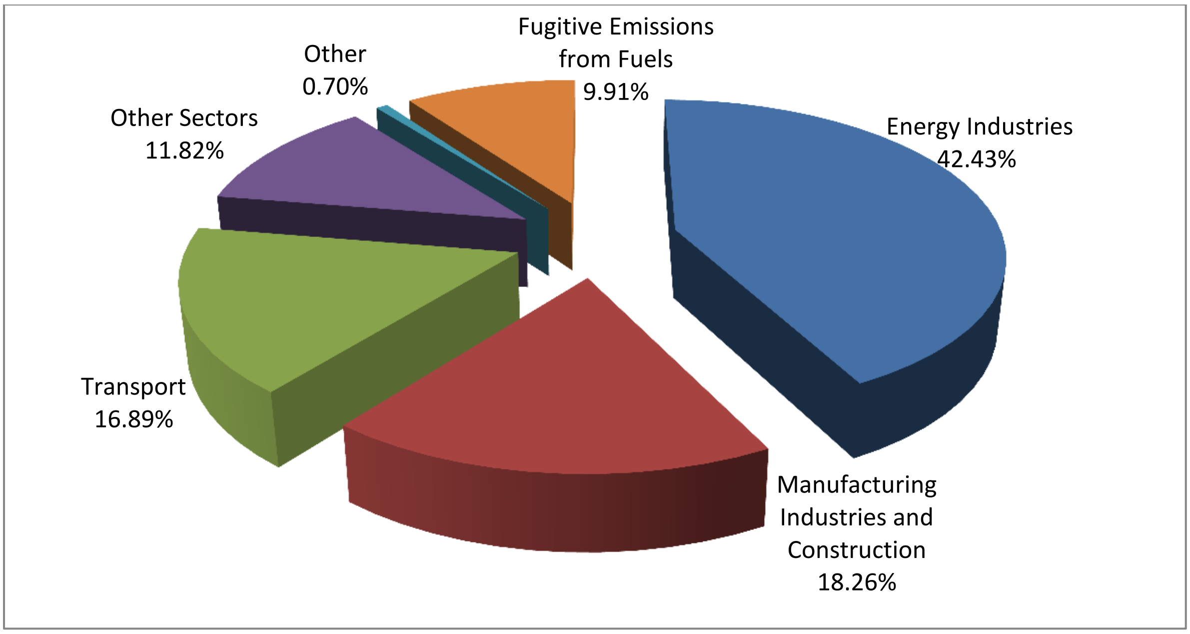


Figure III_B_ 8 *Shares of GHG emission categories within the Energy sector, in 2011*

Industrial Processes (CRF sector 2)

In this sector are considered only the process related emissions. According to IPCC, GHG emissions from Industrial Processes are grouped in the following Sub-sectors:

- 2.A Mineral Products;
- 2.B Chemical Industry;
- 2.C Metal Production;
- 2.D Other Production;
- 2.F Consumption of Halocarbons and SF_6.

The direct GHG emissions reported in this sector are associated with CO_2, CH_4, N_2O, HFCs, PFCs and SF_6.

In 2011 the GHG emissions from Industrial Processes Sector contributed with 10.22% to the total GHG emissions in Romania (Figure_III_B_5).

Due to the decrease of several productions levels, mainly within the chemical, mineral and metal industry, after 1989 the Industrial Processes overall emission has decreased. The overall emissions trend of this sector is presented hereunder:

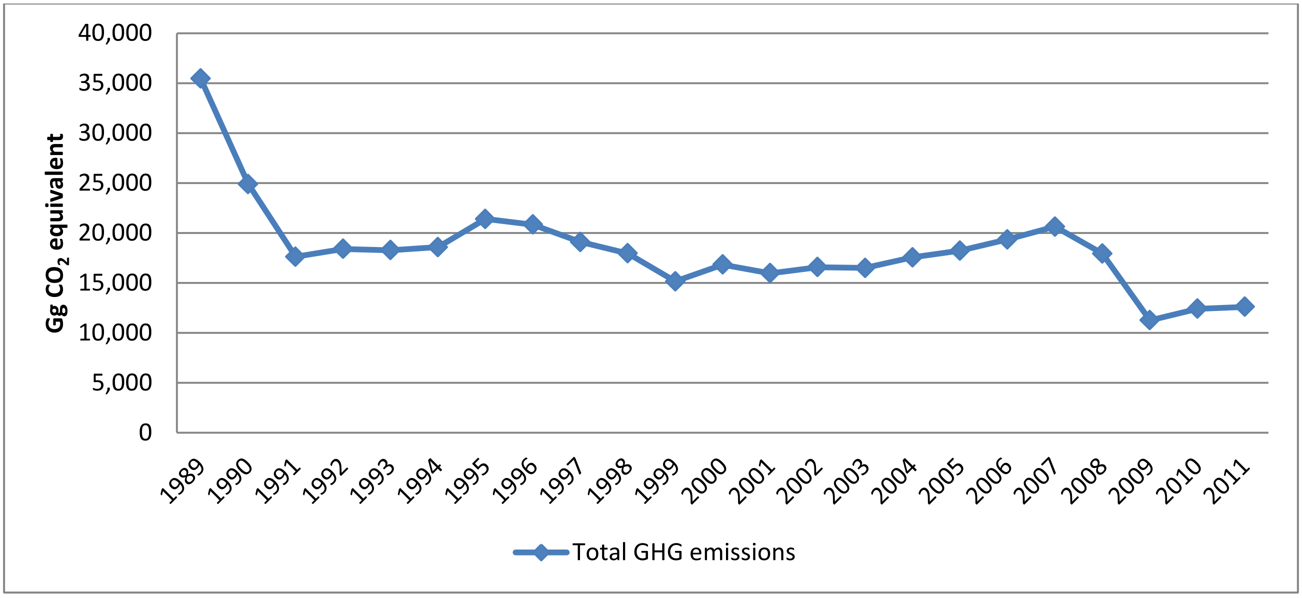


***Figure III_B_ 9** Overall emissions trend for Industrial Processes Sector*

Overall emissions from this sector estimated in 2011 decreased by 64.46 % compared with 1989 and increased with 1.54% compared with 2010. The decrease from 1989 to 2011 is the result of the restructuration and privatization in various activity sectors.

Starting with 2008 the emissions mainly decreased due to the reduction of various productions. In 2009 the emissions had also decreased due to the economic crisis reflected in many activity areas. In 2011 the emissions have recorded an increase due to increase of various industry productions.

After 1989 the whole Romania recorded a decrease within the Industrial Processes, because many categories of industrial production have decreased (Chemical Production, Mineral Production and Metal Production):

- Cement production, lime production, limestone and dolomite consumption, soda ash production and use, glass production recorded a decrease after 1989;
- Starting with 2004 the cement production has recorded a minor increase;
- In 2008 a minor decrease was recorded in consumption of limestone and dolomite level;
- The lowest level of emissions from ammonia production was recorded in 1998, due to the activity data whose level decreased by almost a half compared to the previous and next year. This happened as one producing plant has stopped its activity since 1998 and another plant has been closed in 1998 and reopened in the next year;
- Nitric acid production recorded a decrease after 1989. Starting with 2010 the nitric acid production level has recorded an increased;

- Adipic acid production stopped at the end of 2001. Starting with 2002, the activity was suspended;
- Calcium carbide production recorded a decrease after 1989 and the activity was suspended starting with 2007;
- Iron and steel production recorded a decrease after 1989;
- Ferroalloys production has recorded a decrease after 1989. The lowest level of emissions from ferroalloys production was recorded in 1999, due to the activity data whose level has decreased. This happened because ferroalloys production has stopped in 1999. In the next year (2000) the production was started again;
- The reduction of PFC emissions from production of aluminium due to changes in technologies, starting with 2003;
- In 2008 the trend of emission decreased due to reduction of production recorded for iron and steel production and ferroalloys production sub-sectors;
- For 2009 year a significant decrease of emissions level was recorded due to the economic crisis within many activity industries;
- In 2011 year the emissions have recorded an increase due to increase of various production activities level (soda ash production, glass production, cement production).

The trend of GHG emissions between 1989 and 2011 was defined by a substantial decrease of emissions from Consumption of Halocarbons and SF6 (86.31%) followed by Metal Production (71.00%) and by Chemical Industry (61.56%) (Figure III_B_10).

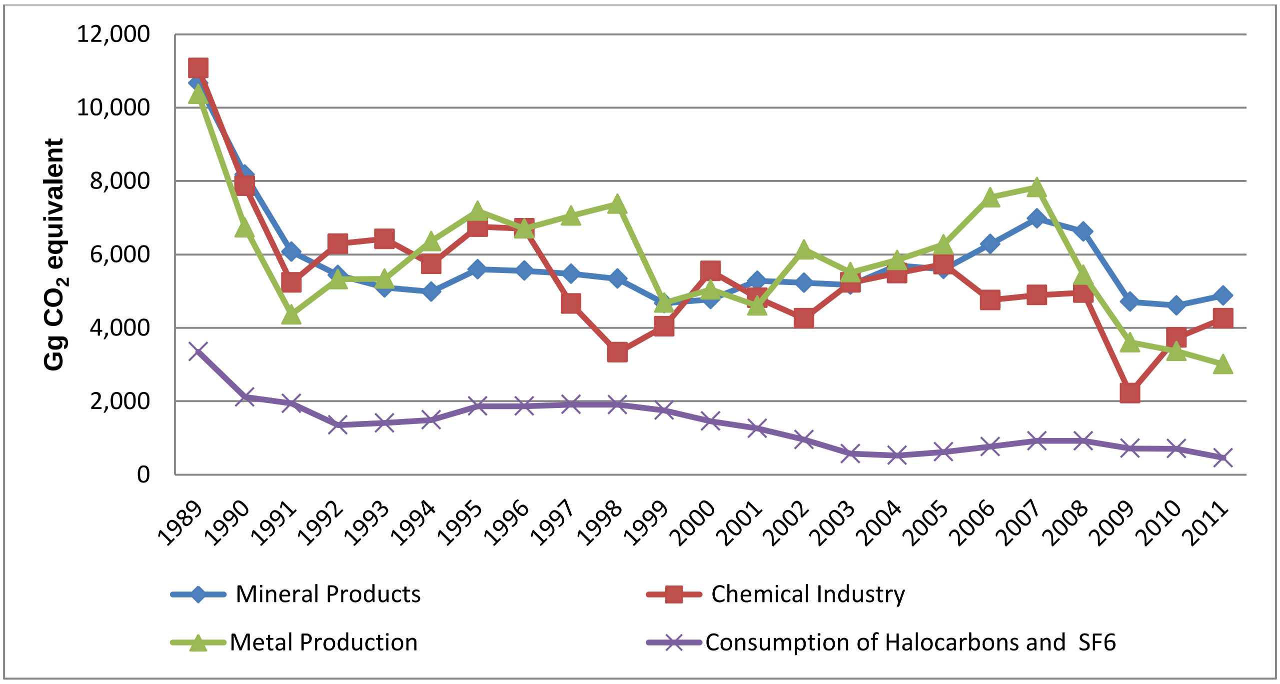


Figure III_B_ 10 *Industrial Processes sub-sectors emission trend for the period 1989-2011*

GHG emissions in the *Mineral Products Sub-sector* have decreased during 1989–2011 period due to the decrease recorded after 1989 in Cement Production, Lime Production, Limestone and Dolomite Consumption, Soda Ash Production and Use, and Glass Production; the emissions were relatively stable during 1993–2007 period. Starting with 2004 the Cement Production has recorded a minor increase. In 2009 a significant decrease of emissions level was recorded in cement, lime, limestone and dolomite, soda ash and glass industries due to the economic crisis.

In 2011, the emissions have risen due to the increase of Cement Production, Glass Production and Soda Ash Production. Mineral Products Sub-sector was responsible for 38.72% of the Industrial Processes Sector related GHG emissions in 2011.

Chemical Industry Sub-sector was responsible for 33.77% of the total Industrial Processes Sector GHG emissions in 2011. GHG emissions trend in the Chemical Industry Sub-sector for 1989–2011 period is due to:

- Lowest level of emissions from the ammonia production was recorded in 1998 (production decreased by almost 50% compared to the previous and the next year) due to closing of a producing plant in 1998 and closing of another plant in 1998 and reopening it the next year;
- Nitric acid production decreased after 1989;
- Adipic acid production had stopped at the end of 2001;
- Carbide production had recorded a decrease after 1989 and it was stopped starting with 2007;
- For 2009 a significant decrease of emissions level was recorded due to the economic crisis;
- In 2011 the emissions have raised due to increase of various production activities (ammonia production, nitric acid production, silicon carbide production).

The overall GHG emissions from *Chemical Industry Sub-sector* decreased by 61.56 %, from 11,074.48 Gg equivalent in 1989, base year, to 4,257.36 Gg equivalent in 2011.

Metal Production Industry Sub-sector is responsible for 23.86 % of the total Industrial Processes Sector GHG emissions in 2011. Emissions decreased by 71 %, form 10,372.1 Gg equivalent in 1989, base year, to 3,008.10 Gg equivalent in 2011.

GHG emissions trend in the Metal Products Sub-sector for 1989–2011 period is due to:

- Iron and steel production recorded decreases after 1989;
- Ferroalloys production has recorded a decrease after 1989. The lowest level of emissions was recorded in 1999 due to the cease of production. In 2000 the production started again;

- The reduction of PFC emissions from production of aluminum due to changes in technology starting with 1997 and 2003;
- After 2008 the trend of emission decreases due to reduction of production level recorded in Iron and Steel Production and Ferroalloys Production Sub-sectors;
- In 2010 and 2011 the emissions trends have recorded an increased due to increase of various production activities (Iron and Steel Production, Ferroalloys Production and Aluminium Production Sub-sectors.

Other Production Sub-sector includes NO_x, CO, NMVOC and SO_2 emission resulted from the Pulp and Paper Production (IPCC category 2.D.1), alcoholic beverages Production and Food Production (IPCC category 2.D.2).

The IPCC 1996 Guidelines provides no default values for emission factors associated to the direct greenhouse gases. No national emission factors have been developed yet.

Regarding *Production of Halocarbons and SF 6 Sub-Sector,* F-gases are not produced in Romania and therefore there are no fugitive emissions from manufacturing. Additionally, there is no production of other fluorinated gases (HCFC) that could lead to by-product F-gas emissions.

Consumption of Halocarbons and SF_6 Sub-sector

The ascending trend of emissions (Figure III_ B_10) in the consumption of halocarbons and SF 6 and consumption of halocarbons and SF_6 – Potential Emissions is caused by the increasing production of equipments using F-Gases.

In 2007 the SF6 actual emissions increased significantly relative to 2006 because according to the questionnaires received from the operators a new economic agent started to use SF6 in its activity (manufacture of other parts and accessories for vehicles and motor vehicle).

The descendent GHG emissions trend of this Sub-sector during 2008-2011 is due to the economic crises that reduced the activity of economic agents.

Metal Production contributes with 23.86 % to the total GHG emissions from Industrial Processes Sector in 2011 (Figure_III_B_11). Mineral Products and Chemical Industry are the two other main contributing Sub-sectors with 38.72% and 33.77%, respectively, of the total GHG emissions in this sector. The contribution of Consumption of Halocarbons and SF_6 Sub-sector to the overall sector is very low: 3.64%.

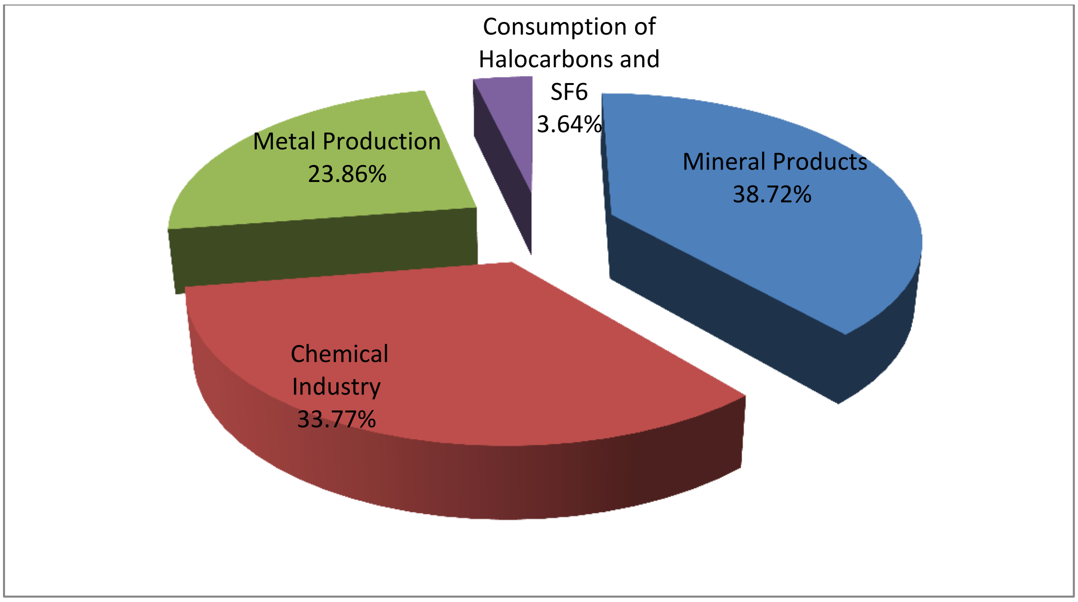


Figure III_B_ 11 *Shares of GHG emission categories within the Industrial Process Sector, in 2011*

In the base year, various Industrial Processes Sub-sectors contributions were: Mineral Products 30.08%, Chemical Industry 31.23%, and Metal Production 29.25%, Consumption of Halocarbons and SF_6 9.44%.

Solvents and Other Products Use (CRF sector 3)

The trend of GHG emissions between 1989 and 2011 was defined by a substantial decrease of emissions – 80.55% comparing with the base year.

The trend of emissions resulted from this sector follow the general trend (Figure III_ B_12): emissions have decreased seriously after 1989, then the emissions were relatively stable from 1992 to 2002 and after 2002, emissions started to increase, because of the revitalization of the economic activities (automobile manufacture, construction and buildings).

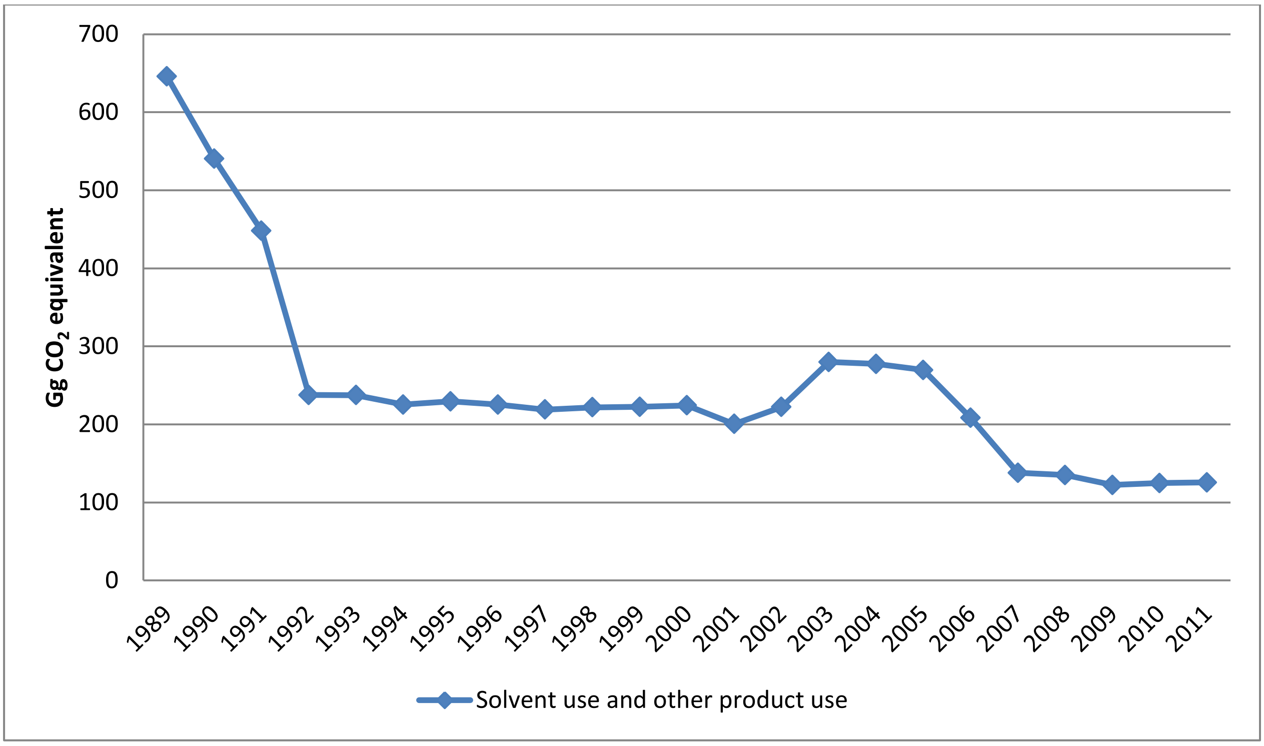


Figure III_B_ 12 *Overall emissions trend for Solvents and Other Products Use Sector*

Agriculture (CRF sector 4)

The Agriculture Sector accounted for 15.35 % of the total GHG emissions in 2011, reaching 18,941.46 Gg CO_2 equivalents (Figure III_B_5).

Within the GHG emissions from the agriculture sector, the N_2O emissions have the largest contribution (in 2011, N_2O emissions contribution is 54.51 % to the total Agriculture Sector's CO_2 equivalent emissions), followed by the CH_4 emissions (that account for the remaining 45.49%).

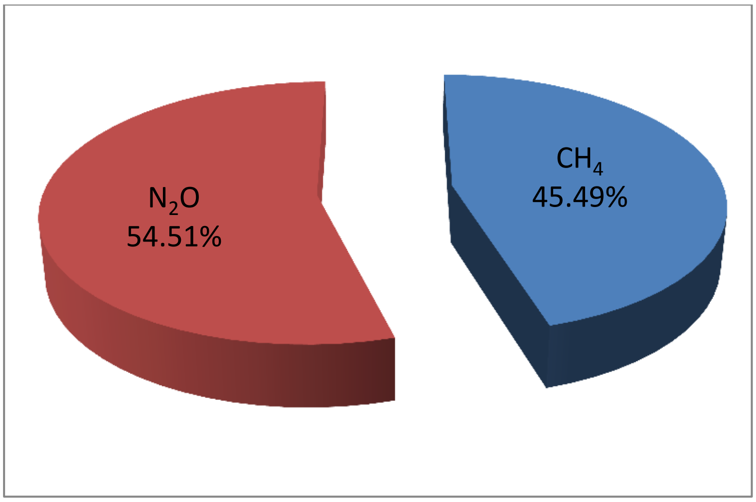


Figure III_B_ 13 *Share of gases within Agriculture Sector in 2011*

Over the period 1989 – 2011, the GHG emissions resulted from Agriculture Sector decreased by 53.50% (Figure III_B_14).

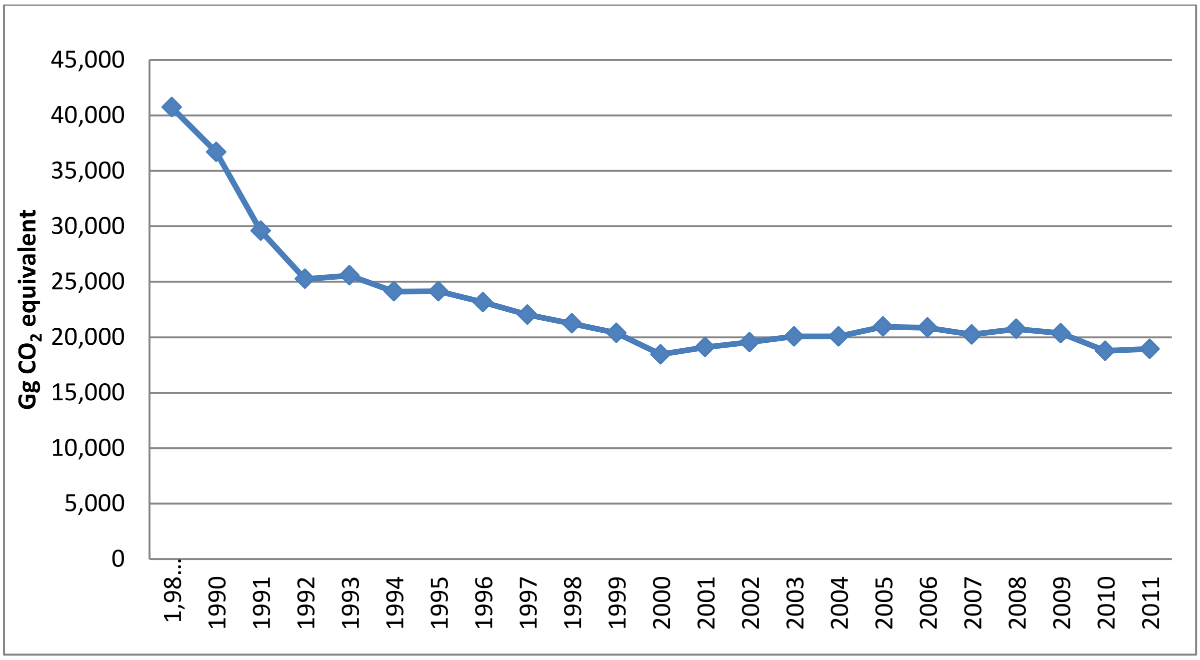


Figure III_B_ 14 *Overall emissions trend for Agriculture Sector*

The number of animals decreased in this period whatever of the species and type of operation.

After a slight recovery of national livestock situation, another dramatic regression occurred, result of economic situation extremely difficult Romania passed in the period 1997-2000. After the period 2001-2002 and in present, for the livestock species of interest there are recorded fluctuations in the livestock number influenced by the economic context, the emergence of various associative forms that have acquired economic power and by the interest shown by farmers for increasing the genetic value of the animals.

After 1989 the livestock from most Agricultural Production Cooperatives (C.A.P.) were attributed to rural population they being sacrificed in large numbers for meat. On the other hand, in most rural areas, a significant number of farmers have lost the interest in animal husbandry.

In case of emissions resulted from enteric fermentation and manure management, the descending trend reflects the decrease in animal population over the period. The number of all cattle categories decreased in the analysed period, the animals being privately owned both in subsistence farms and individual households. The lack of interest for these species is also due to the lack of associated governmental incentives.

Comparatively with the 2010 year, in 2011 were slowly increased some livestock categories for example: calves for slaughter, young cattle breeding- cattle under 1 year and sheep. The rice cultivation generated in 2011 a significantly reduced emission compared to the base year 1989 due to the decrease of areas (69.15% decrease comparing with the base year).

In case of agricultural soils, the emissions decreased over the period (50.63% decrease in 2011 comparing with 1989), due to the decrease of the amount of the synthetic fertilizer applied, of the livestock populations and of the crop productions level.

Starting with the 2000 year, the N_2O emissions from Agricultural Soils fluctuates: increases until 2005 and then decreases. This is due variation of quantities of synthetic fertilizers, number of animals and of the crop productions.

In the general context of the transition of the economy to a market based approach, the activity data level decreased substantially in the last years of the characterized period in comparison to the base year.

The livestock number decreased in the last years of the characterized period in comparison to 1989 mainly due to:

- The import of animals;
- The draught which affected the crop production levels and the crop production prices;
- State incentives in some periods;
- Closing of the old/opening new facilities due to the restructuration of the economy.

The crop productions level decreased in the late years of the analysed period in comparison to 1989 mainly due to the change in agricultural land property regime and to the transition to the market economy. Reasons for the inter-annual changes in crop production levels include:

- Existence of draught periods;
- Existence if state incentives for some periods;
- Changes in the land property regime, including the disaggregation of large farms before 1990 and crystallization of new large farms in the late years.

The livestock number was decreased in the 2010 year comparative with the 2009 year due to:

- The deficiency precipitation that which led to decreased of production needed for feeding;
- The increases of price per food.

The trend of GHG emissions between 1989 and 2011 was defined by a substantial decrease of emissions from Rice Cultivation (69.15%) followed by Manure Management (56.43%) and by Enteric Fermentation (56.23), as well as a increase of emissions from Field Burning of Agricultural Residues (5.56%) (Figure III_B_15).

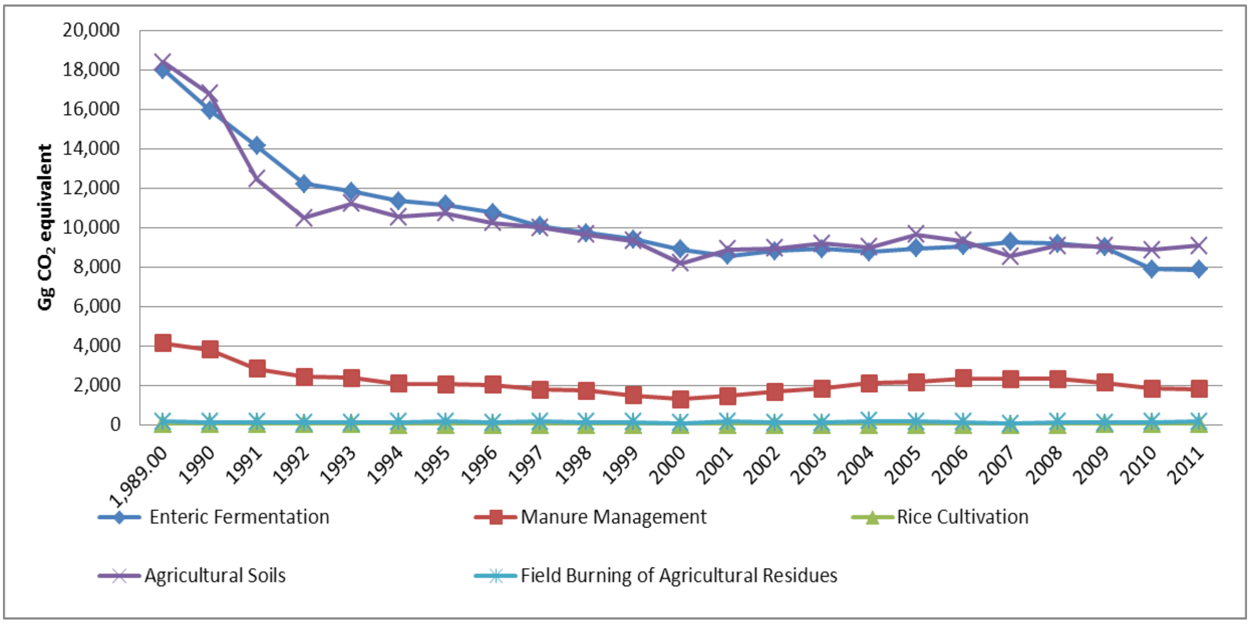


Figure III_B_ 15 *Agriculture sub-sectors emission trend for the period 1989-2011*

Compared to 1989, total GHG emissions from *Enteric Fermentation Sub-sector* decreased with 56.23 % in 2011 (Figure III_B_15). The decreasing trend is in direct correlation with the dynamics of livestock. The livestock number for all species of economic interest, except goats, due to increased interest in recent years for this species, declined; the interest for goats products is a consequence of the consumers' taste refineries, especially for urban consumers, and of the requirements for milk and goat meat for export.

The administration of goat livestock is based also on valuable genetic biological material import, especially from breeds specialized in milk production.

Manure Management Sub-sector is the fourth source in the Agriculture sector (in 2011, GHG emissions as CO_2 equivalent from Manure Management represented 9.52% from Total Agriculture emissions).

Emissions from Manure Management Sub-sector are declining since 1989 (by 56.43%) due to the decrease of the animal population. This diminish is referable to lower number of animal on one hand, and on the other hand to the switchover from traditional systems to economically organized farms, in which is practiced different waste management systems (Figure III_B_15).

The dynamic of emission of GHG from manure management reflect the livestock described situation in Romania.

The years 1997-2000 have been of Romania unfavourable, in economically terms reflecting the number of animals decrease and implicitly the emissions diminish.

After 2000, livestock will return with higher share, steps first taken by farmers of especially hens and the emissions increased to 2006, then again begin to fall.

Rice Cultivation Sub-sector is the smallest source of GHG emissions in the Agriculture sector (in 2011, GHG emissions as CO_2 equivalent accounted.10% from Total Agriculture emissions).

Emissions from rice cultivation are declining since 1989 due to the decrease of rice cultivated area (Figure III_B_15) by 69.15%. The rice cultivated area has decreased from 21.6 thousands ha in 1991 to 100 ha in 2003. The reduction of rice cultivated area is due to areas privatization process and concession of the land from state patrimony, which ended in 2004. In 2011 the rice cultivated area was 12.7 thousand ha.

Due to natural conditions, Romania benefits of a relatively balanced production of rice while the cultivated area and the emissions from rice continue to fall.

Agricultural soils Sub-sector registered a declining of livestock population and the crop productions, and a diminishment of the synthetic fertilizer amount applied determining a 50.63% decrease of emissions in 2011 comparing to the 1989 (Figure III_B_15).

The decrease of crops, for example in 1992 was caused by unfavorable weather conditions, while the situation was completely opposite in 2004. In the 2007 year, the crop was reduced from 2006 due to drought.

Cultivated areas were maintained crop except soybeans which recorded significant decreases.

During the 1989-2001 GHG the emission levels of *Field burning of agricultural residues Sub-sector* were directly proportional with the crop production levels.

Emissions from *Field burning of agricultural residues* in 2011 are higher than emissions in 1989 with 5.56 % Gg CO_2 equivalent, due to the lower agricultural yields. The lowest emissions are found in years 2000 and 2007 (Figure III_B_15).

Agricultural Soils and Enteric Fermentation are the two main contributing sub-sectors with 47.90 % and 41.58 %, respectively, to the total GHG emissions in Agriculture Sector in 2011 (Figure_III_B_16). The Manure Management sub-sector has contributed with 9.52 % to the total GHG emissions. The contributions of Rice Cultivation and Field Burning of Agricultural Residues Sub-sectors to the overall sector emissions are very low: 0.10%, respectively 0.91 %.

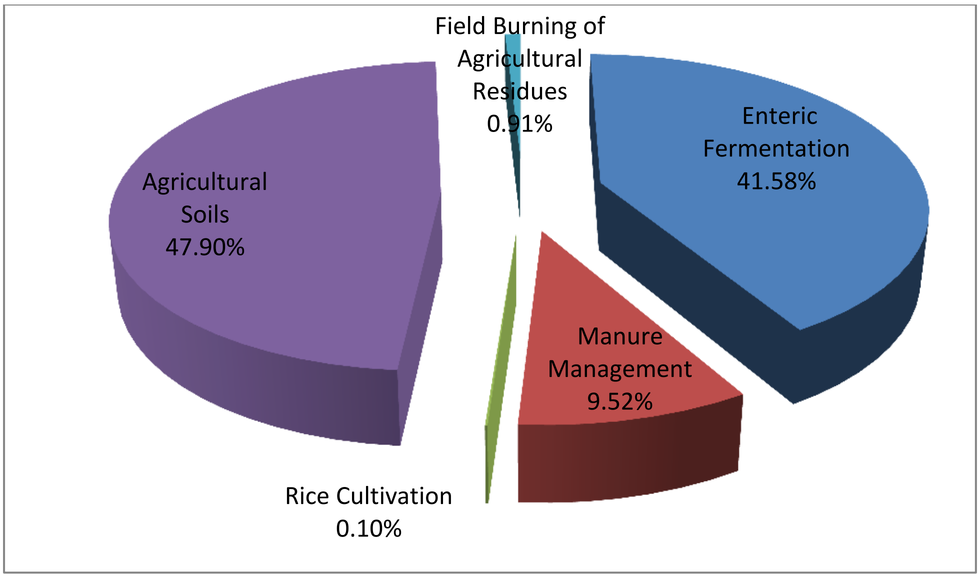


***Figure III_B_ 16** Shares of GHG emission categories within the Agriculture Sector, in 2011*

Land Use, Land Use Change and Forestry (CRF Sector 5)

Agricultural lands, including arable, orchards, vineyards, pastures and hayfields makes up 61.2% of Romania's total national area. Forests cover 28.5% while constructed areas and road/railways, cover some 4.7%, humid areas, water and lakes some 3.5% and other land 2.1%.

Emissions from LULUCF comprise CO_2, CH_4 and N_2O emissions from biomass burning. Due to the long drought in Romania, during the period 1999-2003, the area affected by wildfires increased and, as a direct consequence, levels of emissions increased.

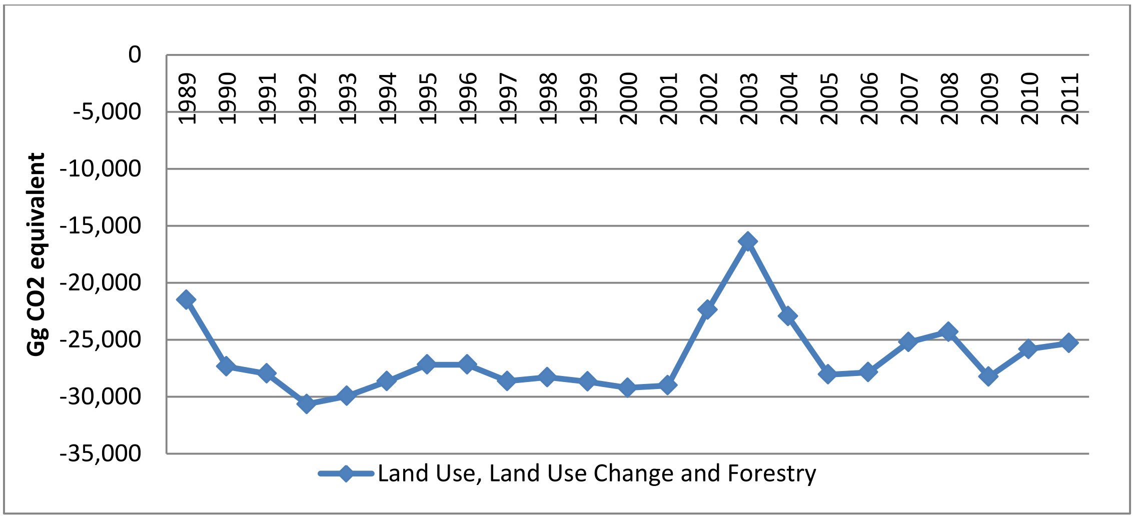


***Figure III_B_ 17** Overall emissions trend for Land-Use, Land-Use Change and Forestry*

The net GHG removals/emissions level is 17.63 % higher in 2011 in comparison with the base year level due to the decrease trend of emissions from all other sectors. The Romanian land use sector acts as a net sink, at an average uptake of 25,304.94 Gg/year, being relatively stable over the last 22 years.

Waste (CRF sector 6)

Over the period 1989 - 2011, GHG emissions resulted from Waste sector increased by 14.91 %, due to population consumption growth, to the increase of waste managed sites number and also to the increase of population connected to sewerage (Figure III_B_18).

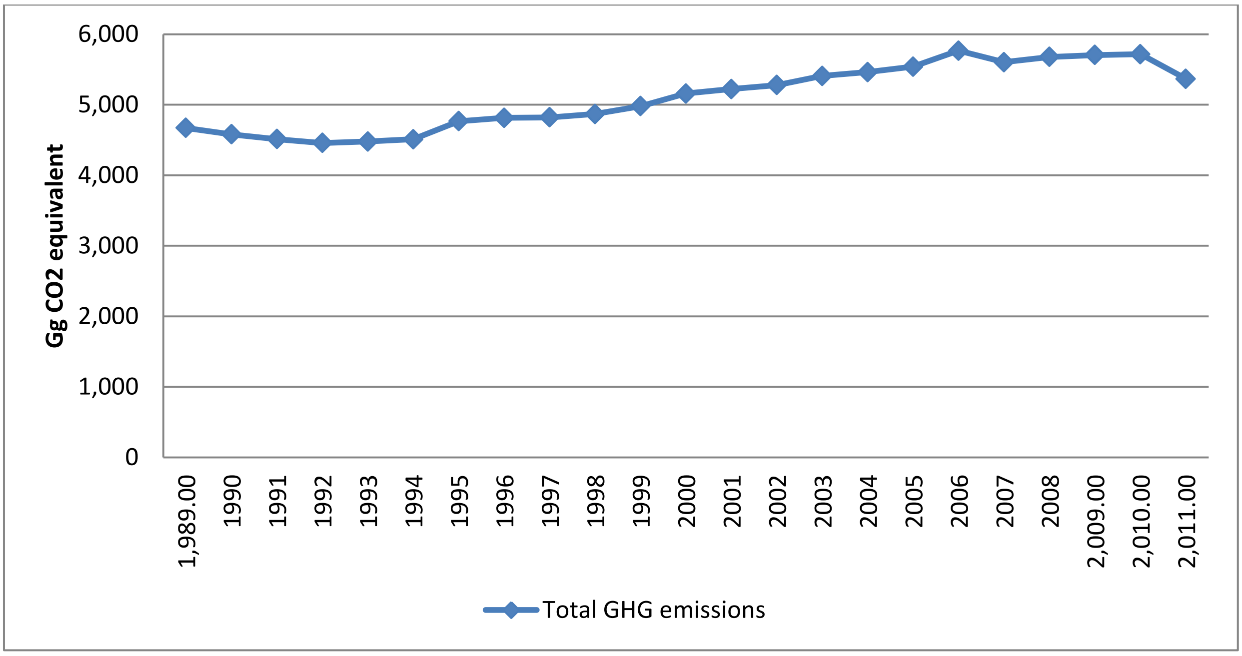


Figure III_B_ 18 *Overall emissions trend for Waste Sector*

In 2011 GHG emissions from the Waste Sector accounted for 5,366.47 Gg CO_2 equivalent, which represent 4.35 % of the total national GHG emissions in this year (Figure III_B_5).

In the base year (1989), the total GHG emissions from the waste sector amounted 4,670.31 Gg CO_2 equivalent, which represented 1.71% of the total national GHG emissions in that year.

Compared with the other sectors, emissions from the waste sector showed a significant increase from the base year, with 14.91 %, due to increasing of population consumption in parallel with increasing of living standards (Figure III_B_18).

The trend of GHG emissions between 1989 and 2011 was defined by a significant increase of emissions from Solid Waste Disposal on Land (97.29), as well of a decrease of emissions from Waste Water Handling (15.67%) (Figure III_B_19).

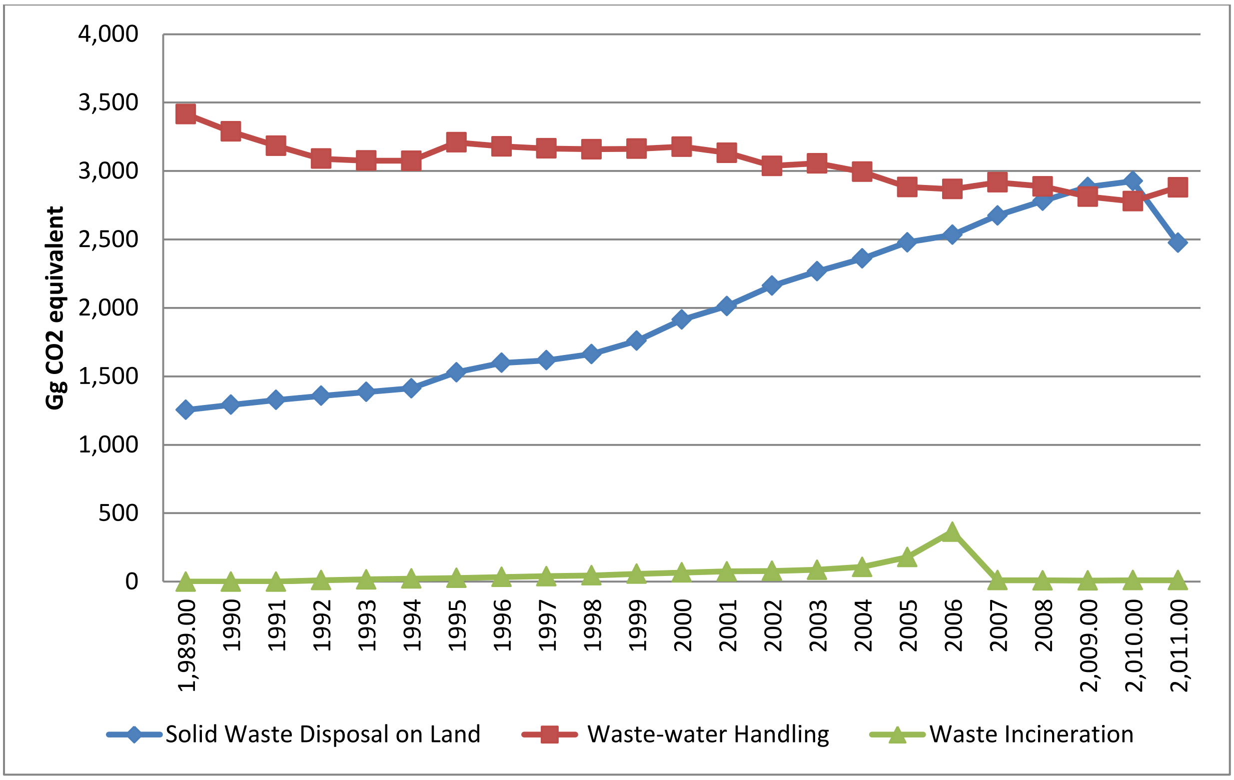


Figure III_B_ 19 *Waste sub-sectors emission trend for the period 1989-2011*

After 2000, Romania began to comply with EU standards, implementing European legislation both in waste and wastewater treatment management. However, the GHG emissions trend is different for the three subsectors of Waste Sector due to improvement of living standards which is reflected differently in the evolution of these subsectors.

GHG emissions trend from Solid Waste Disposal on Land category increased significantly in 2011 year comparing with the level in the base year, with a percentage of 97.29% (Figure III_B_19). This increase is due to the increasing trend of waste generation rate following the increasing trend of population consumption.

Emissions from wastewater handling decreased with 15.67% in 2011 compared to 1989. This decrease is due to the decreasing number of population and to the increased number of inhabitants connected to sewerage on the one hand and on the other hand to the decreasing level of industrial production.

In Waste Incineration Subsector the emissions trend has remained almost constant because the amount of waste destined for incineration was constantly, except for the period 2004-2006 when there was intensified burning of industrial hazardous waste due to compliance with Directive 2000/76/CE.

The most important contribution to GHG emissions from Waste Sector, in 2011 year, has Wastewater Handling Subsector, contributing with 53.67% in the total (Figure III_B_20); Solid Waste Disposal on Land Sub-sector contribute with 46.13% and Waste Incineration Sub-sector accounts for only 0.20%.

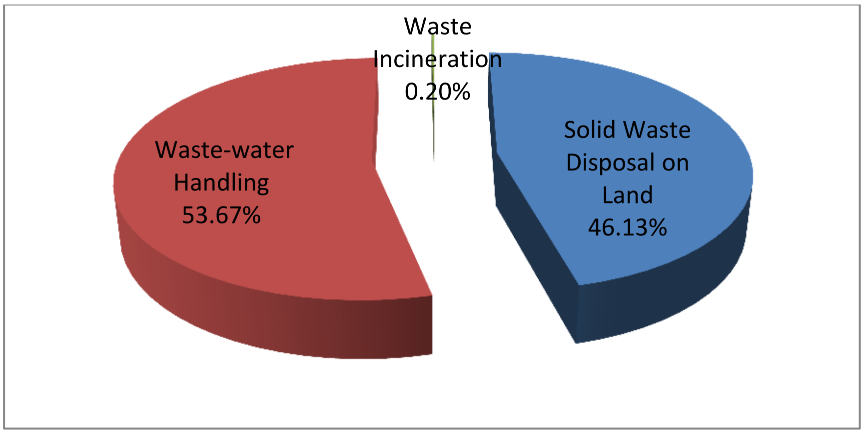


Figure III_B_ 20 *Shares of GHG emission categories within the Waste Sector, in 2011*

III.C. National systems in accordance with Article 5, paragraph 1, of the Kyoto Protocol

(a) Name and contact information for the national entity and its designated representative with overall responsibility for the national inventory of the Party

The contact information for the national entity, including its designated representative with overall responsibility for the national inventory are:

- National entity: Ministry of Environment and Climate Change;

  Address: Bd. Libertăţii no. 12, Sector 5, Bucharest;

  Telephone/ fax: +40-21-2071141.

- Designated representative with overall responsibility:

  Name: Sorin Deaconu;

  Telephone/fax: +40-21-2071141;

  e-mail: sorin.deaconu@anpm.ro.

(b) Roles and responsibilities of various agencies and entities in relation to the inventory development process, as well as the institutional, legal and procedural arrangements made to prepare the inventory

Based on Article 5 of the Kyoto Protocol, Romania established a National System (NS) for estimating the anthropogenic emissions for all greenhouse gases not covered by the Montreal Protocol.

The system complies with the provisions of the subsequent decisions of the CMPs of the Kyoto Protocol and with provisions of the Decision 280/2004/EC[3] and of the Decision 166/2005/EC concerning a mechanism for monitoring the Community GHG emissions and for implementing the Kyoto Protocol.

In order to fulfil the obligations under the United Nations Framework Convention on Climate Change (UNFCCC), Kyoto Protocol and European Union legislation, in 2007 the Governmental Decision (GD) no. 1570 for establishing the National System for the estimation of anthropogenic greenhouse gas emissions levels from sources and removals by sinks was adopted, setting all institutional, legal and procedural aspects for supporting the Romanian authorities to estimate the GHG emissions/removals levels, to report and to archive the National Greenhouse Gas Inventory (NGHGI) information, including supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol.

The GD no. 1570/2007 was modified and completed, by GD no. 668/2012 and GD no. 48/2013.

Before 1 April 2013, the competent authority was the National Environmental Protection Agency (NEPA), under the subordination of the Ministry of Environment and Climate Change (MECC).

Based on the GD no. 48/2013, all NEPA climate change related structure, personnel, attributions and responsibilities were took over by MECC, in order to improve the institutional arrangements and capacity within the climate change domain, thus increasing the efficiency in activities implementation also in respect to the NS/NGHGI administration.

Starting with 1 April 2013, MECC is the competent authority, responsible for administrating the National System.

Institutional arrangements

The characteristics of the institutional arrangements include:

- Centralized approach – MECC maintain a large degree of control and decision making authority over the inventory preparation process;
- In-sourced approach, in majority – the major part of the inventory is prepared by MECC (governmental agency);
- Single agency – the single national entity is housed within a single governmental organization;

[3] *Repealed by Regulation (EU) no 525/2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC*

- Separate approach – the NGHGI related work is not integrated with other air pollutant inventories work; however, cross checking activities are periodically implemented.

The main institutional arrangements include:

- MECC, as the competent authority, responsible for administrating the National System;
- Central and territorial public authorities, research and development institutes and other public organizations under the authority, in the subordination/coordination of central public authorities, owners and professional associations, economic operators and other relevant organizations, which have the obligation of providing to MECC the necessary activity data, emission factors and associated uncertainty data;
- The National Institute for Statistics, as a main activity data supplier, through the yearly-published documents (National Statistical Yearbook, Energy Balance, other documents);
- Several sectors – Energy, Industrial Processes, Agriculture and Waste – have been significantly improved during 2011, as a result of implementation the study [4] performed by Institute for Studies and Power Engineering (ISPE), based on a contract with Ministry of Environment and Forests;
- The NGHGI Land Use, Land-Use Change and Forestry (LULUCF) Sector, both under the UNFCCC and KP, administrated during 2011 and 2012-2014 period by the Forest Research and Management Planning Institute (ICAS), based on contract (for 2011) or Protocol of collaboration no. 2029/MMP-RP/3.07.2012 between Ministry of Environment and Forests, NEPA and ICAS (for period 2012-2014);
- The preparation of Road transport category estimates, based on COPERT 4 model, administrated also based on the Protocol of collaboration no. 3136/MMP/9.07.2012 between Ministry of Environment and Forests, NEPA, Romanian Automobile Register and Directorate on Driving Licenses and Vehicles Registration in the Ministry of Administration and Interior. The period of collaboration is undetermined.

The institutional arrangements currently used in Romania, presented in the Figure III_C_1, were updated during 2011÷ January 2012, based on the study[5], performed in 2011, which aimed to improve NS, develop the institutional capacity and establish the programs/measures for determining the emissions factors and other national relevant parameters.

[4] *"Elaboration/documentation of national emission factors/other parameters relevant to NGHGI Sectors Energy, Industrial Processes, Agriculture and Waste, values to allow for the higher Tier calculation methods implementation"*, ISPE

[5] *"Support for the implementation of the European Union requirements on the monitoring and reporting of the carbon dioxide (CO_2) and other greenhouse gas emissions",* Institute for Studies and Power Engineering (ISPE)

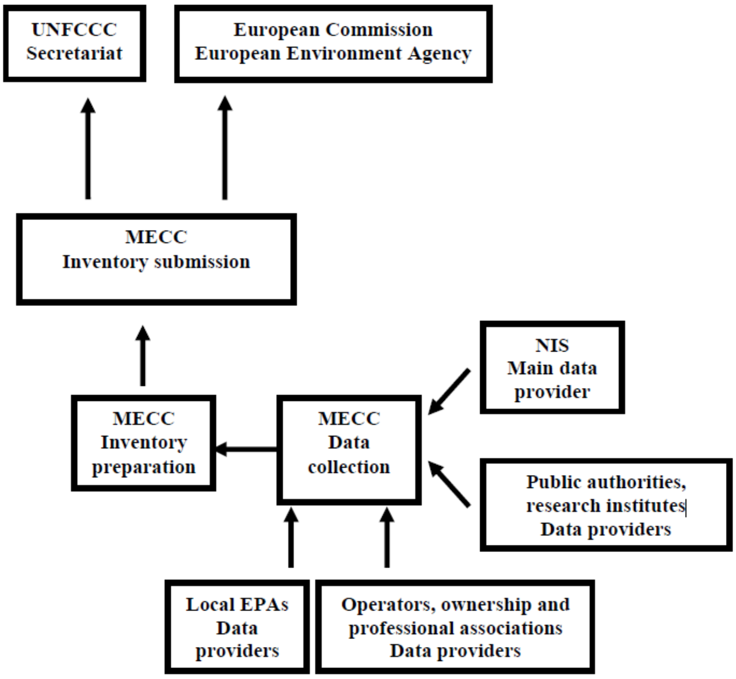


Figure III_C_ 1 *Legal and procedural arrangements*

The legal and procedural framework specific to the NS include:

- GD no. 48/2013 related to organization of the Ministry of Environment and Climate Change and for modifying some environment protection and climate change domain related legal acts; the GD also modified the GD no. 1570/2007;
- GD no. 668/2012 for modifying and completing the GD no. 1570/2007 for establishing the National System for estimation of anthropogenic greenhouse gas emissions levels from sources and removals of CO_2 by sinks, regulated through the KP;
- Ministry of Environment Order (MoEO) no. 1376/2008 for approving the Procedure on NGHGI reporting and the modality for answering to the observations and questions raised following the NGHGI review;
- MoEO no. 1474/2008 for approving the Procedure on processing, archiving and storage of data specific to the NGHGI;
- NEPA's President Decision no. 23/2009 for approving the Procedure on selection of the estimation methods and of the emission factors for the estimation of the GHG levels;
- NEPA's President Decision no. 417/2012 on abrogating the NEPA's President Decision no. 119/2012 (on abrogating the QA/QC Procedure approved through the Decision no. 24/2009 and on approving a updated QA/QC Procedure related to the NGHGI) and on approving a updated QA/QC Procedure related to the NGHGI;
- Protocol of collaboration no. 3029/MMP-RP/3.07.2012 between Ministry of Environment and Forests, NEPA and ICAS, on administrating the NGHGI LULUCF Sector both under the UNFCCC and KP;

- Protocol of collaboration no. 3136/MMP/9.07.2012 between Ministry of Environment and Forests, NEPA, Romanian Automobile Register and Directorate on Driving Licenses and Vehicles Registration in the Ministry of Administration and Interior, on the preparation of Road transport category estimates based on COPERT 4 model.

(c) Description of the process for collecting activity data, for selecting emission factors and methods, and for the development of emission estimates

According to the GD no. 1570/2007 establishing the National System for the estimation of the GHG emissions levels from sources and removals by sinks, modified and completed by GD 668/2012 and GD no. 48/2013, the implementation of the National System ensures the NGHGI quality in three phases:

- Planning;
- Preparation;
- Management of the NGHGI preparation activities.

Data collection process comprises the following steps:

- Identification of data requirements;
- Identification of potential data suppliers;
- Preparation of specific questionnaires;
- Submitting the questionnaires to the potential suppliers of data;
- Data collection;
- Data verification: activity data received are examined (time series discrepancies, large changes in values from the previous to the current inventory year).

Emission factors selection is performed according to the provisions of the NEPA's President Decision no. 23/2009 for approving the Procedure on selection of the estimation methods and of the emission factors needed for the estimation of the GHG levels.

Due to NEPA's work, for the implementation of the study[6] performed in 2011 for several sectors (Energy, Industrial Processes, Agriculture, LULUCF and Waste) and implementation of Protocol of collaboration (for LULUCF sector and Road transport category), a significant

[6] *"Elaboration/documentation of national emission factors/other parameters relevant to NGHGI Sectors Energy, Industrial Processes, Agriculture and Waste, values to allow for the higher Tier calculation methods implementation"*, ISPE
"*NGHGI LULUCF both uner the UNFCCC and KP obligations"*, ICAS
"Compilation of the 2013 National Greenhouse Gas Inventory Land Use, Land-Use Change and Forestry Sector both under the UNFCCC and KP obligations", ICAS
"Determination of emission/removal factors for the forest and for conversions from/to forest land associated pools both under UNFCCC and KP obligations", ICAS

amount of activity data and emission factors have been collected/processed/developed, enabling the development of higher estimates/tier estimates and a significant decrease of the number of categories characterized using the NE notation key.

Also, the informational fluxes for data collection from the operators from the Energy Sector (Energy Industries and Manufacturing Industries and Construction) and from the the Waste Sector (Solid Waste Disposal on Land and Waste Water Handling) were optimized, due to the implementation of an integrated informational system, developed according with the study[7] performed SC Asesoft International SA-SC Team Net International SA-SC Star Storage SRL consortium, based on a contract with NEPA.

The main data sources used for activity data are presented in the following table.

Table III_2 *Data sources used for activity data*

Sector	Data sources
Energy	National Institute for Statistics (Energy Balance) Energy producers Ministry of Economy Romanian Civil Aviation Authority Transgaz SA National Authority on Regulating in Energy National Agency for Mineral Resources Romanian Automobile Register Directorate Driving Licenses and Vehicles Registration
Industrial Processes	National Institute for Statistics (Statistical Yearbook, other data sources) Industrial operators through 42 Local Environmental Protection Agencies Direct information from industrial operators
Solvent and other product use	National Institute for Statistics Industrial operators through 42 Local Environmental Protection Agencies
Agriculture	National Institute for Statistics
LULUCF	National Institute for Statistics (Statistical Yearbook) Ministry of Agriculture, Forests and Rural Development (MADR)-Forests General Directorate (2007-2008); Ministry of Environment and Forests-Forests General Directorate (2009-2011) National Forest Administration (RNP)
Waste	National Institute for Statistics National Environmental Protection Agency Public Health Institute National Administration "Romanian Waters" Food and Agriculture Organization Landfill operators through 42 Local Environmental Protection Agencies

The sources of the emission factors/increment rates used are: national studies, IPCC 1996, IPCC GPG 2000, IPCC GPG 2003, national research institutes and plants, in a limited number.

7 *"Environmental Integrated Informational System"* , SC Asesoft International SA, SC Team Net International SA, SC Star Storage SRL

Data processing and emissions calculation

Data processing is performed according to the provisions of the Ministry of Environment Order no. 1474/2008 for approving the Procedure on processing, archiving and storage of data specific to the NGHGI.

Activities were carried out mostly by NEPA, ISPE and ICAS, as contractors of studies[8] implemented in 2011 and 2012; specific activities comprise:

- Primary data processing:
- Checking the completeness of all data and information for all years and categories within the analyzed period;
- Completing the datasets, using also default IPCC interpolation/extrapolation and/or alternative techniques;
- Checking the accuracy and consistency of datasets;
- Values transformation, in order to reach the measurement unit adequate within the method used;
- Data aggregation/disaggregation considering the IPCC classification;
- Calculation and/or adjustment of different parameters considering the available data;
- Selection of the emission factors and of the methods;
- Application of methods;
- Emissions/removals estimates, using the most recent data;
- Internal review (errors are rectified);
- Preparation of the national inventory report.

The previous activities were also implemented as part of collaboration between:

- MECC, NEPA, Romanian Automobile Register and Directorate on Driving Licenses and Vehicles Registration in the Ministry of Internal Affairs, in the framework of the Protocol of collaboration no. 3136/MMP/9.07.2012, on preparation of Road transport category estimates based on COPERT 4 model;

[8] *Elaboration/documentation of national emission factors/other parameters relevant to NGHGI Sectors Energy, Industrial Processes, Agriculture and Waste, values to allow for the higher Tier calculation methods implementation",* ISPE
"NGHGI LULUCF both under the UNFCCC and KP obligations" and "Compilation of the 2013 National Greenhouse Gas Inventory Land Use, Land-Use Change and Forestry Sector both under the UNFCCC and KP obligations", ICAS

- MECC, NEPA and ICAS, in the framework of the Protocol of collaboration no. 3029/MMP-RP/3.07.2012, on administrating by ICAS of the LULUCF Sector, both under UNFCCC and KP.

The emissions from KP Annex A Sectors are estimated following the IPCC 1996, as elaborated by IPCC GPG 2000. Emissions/removals from LULUCF Sector are estimated using IPCC GPG 2003. CORINAIR methodology was applied in case of the NGHGI Solvent and Other Product Use Sector.

Data archive

Data archiving is done according to the provisions of the Ministry of Environment Order no. 1474/2008 for approving the Procedure on processing, archiving and storage of data specific to the NGHGI.

MECC team manages and maintains the NGHGI database and the documentation of specific inventory information. According to the provisions set by IPCC GPG 2000, the NGHGI documentation includes:

- Assumptions and criteria for selection of AD and EF;
- EF used, including references to IPCC documents for default factors or to published references or other documentation for emission factors used in higher tier methods;
- AD or sufficient information to enable activity data to be traced to the referenced source;
- Information on the uncertainty associated with AD and EF;
- Rationale for choice of methods;
- Methods used, including those used to estimate uncertainty;
- Changes in data inputs or methods from previous years;
- Identification of individuals providing expert judgment for uncertainty estimates and their qualifications to do so;
- Details of electronic databases or software used for the inventory, including versions, operating manuals, hardware requirements and any other information required to enable their later use;
- Worksheets and interim calculations for category estimates, aggregated estimates and any recalculations of previous estimates;
- Final inventory report and any analysis of trends from previous years;
- QA/QC plans and outcomes of QA/QC procedures.

All inventory information, as far as needed to reconstruct and interpret inventory data and to describe the national system and its functions, is accessible at a single location – MECC. While all information officially submitted according to the requirements of the Kyoto Protocol is translated into English, this is not possible for all background information made available during the review process, as the official inventory documentation language is Romanian.

Specific NGHGI data are archived as follows:

- Electronically – all available documents;
- On paper – the documents used for the NGHGI preparation unavailable in electronic format and the correspondence with different organizations.

In order to ensure the security of databases and the confidentiality of the background data, both paper and electronic data are kept under restricted access conditions (MECC site). Furthermore, electronic data backup activities are undertaken on server with daily frequency during the generation of the official submission and weekly in rest of cases.

(d) Description of the process and the results of key source identification and, where relevant, archiving of test data

The key category analysis (KCA) has been performed according to the provisions in Chapter 7 of IPCC GPG 2000 and Chapter 5 of IPCC GPG 2003, both following the Tier 1 and Tier 2 approach.

Separate key category analysis were conducted taking into account both the exclusion and inclusion of the LULUCF sector and also both level and trend criteria; all IPCC sectors and categories, sources and sinks (as recommended in Table 7.1 of IPCC GPG 2000 and in Table 5.4.1 of IPCC GPG 2003), and gases were analyzed. KCA was conducted for every year of the characterized period.

KCA was implemented using an integrated software application developed in 2012 by the Environment Agency of Austria - University of Graz consortium, in the context of the study[9], implemented by the SC Asesoft International SA - SC Team Net International SA - SC Star Storage SRL consortium; the application allows:

- Automatic data import from the CRF Reporter application, through the use of CRF Tables;
- Integrate both key category and uncertainty analysis performed, following both Tier 1 and Tier 2 approach;
- Automatic export of results, data and information, within the relevant reporting templates.

[9] „*Environmental Integrated Informational System",* Environment Agency of Austria and University of Graz, SC Asesoft International SA, SC Team Net International SA, SC Star Storage SRL

The results of the KCA, for 2011, are presented in the following table.

Table III_3 *Key category analysis for 2011*

KCA	**Number of key categories**		
	Level and trend	**Level**	**Trend**
Tier 1 (excluding LULUCF)	30	45	37
Tier 1 (including LULUCF)	29	48	41
Tier 2 (excluding LULUCF)	23	29	36
Tier 2 (including LULUCF)	26	30	38

The following categories were identified as key categories following the Tier 2 analysis, additionally to the Tier 1 related key categories:

- 1.A.4.b Residential-biomass fuels (N2O emissions);
- 1.B.2.a Oil - CO2 emissions;
- 2.F.1 Refrigeration and Air Conditioning Equipment (HFCs emissions);
- 2.F.2 Foam Blowing (HFCs emissions);
- 2.F.9 Other (HFCs emissions);
- 3. Solvent and Other Product Use (CO2 emissions);
- 4.B.14 Other AWMS (N2O emissions);
- 5.C.2 Land converted to Grassland (CO2 emissions).

The identification of the KP LULUCF key categories followed the procedure described within the Chapter 5 of the IPCC GPG 2003.

Summary of key categories in 2011, by level and trend (excluding/including LULUCF), are presented in Annex 3.2.

KCA was used for prioritizing the efforts for improving the quality of the NGHGI - the relevant implemented and future studies referring mainly to the use of higher Tier methods in key categories; the KCA results were considered within activities part of the Romanian inventory improvement plan (including the prioritization plan for moving to higher tier methods for key categories) – 2012-2013.

(e) Description of the process for the recalculation of previously submitted inventory data

According to the relevant provisions in Chapter 7 of the IPCC GPG 2000 and the Ministry of Environment and Forests Order no. 1376/2008 for approving the Procedure on NGHGI reporting and the modality for answering to the observations and questions raised following the NGHGI review, the recalculations of the emissions/removals estimations are performed by MECC and applied in the following cases:

- Available data have changed;
- The previously used method is not consistent with good practice guidance for that source category;
- A category has become a key category;
- The previously used method is insufficient to reflect mitigation activities in a transparent manner;
- New methods become available;
- Inclusion of new source/removal categories;
- Changes in the activity data and emission factors acquisition and use;
- Correction of identified errors;
- Other cases, in accordance with the relevant good practices

Regardless of their magnitude, the recalculations are performed by MECC for every year of the analyzed period, between the base year and the last reported year. Recalculations are performed using a single method for all years, including, when needed, alternative techniques as interpolation, extrapolation and other relevant techniques.

Based on IPCC GPG 2000 and IPCC GPG 2003, Romania implemented significant recalculations in order to account for better AD and/or EFs, mainly based on NEPA's work, on the studies[10] implemented in 2011- 2013 period. The recalculations resulted in significant increase of the accuracy, completeness and consistency of data series.

The information on recalculations, reported within the CRF Tables and within the NIR, contains the information on used procedures, methods applied, emission factors and activity data and information on source/removal categories not previously analyzed.

[10] *Elaboration/documentation of national emission factors/other parameters relevant to NGHGI Sectors Energy, Industrial Processes, Agriculture and Waste, values to allow for the higher Tier calculation methods implementation",* ISPE
"NGHGI LULUCF both under the UNFCCC and KP obligations" and "Compilation of the 2013 National Greenhouse Gas Inventory Land Use, Land-Use Change and Forestry Sector both under the UNFCCC and KP obligations", ICAS

(f) Description of the quality assurance and quality control plan, its implementation and the quality objectives established, and information on internal and external evaluation and review processes and their results in accordance with the guidelines for national systems

Romania established the QA/QC Procedure based on the UNFCCC and Kyoto Protocol's provisions related to the NGHGI and the NS, the IPCC 1996 and IPCC GPG 2000 provisions, and on the GD no. 1570/2007 establishing the National System for the estimation of the anthropogenic GHG emissions levels from sources and removals by sinks, as modified and completed. QA/QC activities are both described within the QA/QC Programme and within the QA/QC Procedure related to the NGHGI, approved by the NEPA's President Decision no. 417/2012.

The QA/QC Programme and the QA/QC Procedure comprise information on:

- The national authority responsible for the coordination of QA/QC activities;
- The objectives envisaged within the QA/QC framework;
- The QA/QC Plan;
- The QC procedures;
- The QA procedures.

According to GD no. 1570/2007 establishing the national system, as modified and completed, and NEPA's President Decision no. 417/2012, the competent authority responsible with the implementation of the QA/QC activities under the NGHGI, is performing the following activities:

- Ensures that specific QA/QC objectives are established;
- Develops and regularly updates a QA/QC plan;
- Implements the QA/QC procedures.

Considering the provisions of relevant regulations, a QA/QC coordinator was designated.

The overall objective of the QA/QC Programme is to develop the NGHGI in line with the requirements of the IPCC 1996, IPCC GPG 2000 and IPCC GPG 2003 and with the provisions of the Decision no. 280/2004/EC[11] and Decision no. 166/2005/EC.

Romania QA/QC plan follows the definitions, guidelines and processes presented in Chapter 8 – Quality Assurance and Quality Control of the IPCC GPG 2000. The QA/QC plan, as a main part of QA/QC procedures, outlines the current and planned QA/QC activities performed during all stages of the inventory preparation.

[11] *Repealed by Regulation (EU) no 525/2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC*

The QA/QC plan is reviewed periodically, if needed, and may be modified as appropriate when changes in processes occur or based on the advice from independent reviewers.

The QA/QC plan is intended to ensure the fulfilment of the NGHGI principles in Romania. The objectives of the plan include:

- Applying greater QC effort for key categories and for those categories where data and methodological changes have occurred recently;
- Periodically checking the validity of all information, as changes in reporting, methods of collection or frequency of data collection occur;
- Conducting the general procedures outlined in QC procedures (Tier 1) on all parts of the inventory over a complete exercise;
- Balancing efforts between development and implementation of QA/QC procedures and continuous improvement of inventory estimates;
- Customizing the QC procedures to the resources available and the particular characteristics of Romania's greenhouse gas inventory;
- Confirming that the National Statistical Institute and other agencies/companies supplying activity data have implemented QC procedures.

QC activities

QC activities were implemented by each sectoral expert during all phases of inventory preparation, focusing on key categories.

The following QC activities are conducted annually, before and during the preparation of estimates (15 September÷ 30 October):

- Checking the specific requirements regarding the reporting deadlines;
- Verification of the data collection against the information needed;
- Checking the correct transcription of input data into the calculation sheets;
- Checking the correctness of conversion factors used in calculation;
- Checking the data structures integrity and the disaggregation of activity data at calculation sheets level;
- Checking the concordance between the data measurement units in the calculation sheets and the equivalent data in the CRF Reporter format;
- Checking the consistency and the data values used in the AD and EF series, at the calculation sheets level;

- Identifying common parameters to multiple source or sink categories and checking the values consistency between source or sink categories;
- Checking the emissions/removals calculation into the calculation sheets, by reproducing a representative sample calculation;
- Checking the correctness of the aggregation of estimated emissions/removals at the calculation sheets level.

The following QC activities are conducted annually, during and after the preparation of estimates (15 October ÷ 10 January ÷ 10 March):

- Checking the emissions/removals estimates for all sources, sinks for the entire time series;
- Checking the explanations, when the emissions/removals estimates are lacking;
- Checking the correctness and consistency of choosing the AD, EF and methods used along the entire time series;
- Checking the trends for identifying the outliers and re-analyze the values;
- Checking the correctness of recalculations and the existence of explanations;
- Checking the recording and archiving of AD, EF and methods used;
- Checking the correctness and the completeness of the data transcription from the calculation sheets level to the CRF Reporter level;
- Checking the correctness and the completeness of the data transcription from the CRF Reporter level to the CRF tables level;
- Checking the data used in the NIR against the CRF tables and calculation sheets;
- Checking the correctness of applied methods descriptions, at the NIR's level;
- Checking the references completeness at the NIR's level;
- Checking the archiving of the CRF tables, NIR, CRF Reporter's specific databases and the calculation sheets;
- Checking the key categories persistency along the time series;
- Checking the adequate qualification of individuals providing expert judgments on the uncertainty estimates and the archiving of documentation regarding the qualification and the expert judgments;
- Checking the uncertainty calculation correctness, by partially replying the Monte Carlo analysis;
- Verification the implementation of ERT recommendations;

- Checking the completeness of archiving the QA/QC documentation (QA/QC programme, checklists, ERT report, improvements lists);
- Checking the performance of QA/QC Programme and propose improvements.

Within the specified deadlines, the previously mentioned activities are performed at sectoral level. Based on specific sectoral responsibilities allocated within the sector, the QC checks are performed for certain category by a sectoral expert not being involved in the administration, including estimating emissions/removals of that category (cross-checking approach).

The results of all checks outlined above are documented in the annual QC checklists for inventory preparation. For this purpose, QC checklists are used consistently throughout the years by all experts involved in the inventory preparation.

Additionally, in 2011 and 2012, the QC activities were performed by contractors, as part of the studies[12] performed for improvement of the NGHGI.

QA activities

As part of EU Member State, starting with 1st of January 2007, Romania has the obligation to prepare and submit the NGHGI according to the Decision no. 280/2004/EC and Decision no. 166/2005/EC, which provides for a QA activity after the first submission (15th of January) and a final QA for all 27 EU Member States (first half of March for the preparation of the EC inventory). In this respect, starting with 2007, Romania has the possibility to verify the inventory twice before the official submission to the UNFCCC Secretariat.

In order to get an objective assessment of the inventory quality and for identifying areas where improvements can be made, NEPA involve third party reviewers at the QA activities level, according to the provisions in IPCC-GPG, depending on the availability of resources. In this scope, NEPA was developing the specific procedural arrangements. MECC through its international contacts and bilateral agreements supported NEPA in identifying the available processes for ensuring the implementation of QA activities.

Until now, NEPA was the beneficiary of technical support provided by the Austrian Environment Agency (as part of the twinning project RO/2006/IB/EN/09). One of the most important activities performed within this framework was the review of different NGHGI sectors. Austrian experts provided specific recommendations consisting in:

[12] *„Elaboration/documentation of national emission factors/other parameters relevant to NGHGI Sectors Energy, Industrial Processes, Agriculture and Waste, values to allow for the higher Tier calculation methods implementation",* ISPE
"NGHGI LULUCF both under the UNFCCC and KP obligations", ICAS
"Compilation of the 2013 National Greenhouse Gas Inventory Land Use, Land-Use Change and Forestry Sector both under the UNFCCC and KP obligations", ICAS
"Determination of emission/removal factors for the forest and for conversions from/to forest land associated pools both under UNFCCC and KP obligations", ICAS

- Improvement of transparency at sectoral level, considering the trend and recalculations description;
- Improvement of transparency at sectoral level, by providing a cumulative table on the status of emissions/removals estimation for each sub-sector;
- Improvement on knowledge on practical ways for performing and documenting the QA/QC activities;
- Improvement of the NGHGI archiving structure.

Until first half of 2011, NGHGI team was the beneficiary of a Netherlands Government to Government (G2G) project. One of the main aims of the project was to develop the reporting capacity of the NGHGI team also by assessing the possibility to use higher tier methods. Specific activities comprised:

- Advices on improving the NGHGI sectoral data documentation (through the use of the documentation list);
- Training courses/presentations related to using of data specific to other reporting mechanisms at the GHG Inventory level (use of ETS data, use of COPERT model);
- Discussions/advices on methodological issues (data collection, emissions estimation) on GHG emissions recovery within the Industrial Processes and Waste activities;
- Advices on moving to higher Tier levels in the Energy Sector:
    - Calculation of specific emission factors;
    - Use of COPERT model in estimating the Road Transport emissions.
    - Advices on using national data for the calculation of natural gas transit fugitive emissions;
    - Advices on moving on Tier 2 at the Enteric Fermentation, Manure Management and Agricultural Soils levels:
        - Precise identification of activity data;
        - Workshop on elaborating the specific requirements for a emission factors/other parameters study development;
        - Other relevant advices.
- Advices on moving on First Order Decay method at the Solid Waste Disposal Sites level and other relevant advices;
- Identification of the practical ways to complete the estimation of emissions/ removals specific to Kyoto Protocol's Art. 3.3 and 3.4 activities: afforestation/ reforestation/deforestation, forest management and revegetation.

QA activities were also performed in 2011, according to the relevant provisions of IPCC GPG 2000, as part of the studies[13] performed for improvement of the NGHGI.

Additionally, in 2012, the NGHGI has been subject to a thorough review within the European Union, review under the Decision no. 406/2009/EC on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020.

National inventory submissions to the UNFCCC Secretariat are subject to the review under Article 8 of the Kyoto Protocol and procedures defined in the relevant COP/MOP decisions.

All recalculations planned and performed (including those following the UNFCCC ERT review) are mentioned in the improvements lists.

The results of QA checks (excepting the checks performed under Decision no. 280/2004/EC[14], Decision no. 166/2005/EC and Decision no. 406/2009/EC and, respectively, by ERT) are documented in the annual QA checklists for inventory preparation. For this purpose, QA checklists are used consistently throughout the years by all inventory experts involved in the inventory compilation.

(g) Description of the procedures for the official consideration and approval of the inventory

According with provisions of the GD no. 1570/2007, modified and completed, and of the MoEO no. 1373/2008, the NGHGI verification and evaluation is performed at MECC level.

MECC personnel, with attributions/responsibilities of preparing the NGHGI, considers the observations/comments, and as appropriate, updates the NGHGI in order to improve it as soon as possible, considering the relevant reporting guidelines.

III.D. Unic consolidated registry

According to the Kyoto Protocol reporting guidelines (para 32), each Annex I Party shall provide a description of how its national registry performs functions defined in the annexes to decisions 13/CMP.11 and 5/CMP.12, and conformity with the requirements of the technical standards for data exchange (DES), including:

(a) The name and contact information of the registry administrator designated by the Party to maintain the national registry

Contact information on the registry administrator:

Directorate General Climate Change

[13] *"Elaboration/documentation of national emission factors/other parameters relevant to NGHGI Sectors Energy, Industrial Processes, Agriculture and Waste, values to allow for the higher Tier calculation methods implementation",* ISPE

[14] *Repealed by Regulation (EU) no 525/2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC*

Adress: Bd. Libertatii, no. 12, sector 5

Telephone: (+4) 021 408.95.50

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Phone: (+4) 021 408.95.50

Fax: (+4) 021 408.95.50

Email: catalin.dulgheru@mmediu.ro

romanian.registry@mmediu.ro

Host – European Commission, Bruxelles

Email: restricted

http://ets-registry.webgate.ec.europa.eu/euregistry/RO/index.xhtml

Phone: restricted

Fax: restricted

b) The names of the other Parties with which the Party cooperates by maintaining their national registries in a consolidated system

Each Party retains its organization designated as its registry administrator to maintain the national registry of that Party and remains responsible for all the obligations of Parties that are to be fulfilled through registries.

(c) A description of the database structure and capacity of the national registry

In 2012, the EU registry has undergone a major redevelopment with a view to comply with the new requirements of Commission Regulation 920/2010 and Commission Regulation 1193/2011 in addition to implementing the Consolidated System of EU registries (CSEUR).

The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. The documentation is annexed to this submission.

During certification, the consolidated registry was notably subject to connectivity testing, connectivity reliability testing, distinctness testing and interoperability testing to demonstrate capacity and conformance to the Data Exchange Standard (DES). All tests were executed successfully and lead to successful certification on 1 June2012.

(d) A description of how the national registry conforms to the DES between registry systems for the purpose of ensuring the accurate, transparent and efficient exchange of data between national registries, the clean development mechanism registry and the transaction log (decision 19/CP.7, para 1)

The overall change to a Consolidated System of EU Registries triggered changes the registry software and required new conformance testing. The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. The documentation is annexed to this submission.

During certification, the consolidated registry was notably subject to connectivity testing, connectivity reliability testing, distinctness testing and interoperability testing to demonstrate capacity and conformance to the DES. All tests were executed successfully and lead to successful certification on 1 June 2012.

(*e) A description of the procedures employed in the national registry to minimize discrepancies in the issuance, transfer, acquisition, cancellation and retirement of emission reduction units (ERUs), certified emission reductions (CERs), temporary certified emissions reductions (tCERs), long-term certified emission recutions (lCERs), assigned amount units (AAUs) and/or* *removal units (RMUs), and replacement of tCERS and lCERs, and of the steps taken to terminate transactions where a discrepancy is notified and to correct problems in the event of a failure to terminate the transactions*

The overall change to a Consolidated System of EU Registries also triggered changes to discrepancies procedures, as reflected in the updated manual intervention document and the operational plan. The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. The documentation is annexed to this submission.

(f) An overview of security measures employed in the national registry to prevent unauthorized manipulations and to prevent operator error and of how these measures are kept up to date

The overall change to a Consolidated System of EU Registries also triggered changes to security, as reflected in the updated security plan. The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. The documentation is annexed to this submission.

(g) A list of the information publicly accessible by means of the user interface to the national registry

As requested by the European Commission Regulation no. 389/2013, Annex XIV, data publicly available (excluding confidential data) posted on the Romanian Registry site (rnges.anpm.ro) are the following:

- Persons holding accounts: contact data;
- Operators holding accounts: PAR/SAR contact data;
- National accounts administrator contact data;
- National Allocation Plan, and list with installations accessing the New-Entry Reserve;
- Number of units (ERUs, CERs and AAUs) cancelled and retired;
- Operators verified emissions for 2008.

The information based on the requirements in the annex to the decision 13/CMP.1 is publicly available on the Romanian registry website (Annexes 6.2.3 – 6.2.6).

(h) The Internet address of the interface to its national registry

The new internet address of the Romanian registry is:

https://ets-registry.webgate.ec.europa.eu/euregistry/RO/index.xhtml

(i) A description of measures taken to safeguard, maintain and recover data in order to ensure the integrity of data storage and the recovery of registry services in the event of a disaster Network errors Disaster Recovery Plan – EU Registry Procedure –confidential (SIAR)- Anex II E, 32 (B) -15/CMP 1

The overall change to a Consolidated System of EU Registries also triggered changes to data integrity measures, as reflected in the updated disaster recovery plan. The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. The documentation is annexed to this submission.

(j) The results of any test procedures that might be available or developed with the aim of testing the performance, procedures and security measures of the national registry undertaken pursuant to the provisions of decision 19/CP.7 relating to the technical standards for data exchange between registry systems.

On 2 October 2012 a new software release (called V4) including functionalities enabling the auctioning of phase 3 and aviation allowances, a new EU ETS account type (trading account) and a trusted account list went into Production. The trusted account list adds to the set of security measures available in the CSEUR. This measure prevents any transfer from a holding account to an account that is not trusted.

The data related to National Registry are presented in Annex 3.4.

IV POLICIES AND MEASURES, INCLUDING THOSE IN ACCORDANCE WITH ARTICLE 2 OF THE KYOTO PROTOCOL AND DOMESTIC AND REGIONAL PROGRAMMES AND/OR LEGISLATIVE ARRANGEMENTS AND ENFORCEMENT AND ADMINISTRATIVE PROCEDURES

IV.A. Policy making process

Decisions related to policies and measures can be taken at different levels: legislative measures at country level, administrative measures at the country, county and municipalities levels.

In accordance with Constitution Act the two chambers of Parliament have legislative power.

The implementation of laws is the domain of the administration, i.e of the ministries and their subordinate administrative units.

Policies and measures with respect to climate change at the municipal level range from land-use planning, public transport and local road construction to public buildings and procurement.

Private business affairs are managed independently.

Ministry of Environment and Climate Change operates as a specialized body of the central public administration subordinated to the Government and it performs the national policies correlated with European and international policies on the environment, climate changes, waters, forests, the hunting fund and fish farming, playing the role of state authority for planning, regulation, synthesis, coordination, monitoring, inspection and control. Moreover, it ensures the coordination of the operations on the integration of requirements on environmental protection and climate change in the other sectoral policies in accordance with the European and international requirements and standards.

Ministry of Environment and Climate Change has the following responsibilities in the field of climate change:

- ensures the interministerial co-ordination of the process for the elaboration, the revision, the implementation and the monitoring of the National Strategy for Sustainable Development;
- co-ordinates the activity for the integration of the requirements of climate change in the others sectoral policies in concordance with international and European requirements and standards;
- elaborates National Strategy and National Action Plan for Climate Change;
- elaborates National Strategy and National Plan related to the contribution of Romania at the attainment of EU target for reduction of GHG emissions up to 2050;
- ensures the administration National System for the estimation of the level of GHG emissions through the annual achievement of National Inventory of GHG emissions;

- ensures the development of an national system for GHG emissions projections in concordance with European stipulations;
- ensures the implementation of the EU emission trade scheme;
- manages the accounts from EU Unique Register of GHG emissions ,which is the jurisdiction of the Romanian State;
- ensures the optimum framework of the implementation for the stipulations of Decision 2009/406/EC on the MS effort to reduce greenhouse gas emissions, so as to observe the Community's commitments to reduce greenhouse gas emissions by 2020;
- ensures the elaboration of national communication of climate change;
- ensures the implementation and the up-to-date of the policies and measures needed for adaptation at negative effect of the climate change;
- ensures the technical secretariat of the National Committee on Climate Change constituted by GD no 658/2006;
- administrates the funds resulted from the transaction of the excess of the quantities attributed for Romania in concordance with Kyoto Protocol and the income obtained through the auction of the GHG emissions certificates .

IV.B. Domestic and regional programmes and/ or legislative arrangements and enforcement and administrative procedures

Romania signed the United Nations Framework Convention on Climate Change (UNFCCC) in 1992. It was ratified by Law no. 24/1994. Thus, Romania has undertaken the commitments stipulated in the respective document.

In 1999, Romania signed the Kyoto Protocol, as the first Part of annex I to the UNFCCC. It was ratified by Law no.3/2001. Thus, Romania undertook the reduction of GHG emissions in the 2008 - 2012 period by 8% compared to the emission value in 1989. Following 1989, the transition from the planned, centralized economy to the free market economy determined an economic decline, following the ending of economic activities in inefficient branches, thus leading to a relevant decrease of the GHG emissions.

In Romania there is a legal framework in the field of climate change which allows for a coherent application of the UNFCCC and the Kyoto Protocol. So there are :

- Primary legislation, including specific acts on climate change;
- General environmental regulations, including climate change aspects;
- Specific legislation related the sectors to energy , transport, agriculture and forestry and waste management.

The Romanian Government adopted in July 2005, through Government Decision no. 645/2005, the first National Strategy on Climate Change (NSCC) 2005 - 2007. The general objective of the strategy focused on two directions:

- Ensuring the meeting of the commitments undertaken by Romania following the ratification of the UNFCCC and of the Kyoto Protocol and of the duties on EU climate change;
- Drafting and implementing Romania's voluntary objectives and activities on adapting to the impact of climate change, reducing carbon intensity in the national economy and using the flexible mechanisms stipulated in the Kyoto Protocol in order to increase the competitiveness of Romanian economy.

The strategy indicates environmental and economic benefits through the implementation of flexible mechanisms and it establishes Romania's approach on the implementation of activities in the field of climate change required for Romania's accession to the EU and for its participation to the EU Emission Trading Scheme (EU ETS).

Therefore, the first steps are taken in the direction of a national effort that is concentrated and coordinated for the implementation of policies in the 2005 - 2007 period for the limitation of GHG emissions and the preparation of measures for adaptation to the potential effects of climate changes. The National Action Plan for Climate Change (NAPCC), approved by GD 1877/2005, published in O.J. 119/2006, was approved in accordance with the NSCC. This plan had concrete actions for the 2005 - 2007 period, ensuring the meeting of the general and specific objectives of the NSCC.

Starting with January 1st, 2007, Romania became an EU Member State with full rights and it obtained significant results by adopting the community aquis. The following Laws and Directives are applied in this context:

- Law no. 104/2011 on environmental quality, aiming to prevent, eliminate, limit the damage and improve air quality, for the avoidance of negative effects on human health and the environment, ensuring the alignment with the international legal norms and with the regulations of the European Union;
- Directive 2008/50/EC – on ambient air quality and cleaner air for Europe;
- Directive 2008/1/EC – concerning integrated pollution prevention and control;
- Directive 2001/81/EC – on national emission ceilings for certain atmospheric pollutants (NEC Directive);
- Directive 2001/80/EC – on the limitation of emissions of certain pollutants into the air from large combustion plants;
- Directive 2010/75/EU – on industrial emissions (integrated pollution prevention and control);

- Directive 1998/70/EC – relating to the quality of petrol and diesel fuels with further amendments and supplements;
- Directive 1994/63/EC – on the control of volatile organic compound (VOC) emissions resulting from the storage of petrol and its distribution from terminals to service stations;
- Directive 1999/13/EC – on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations with further amendments and supplements;
- Directive 1998/69/EC – on the measures to be taken against air pollution by emissions from motorized vehicles;
- Directive 2009/29/EC – amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community;
- Decision 2009/406/EC on the MS effort to reduce greenhouse gas emissions, so as to observe the Community's commitments to reduce greenhouse gas emissions by 2020;
- Directive 2009/30/EC of the European Parliament and Council of 23 April 2009 amending Directive 98/70/EC on the specifications of petrol and diesel fuels, for the introduction of a greenhouse gas emission monitoring and reduction mechanism and amending Directive 1999/32/EC of the Council relating to a reduction of the sulphur content of certain liquid fuels and amending Directive 93/12/ECC;
- Directive 2009/31/EC on the geological storage of carbon dioxide and amending Directives 85/337/EEC, 96/61/EC, 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC and EC Regulation no. 1013/2006;
- (EC) Regulation no. 443/2009 of the European Parliament and Council of 23 April 2009 setting emission performance standards for new passenger cars as part of the Community's integrated approach to reduce CO2 emissions from light-duty vehicles.

The National Legislation on Climate Change is as follows:

- GD 658/2006 on the reorganization of the National Commission on Climate Change (NCCC) (published in the O.J. 465/.2006);
- GD 780/2006 establishing the greenhouse gas emission allowance trading scheme, amended by GD 133/2010, GD 399/2010, GD 1300/2010;
- GD 60/2008 approving the National allocation plan on greenhouse gas emission allowances for 2007 and 2008-2012;
- GD 48/2013 on the organization and operation of the Ministry of Environment and Climate Change and for the amendment of certain normative acts on the environment and climate change;

- GEO 29/2010 on the capitalization of the surplus units of the quantity awarded to Romania by the Kyoto Protocol, approved by Law 145/2010;
- GEO 115/2011 establishing the institutional framework and the authorization of the Government by the Ministry of Public Finance to auction the greenhouse gas emission allowances awarded to Romania at the European Union level;
- M.O. 1474/2007 approving the Regulation on the management and operation of the national registry of greenhouse gas emissions (published in O.J.680/2007);
- M.O. 1897/2007 approving the procedure on the issuance of the permit for the issuance of greenhouse gas emissions for the 2008-2012 period (published in O.J. 842/2007);
- M.O. 254/2009 approving the Methodology on the allocation of greenhouse gas emission allowances from the New Entrants Reserve, for the 2008-2012 period (published in O.J. 186/2009);
- M.O. 1170/2008 approving the Guide on adaptation to the climate change effects – GACC (published in O.J. 711/2008).

In 2013, Romanian Government approved "National Strategy for Climate Change 2013 - 2020", which approached in two distinct parts the process of the reduction GHG emissions for achieving the national objectives assumed and the process of the adaptation at the effects of the climate change, considering the EU policy related to climate change and the knowledge obtained in the frame of the actions for collaboration with foreign partners and international institutes.
The implementation of this strategy is in the responsibility of the Romanian Government under the co-ordination of the Ministry of Environment and Climate Change.
The revision of the strategy and the up-to date of its objectives will be achieved in 2015 and in 2020 in accordance with the following diagram:

***Table IV_ 1** Diagram of National Strategy on climate change revision and up to date of its objectives*

Implementation	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Elaboration of Action Plan								
Evaluation of the degree for the achievement of the objectives								
Revision of strategy								

For achieving the GHG emissions reduction objectives up to year 2020, through the applications of EU-ETS and of the objectives defined by Decision no.409/2009/EC, substantial contributions of all economic sectors and all GHG emissions sources are necessary.
The institutional structure, in line with the Memorandum "Action Plan for the implementation of Energy – Climate Change Package in Romania", signed by Romanian Government in year 2009, is necessary to be create and strengthen
National policy related to the GHG emissions reduction is in line with the EU policy, namely:

- The implementation of the EU-ETS scheme;

- The adoption of the policies and measures at the sectoral level, thus that at national level, the GHG emissions of the sectors must respect the linear trajectory of the levels of the emissions allocated on base of the Decision no.406/2009/EC.

At national level, the limitation and the reduction of the GHG emissions will be achieved through the application of EU-ETS and of the provisions of Decision no 406/2009/EC (for Romania, in 2020, the GHG emissions will increase with 19% in comparison with the emissions level registered in year 2005).

IV.C. Policies and measures and their effects

This section provides information on adopted and planned policies and measures, which contribute to achieve the GHG emissions mitigation goals at EU level and of the Convention taking into consideration the Kyoto Protocol.

The adopted and planned policies and measures took into considerations the GHG emissions of the each sector, theirs potentials of the reductions and the national priorities for economic development.

IV.C.1. Sector Energy

The Romanian Government established the strategic scope for the energy sector in order to meet both the current, medium and long term energy demand, for the lowest possible price, adequate to a modern market economy and to a civilized living standard, under quality and safety in supply conditions, in line with the sustainable development principles.

Considering the role of the energy for the economy and the society, the development of this sector is carried out under state supervision, by drafting and implementing a sectoral strategy, and, on a short term, through the implementation of a policy correlated with the strategic field
Romania transposed the following EU Directives into national legislation, with implications on the national primary energy consumption, respectively:

- Directive 2006/32/EC on energy end-use efficiency and energy services - transposed by OG 22/2008 and the Methodological norms for the enforcement of GO 22/2008 approved by GD 409/2009;
- Directive 2005/32/EC establishing a framework for the setting of eco-design requirements for energy-using products - transposed by GD 1043/2007;
- Directive 2009/28/EC on the promotion of the use of energy from renewable sources - transposed by Law no. 220/2008 republished;
- Directive 2004/8/EC on the promotion of cogeneration based on a useful heat demand in the internal energy market - transposed by GD 219/2007;
- Directive 2009/33/EC on the promotion of clean and energy-efficient road transport vehicles – transposed by GEO 40/2011;

- Regulation 2009/443/EC establishing the emission performance standards for new passenger cars – transposed by GD 90/2011;
- Directive 2010/40/EU on the framework for the deployment of ITS in the field of road transport and for interfaces with other modes of transport - transposed by GO 7/1021.

The contribution of Romania at the EU objectives in the frame of the legislative packet "Energy-Climate Change" is the following: "24% of the final energy consumption will be cover by renewable energy resources in 2020"

IV.C.1.1. Electricity and Heat Generation

The primary energy saving measures on the generation of electricity and heating are as follows:

- Withdrawing from service the generating units whose lifespan has been exceeded and which have become obsolete and the replacement thereof with modern units with superior efficiencies;
- Re-engineering 330 MW units operating in lignite-fired power plants;
- Promoting high efficiency cogeneration; gas turbines with a heat recovery boiler (GT+HRB) and a combined cycle with gas turbines (CC+GT) of approximately 1000 MW and 600 MW biomass-fired units shall be installed;
- Continuing the upgrade works of district heating supply systems, respectively the units generating heat fluid, the primary heat fluid (hot water) transmission grid, the heating stations and heating modules, the hot water and heat fluid distribution network;
- Generating electricity from renewable energy sources;
- Distributed electricity generating administrated with modern technology of information.

Beginning with 1 April 2011, the state support scheme for promoting high efficiency cogeneration was applied; the support scheme is in force till 2023.
Based on the National Action Plan for Renewable Energy Sources, which indicates the installed powers per types of technologies from renewable energy sources, results the evolution of energies generated, presented in table IV_2.

Table IV_ 2 *Evolution of electricity generated from Renewable Energy Source*

[GWh]

	2013	2014	2015	2016	2017	2018	2019	2020
Total generated electricity, of which:	**23,558**	**25,923**	**27,523**	**28,845**	**29,577**	**30,225**	**30,866**	**31,388**
Hydropower plants	17,624	18,191	18,679	18,904	19,063	19,214	19,491	19,768
Photovoltaic power stations	100	140	180	220	246	271	295	320
Wind power plants	4,634	5,952	6,614	7,271	7,668	8020	8,230	8,400
Biomass-fired power plants	1,200	1,640	2,050	2,450	2,600	2,720	2,850	2,900

The main objectives for the utilization of the renewable energy are:

- The integration of renewable energy in the structure of the Romanian Power System;
- The integration of renewable energy in the requirements of the economic efficiency;
- The promotion of the sectoral policy for ensuring the energy security due to the increase share of the renewable energy in final energy consumption, determining lower dependence of imported energy;
- The energy supply for the isolated localities, through utilization of the local energy resources.

IV.C.1.2. Utilization of energy

The energy is used in all economic and social activities. For this reason it is important to use energy in efficient mode with positive impact on the GHG emissions.

The second National Action Plan on Energy Efficiency (PNAEE) for 2011 - 2020 period takes into consideration the sustainable development of Romania and promotes measures for efficient use of energy, in order to achieve the EU commitment (20% reduction in year 2020).

In accordance with National Strategy for Climate Change 2013-2020 resulted that through the elaboration of PNAEE the reduction of GHG emissions in residential sector will be 41.5% in 2020 in comparison with the average value of the period 2001 - 2005.

In this strategy are presented the following specific objectives:

- The improvement of the thermal performance of the buildings.

  The requirements of the Norm for design and execution of the thermal isolation (C107) will be apply for new residential buildings.

  The thermal rehabilitation of the residential buildings will be achieved with two mechanism of finance:

  a. 50% from state budget,30% from local budget and 20% from owners fund;
  b. A new mechanism for crediting for single family houses and for the mounting of the equipment using renewable energy.

The application of these measures is estimated to determinate an energy economy of about 25%, in comparison with actual situation.

- The encouragement of the development of the projects for ecologic houses, passive houses and /or active houses.

- The modernization of the infrastructure for transport and distribution of heat in centralized system.

  This objective will be achieve also through "The heating 2006-2015 heat and comfort" National Program (GD 462/2006). The period for the implementation of this program will be extended up to 2020. Through the application of this program, the cost with thermal energy for heating, preparing hot water and consumption of the primary energy resources will decrease with about 100,000 toe per year, in comparison with the consumption used for ensuring the thermal energy in year 2004.

- The program for the efficient energy improvement in the building occupied by persons with low income.

  The project "The improvement of energy efficiency in the farm and communities with low incomes from Romania" begun in 2011 for increasing the energy efficiency at 40 buildings (kindergartens, nurseries, health units, asylum for old men etc.) from communities with low income, using local technology (traditional materials) for the reduction of the cost used for fuels.

  This project will be extended for the buildings occupied by the persons with low income.

- The program for the encouragement of the consumers for the acquisition of the electrical goods with high energy efficiency, considering the provisions of the Regulation 106/2008/EC;

- The reduction of the water consumption, as a national priority for the following decade, which will determinate a substantial reduction of the energy consumption for water pumping.

The PNAEE foresees the co-finance of several types of projects (increasing the energy efficiency for urban heating, thermal rehabilitation of public building, public lightning).

The application of Ecodesign Directive will lead to the reduction of electricity consumption in services sector and residential sector, due to the use of efficient lighting technologies.

For the Agriculture sector there is a specific objective "The improvement of energy efficiency and the development of the sector for obtaining of energy from renewable resources", achieved by:

- The use of bio - liquid and biomass for obtaining the thermal energy in the farms;

- The implementation of the technologies for collecting and use of the agricultural residues;
- The achievement of the micro installations for obtaining biogas in farms or in groups of farms;
- The introduction of other renewable energies, such us: wind energy, solar energy, geothermal energy;
- The development of the deposits for the agriculture production.

IV.C.1.3. Industry Sector

Romanian industry was severely affected by the transition from planned economy to market economy and the loss of existing market within Comecon. In the period 1990-2005 was carried out restructuring and privatization of industrial enterprises, ceasing its business undertakings which had no market or cannot handle compete. After 2008 due to the global economic crisis, they had ceased undertaking market (metallurgical enterprises, heavy machinery businesses, etc.).

The National Strategy for Sustainable Development (GD no.1460/2008) provides industrial development policy in accordance with general objectives of the sustainable economic development, in line with EU industrial policies.

The evolution of various industrial sectors in the medium term depends on:

- Maintain and develop an attractive business environment, enhancing investment flows stimulating technological upgrading, renewal processes and products;
- Consider environmental impacts of products throughout their lifecycle (from design, manufacture, assembly, marketing, sale and use to recycling and disposal);
- Support research, development and innovation in conjunction with the real needs of industry and market demand to achieve competitive advantages and reduce the technological gap from advanced countries in the EU;
- Promoting digital technologies at all stages from design to production, marketing management including the management of companies;
- Encourage direct investment as a source of capital, know-how, modern technology and management skills;
- Supporting the emergence of small and medium enterprises (SMEs) in the manufacturing sector, for achieving high quality products with low cost, in line with market requirements.

By applying appropriate tools for economic policy in the period 2008-2030, the resource productivity and energy consumption will increase by an average annual rate of 3-4%, by reducing weights intensive subsectors by upgrading technology and improving management.

After 1990, many new small and medium enterprises (SME) industrial profile appeared.

Considering the EU need for a strong, competitive and innovative industry, competing at international level on excellence basis, the clusters and clusters networks were promoted, as key drivers for innovation and growth through the development of collaborative and multi-sectoral approaches and by stimulating interactions between innovator actors.

Romanian Government will support with public funds the competitiveness of industrial enterprises, the development of high added value products and the production of exported products.

Industrial policy aims to apply the best technologies for improving energy efficiency and providing quality products at competitive prices with environmental compliance. It follows that for the industrial processes sector impose retrofitting and use of new technologies for the efficient processing of raw materials and energy resources leading to reduction of GHG emissions.

IV.C.1.4. Transport sector

In accordance with the White Paper on Transport 2050, a 20% reduction of GHG emissions is forecast by 2030, compared to 2008, and by 60% in 2050, compared to the level registered in 1990.

The development of the transport system in Romania considers the increase of the inclusion the urban systems in the EU environment, by improving the services (road, railway, sea, river and air transport) with the main destinations in Europe. The relative accessibility indicator (combining services, transhipments, transport prices and durations) shall progressively align, by 2020, to the current indicator for European metropolitan areas.

The general objective of the National Strategy for Sustainable Development is to assure that the transport systems satisfy the economic, social and environmental needs of society, with a minimum impact on the economy, society and environment.

In order to improve behaviour in relation with the environment, the global impact of pollutant emissions generated by the transports sector shall gradually be decreased, in order to meet the objectives established for Romania (national emission ceilings). The emissions will be reduced with 5% by 2015 (case of the cities where air quality emissions limit levels are exceeded), and with 15% (case of the cities where the transports are the main source of pollution).

The national objective for the 2020 time horizon is to meet the current EU average level in terms of the economic, social and environmental efficiency of transports and to perform substantial progresses for the development of the transport infrastructure.

The national objective for the 2030 time horizon is to grow closer to the EU average level of that year in terms of all basic parameters of sustainability in the transport operation.

In May 2011, the Ministry of Transports and Infrastructures in the *Romania Intermodal Transport Strategy – 2020,* underlined the key role of intermodal transport for efficient use of transport means with high capacity (railway, inland waterways and sea transport), with benefit effects on energy consumptions and pollutant emissions (table IV_3).

Table IV_ 3 *Reducing energy consumption and CO_2 emissions by using intermodal transport*

Combined transport versus Road transport	Accompanied combined transport (railing road)	Unaccompanied combined transport (containers/trailer cars)
Reducing energy consumption from the origin to the destination	10%	29%
Reducing energy consumption / km	11%	29%
Reducing CO_2 emissions from the origin to the destination	18%	55%
Reducing CO_2 emissions /km	23%	60%

The general aim of the Intermodal Transport Strategy is the development of the national system for intermodal transport of goods aiming to increase the efficiency of goods transport, with positive impact on environment and on traffic safety in Romania.

In accordance with this strategy, the general target for 2020 is meeting, via this system, of a transport share amounting to at least 40% of the volume of goods carried in intermodal transport units (ITU) on the Romanian territory.

The measures for increasing energy efficiency and reducing pollutant emissions in the transport sector are as follows:

- Using smart transport systems;
- Reducing road transport;
- The program for the renewal of the National car park, funded by the Environmental Fund budget;
- Measures applied by economic agents, local and central public administrative units, holding over 25 vehicles, for monitoring and management of fuels in order to reduce the fuel consumption;
- Upgrading railway cargo and passenger transport by procuring high energy efficiency rolling stock;
- Implementing a tele-management system of electricity and for the compensation of the power factor in electric traction substations;
- Implementing the level 2 European Railway Traffic Management System (ERTMS);

- Reducing the electricity consumption afferent to the generation of compressed air required for the operation of fixed subsystems testing train brakes by replacing old, Reșița type compressors, with modern and efficient equipment;
- Upgrading underground transport by upgrading the electric train park and the public space lighting systems;
- Using biofuels (meeting the bio-fuel usage share amounting to 10% of the final national consumption by 2020);
- Reducing the annual resource consumption by 303 ktoe in the 2014 - 2020 period.
- Promoting "clean passenger cars" and stimulating the manufacturing thereof. In order to encourage the procurement of such passenger vehicles, Emergency Ordinance no. 40/2011 on the promotion of non-polluting and energy-efficient road transport vehicles, amended by Emergency Ordinance no. 9/2013 on the environmental stamp for the passenger vehicle, stipulates the granting of a new environmental ticket for each electric passenger vehicle.
- Encouraging forms of alternative transport (cycling, car-pooling, car-sharing, etc.) through urban planning and the development of an adequate infrastructure for cycling (bicycle tracks, bicycle racks, special bicycle wagons/compartments in the subway and on trains, etc.) and expanding the pedestrian areas, particularly in large urban agglomerations.
- Increasing the degree of using public transportation, by optimizing means of public transport (trains, buses, trolley-buses, trams) and the infrastructure required for the proper operation thereof, expanding the underground network by completing section 1 Mai – Laminorului; carrying out section Drumul Taberei – Universitate - Pantelimon; carrying out section Piaţa Victoriei – Băneasa Airport –Henri Coandă Airport, replacing the park with an expired lifespan (50% of the running park), increasing traffic frequency, as well as equipping the new arteries with trains.

The National Action Plan for the reduction of GHG emissions in civil aviation has the following scopes:

- Improving the efficiency of fuel used, by at least 2%/year (reducing fuel consumption on average by 1.5% per hour of flight);
- Capping CO_2 emissions from civil aviation sector activities, starting with 2020.

Romania, as EU member state, supports the EU vision for a competitive and sustainable transport system through the integration of community objectives into national strategies.

Therefore, in order to meet the 10% renewable share target in the final national energy consumption in transports for 2020, considering the provisions of the Directive 2003/30/EC and Directive 2009/29/EC, transposed in national legislation by GD no. 935/2011 promoting the use of biofuels and bio liquids, the suppliers have the following duties concerning fuels entered on the market:

- Diesel fuel:
    - 10 Nov. 2011 biofuel content with minimum 5% volume;
    - 1 Jan. 2013 biofuel content with minimum 6% volume;
    - 1 Jan. 2015 biofuel content with minimum 7% volume;
- Gasoline:
    - 10 Nov. 2011 biofuel content with minimum 4% and maximum 5% volume;
    - 1 Jan. 2013 biofuel content with minimum 6% volume;
    - 1 Jan. 2015 biofuel content with minimum 8% volume;
    - 1 Jan. 2017 biofuel content with minimum 9% volume;
    - 1 Jan. 2019 biofuel content with minimum 10% In volume;

In accordance with the provisions of the same decision, the GHG reduction as a result of biofuels usage shall be:

- Minimum 35%, starting with 1 Jan. 2012, or with 1 April 2013 for installations currently in operation;
- Minimum 50%, starting with 1 Jan. 2017;
- Minimum 60%, starting with 1 Jan. 2018, for installations where the production will start on/after 1 Jan. 2017;

The Regulation (EC) no. 443/2009 setting emission performance standards for new passenger cars, as part of the Community's integrated approach to reduce CO_2 emissions from light-duty vehicles, establishes the average value for new vehicles of 130 g CO_2/km, obtained through technological improvement of the vehicles' engine technology. Starting with 2020, the regulation establishes the objective of meeting the average value of 95 g CO_2/km for new vehicle fleet.

Currently, a proposal for amendment of the Regulation (EC) no. 443/2009 is in debate with the Commission, for defining the methods for achieving the 2020 target.

So, according with the Regulation (CE) no. 443/2009, the average CO_2 emission for new vehicles (light-duty vehicles) shall be:

- 130 g CO_2/km in 2012÷2013;
- 95 g CO_2/km in 2020.

The Regulation (EC) no. 510/2011 setting emission performance standards for new light commercial vehicles, as part of the Union's integrated approach to reduce CO_2 emissions from light-duty vehicles, establishes the average value for new vehicles of 175 g CO_2/km, obtained through technological improvement of the vehicles' engine technology. Starting with 2020, the regulation establishes the objective of meeting the average value of 147g CO_2/km for new light-duty utility vehicle fleet.

So, according with the Regulation (EC) no. 510/2011, the average CO_2 emission for new, light-duty vehicles shall be:

- 175 CO_2/km in 2014÷2017;
- 147 g CO_2/km in 2020.

IV.C.2. Solvent and Other Product Use

Solvents and other products are widely used both in industry (chemical, machinery, wood, etc.), in construction sector, services sector (vehicle maintenance, cleaners, repair phones, etc.) as well as households.

The policy for use of solvents and other products aimed at applying the best technologies for reducing solvents and other products and providing quality products and services at competitive prices with environmental compliance. The new investments will ensure the environmental protection.

IV.C.3. Agriculture

The National Sustainable Development Strategy of Romania - 2013 – 2020 - 2030 Horizon (GD 1460/2008) emphasizes, in the field of agriculture and food production, on ensuring the safety in supply and the safety of food. Agriculture continues to play an important role in ensuring the incomes of a significant part of the active population. It shall promote a sustainable production model, protecting the ecosystems and ensuring the sustainability of food production, the reduction and elimination of imbalances on the agricultural market, generated by the manner of using natural resources, ensuring an improved capitalization of the advantages held by the Romanian agriculture.

The following national aims are considered within the National Sustainable Development Strategy of Romania for agriculture and forestry:

- *2013 horizon*. Increasing the economic dynamism of rural areas in Romania under the conditions of maintaining social balance through the sustainable development of agriculture, forestry and fishing, including of the afferent processing industries for the optimum satisfaction of the population's food demand and to ensure the conservation and improvement of natural resources.

- *2020 horizon*. Consolidating the structures in the agro-food and forestry field, with the economic and social development of rural areas for the continued reduction of gaps and in order to meet the current average performance level of EU member states; Romania's affirmation as an element of stability for food security in South-Eastern Europe.

- *2030 horizon*. The full adoption of community policies and practices on agriculture, forestry and fishing; completing the restructuring and upgrade of such sectors and of the rural space.

In accordance with this strategy, in the period following 2013, the main aims are:

- Developing the competitiveness of the agricultural sector based on knowledge and private initiative;

- Reducing the population active in the agriculture field, in correlation with increasing reliable farming;

- Reducing the fragmentation degree of agricultural surfaces and stimulating the concentration of small farms;

- Maintaining the quality and diversity of rural and forest space, by following the balance between human activities and the conservation of natural resources.

The National Rural Development Program 2007 - 2013, updated in 2012, grants significant importance to the performances of the agricultural, forestry and food sector. According to this program, the priority directions are:

- Increasing the transformation and upgrade of the dual structure of agriculture in order to increase its competitiveness and to contribute to the economic development and the convergence of incomes from the rural space in parallel with ensuring living conditions and environmental protection in rural areas;

- Maintaining and improving environmental quality in rural areas by promoting sustainable management on agricultural services.

The strategy on the organization of the activity on the national improvement and operation of pastures on a medium and long term, approved by the joint Order 226/2003 of the Ministry of Agriculture, Food and Forests and the Ministry of Public Administration has the fundamental aim to increase the total production of green mass and the quality thereof, in accordance with the increase of economic efficiency of animal operations, particularly of the cattle and sheep livestock.

The specific objectives of this strategy are:

- The quantity increase of the green mass and hay production on the entire surface of pastures and meadows;

- Increasing the nutritional value of the herbaceous carpet, ensuring the balanced and efficient meal of various categories of animals, particularly cattle and sheep, in order to obtain non-polluted zootechnical products and an adequate state of animals health;
- Performing the entire annual demand of legume and perennial grass seeds, specific to the improvement of pasture surfaces;
- Developing scientific research actions related to the generation of new types of plants specific to pastures, the performance of regeneration, fertilization and maintenance works, fighting erosion and excessive moisture, mitigation, works of irrigation on pastures, as well as the efficient use of the green mass and hay production;
- Applying the production technologies specific to natural areas, while also benefitting from the same financing and crediting conditions applied to crops from the crop sector.

Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources was transposed in the Romanian legislation by GD 964/2004, approving the Action plan for the protection of waters against pollution caused by nitrates from agricultural sources. GD 964/2000 stipulates that Romania shall re-examine, revise or supplement at least once every 4 years the list of areas vulnerable to nitrates, appointed to consider the changes and factors resulting from the previous appointment. Therefore, the joint Order 1552/2008 of the Ministry of Environment and Sustainable Development and of the Ministry of Agriculture and Rural Development approves the list of localities per counties where there are sources of nitrates from agricultural activities. Following this approved list, the Inter-ministry Commission for the enforcement of the Action Plan approved the Action Plan for areas vulnerable to nitrates through Decision 21130/DC/14.10 2010. In accordance with this program, the provisions of the Agricultural good practice code for the protection of waters against pollution caused by nitrates from agricultural sources approved by the joint Order 1182/1270/2005 of the Ministry of Environment and Sustainable Development and of the Ministry of Agriculture and Rural Development, are compulsory in areas declared vulnerable to pollution caused by nitrates. The nutrient management plan is carried out under the guidance of the Soil Science and Agro-chemistry Study Offices, based on the nutrient framework management plan that was drafted and made available by the Ministry of Agriculture and Rural Development.

The monitoring of the Action program for vulnerable areas to nitrates from agricultural sources considers the following indicators:

- Monitoring the nitrate content of underground and surface waters (in the points established by the National Administration "Romanian Waters") and ground waters (in the points established by the National Research and Development Institute for Soil Science, Agro-chemistry and Environment);
- The manure storage capacity on individual or collective platforms;
- The compliance period for applying manure on lands;

- The loading of animals per hectare, the technical measures and actions of shepherding arrangements shall be observed on communal pastures;
- The compliance for the protection strips located near surface waters or drinking water captures, in accordance with the Action plan indicators.

It should be emphasized that Romania has an Integrated national system for soil monitoring, surveillance, control and decisions to reduce the share of pollutants resulting from agricultural and management sources of organic residues resulting from animal husbandry services in vulnerable and potentially vulnerable areas to nitrate pollution, within the structures of the National system on the integrated monitoring of water resources and of protected areas, managed by the National Research and Development Institute for Soil Science, Agro-chemistry and Environment.

Romania receives funds through the European Economic Recovery Plan (EERP) in order to comply with the priorities established through the Health Balance of the Common Agricultural Policy (CAP). Such funds shall be used to perform certain measures initiated in the National Strategic Plan, respectively:

- Improving the efficiency in the use of nitrate fertilizers, as well as fertilizer storage to reduce CH_4 and N_2O emissions and to contribute to the mitigation of climate change;
- Stimulating /encouraging the use of equipment for the treatment of waste waters in farming.

IV.C.4. Land Use, Land-Use Change and Forestry Sector (LULUCF)

The development strategy of the forestry sector in Romania has the main goal of increasing its contribution to increase the quality of life level, based on the sustainable management of forests.

The sustainable management of forests is defined by the Romanian legislation to ensure, now and in the future, the capacity to exercise multiple permanent ecologic, economic and social functions at a local, regional, national and global level, without prejudicing other ecosystems. This wording provides a general definition of the climate issue or of the potential contribution to economic development through reductions or compensation of emissions from other economic sectors.

The following are required in order to meet the main aim:

- Updating the institutional framework in order to carry out the unitary and supported implementation of the forestry sector's development strategy.
- Developing the forestry sector regulation framework.
    - ✓ Updating the forestry and rural development legislation according to the requirements set by the sustainable management of the national forestry fund;

- ✓ Harmonizing the national legislation with the specific EU legislation, the international conventions and agreements under which Romania is a signatory party;
- ✓ Adapting the regulations on the promotion of market mechanisms and instruments in the sector;
- ✓ Revising and promoting the normative acts on the forestry administration of the national forestry fund through forestry districts, irrespective of the nature of the property;
- ✓ Adapting the regulatory framework specific to wood operation and processing operations, to the environmental protection and conservation requirements and conditions;
- ✓ Improving the legal framework to benefit the association of limited forest area owners;
- ✓ Promoting normative acts (through a participative process) on:
    - the creation of facilities for forest land owners, in order to ensure stability and the increase of the forestry ecosystems' operational efficiency,
    - management of protected areas from the forestry fund;
- ✓ Drafting and promoting the financing and compensation – stimulation mechanisms for activities concerning the conservation of biodiversity and the management of protected areas;
- ✓ Promoting norms and regulations specific to the economic agents from the forestry sector, required for the development of efficient activities;
- ✓ Promoting regulations on the granting of facilities to research beneficiaries and those investing in the research-development activity.

The Ministry of Environment and Climate Change has defined the Forestry Development Project with the aim of maintaining and improving the environmentally sustainable management of forests owned by the State and private property, in order to increase the contribution to the national economy and to the rural economies derived from the Romanian forestry resources. The aim of the project shall be met by implementing the following *five components*:

Component 1: *Establishing systems ensuring the sustainable management of forestry funds found under private property by:*

(a) The strengthening of the forestry department, with particular emphasis on forestry inspectorates at the national level and support services, of the MAFE, in order to provide extensive services and advice relating to the needs of new private forest owners as well as overseeing, regulating and monitoring the activities of the sustainable forest management of State-owned land and private property.

(b) Developing the Association of Private Forest Owners (APPR) by providing basic staff, logistic support and basic office equipment; and by preparing a five-year business development plan, to define the profile of new members and the recruiting action plan, to identify and develop a range of services required for new members, and to include and analyse the funding of the cash flow ensuring the financial sustainability of the APFO national office and to expand its network of new members. The essential activity of APFO shall concern the facility of the national and local establishment of associations of members - private forest owners and the support thereof for the acquirement of funding within the SAPARD program, with the funds received from the European Union.

(c) Supporting the establishment of Local Associations of Forest owners (LAFO) based on the community through development-oriented assistance in areas with high levels of poverty where forest land will be returned to the individual property owners in common ownerships and commons (at the level of village and commune) which currently have limited organizational abilities; and

(d) The establishment of a national forest monitoring and management system (FMIMS) required for supervision and control in order to ensure the sustainable management and development of the forestry sector, by providing integrated and updated access to forestry arrangement, cadastre, legislation, inventories of the forest and biodiversity, data concerning the forest product circuit, as well as statistics on wood trade and industry.

Component 2: *Mitigating the consequences of the return on the management of forest lands owned by the State by:*

(a) Supporting the reform and the strategic development of the NFD by preparing and supporting the NFD in the implementation of a strategic development plan and funding the role thereof in the management of forests owned by the State. It shall be carried out by: (i) identifying, quantifying and separating the costs and benefits of public goods and economic functions of the NFD, as well as preparing a financial-accounting system ensuring that all activities benefit from adequate resources, (ii) performing and supporting in the implementation of a plan for the reform and consolidation of the institutional capacity, of the improvement of operative and commercial efficiency, this optimizing the generation of incomes from production forests, while safeguarding public interest and ecologic services provided by production and protection forests; (iii) developing a detailed and budgeted action plan, per stages, on the non-fundamental activities of the NFD, both for privatization, and for development, including the supply of management services for the new private sector; (iv) supporting the NFD in defining the requirements for its information management system, in order to support its strategic development, and providing an interactive connection with the national monitoring system and information on the forest management, which shall be established by the project within the Forestry Directorates; (v) defining an objective and process that can be audited to determine the

price in wood material auctions; and (vi) supplying the logistic support, materialized in the vehicles and equipment required for the management of the protected forest area network, that is on-going defining, with support from the Biodiversity Conservation Management project on-going development; and

(b) Restoring and widening the forest road network so as to reduce environmental impact and to improve the economic reliability of wood operation in production forests owned by the State. Investing in 10 km of new roads and restoring 425 km of old forest roads shall have significant positive impact on the economic performances of the NFD and it shall aid the compensation of high costs occurring as a result of decreasing the share of production forests compared to protection forests. The places where all the road sub-projects shall be carried out were selected through an economic, social and environmentally detailed analysis process and all new roads, as well as all re-engineering projects, shall be based on the Environmental impact study.

The drafting of this work also proposed a wide consultation of all factors involved in the construction and re-engineering of forest roads in our country: non-governmental organisations, National Forest Administration – ROMSILVA, local and central environmental agencies, other agencies responsible for the supervision and authorization of forest road constructions, as well as companies whose scope is forest road constructions and re-engineering**.**

Component 3: *Support for productivity growth and the competitiveness of the wood industry* by establishing the centre of information for businesses in the forestry sector (ForsBIC), a business development and consulting, which will establish connections and coordination in the wood industry (e.g. forestry, harvesting, transport and processing of primary and secondary wood products), will also provide assistance to the related wood industries, through the analysis and dissemination of information relating to new technologies, markets and prices, hygienic requirements and export, product promotion and registration of trademarks, joint partnerships opportunities and availability of donations and loans etc.

Component 4: *Building public support for sustainable forest management* through the preparation and implementation of the strategy of public awareness campaign focused on the key factors, including the general public, focusing specifically on the communities living in forest areas; private forest owners; the staff of forestry inspectorates; NFD; decision makers in the Government; and other influential groups such as the Church and NGOs. Implementation of the program will be assisted by an inter-ministerial committee comprising of the Ministry of Industry and Commerce, Education, Water and Environmental Protection, Culture, Tourism and Public Administration.

Campaign strategies will include: media education; the provision of public relations for the forestry inspectorates, preparing promotional and educational materials to be used in schools; local educational events; the involvement of NGOs in environmental educational projects, and supporting project implementation units to develop its own public relations capacity and informing key decision-makers on the progress of implementation of the project. Public awareness campaign will involve regular assessments of the factors involved; they will be used in refining the implementation of the campaign in line with the changing needs.

Component 5: *Management and monitoring of the project* will be submitted by the Project Management Unit (PMU), which will be made up of a project director, financial director, two specialists (for forest roads, and public awareness), a specialist in procurement, second specialist in procurement, procurement activities related to construction and rehabilitation of the network of forest roads and an administrative assistant. ECP will oversee and support the implementation of all the activities of the programme in accordance with indicators of which they agreed.

Ecological forestry, reconstruction through afforestation of degraded areas considered unsuitable for agriculture, as well as non-productive land, regardless of their form of ownership, aims to protect the soil, restoring balances and improving environmental conditions.

Land through erosion, pollution or destructive actions of some anthropogenic factors have permanently lost the ability of agricultural production, but can be improved through afforestation of degraded lands are considered. Degraded lands are the following categories of land:

- Land with very strong and excessive surface erosion;
- Land with erosion in ravines, torrents;
- Land affected by landslides, collapses, spillages and mudflows;
- Sandy lands exposed to erosion by wind or water;
- Land with clumps of gravel, cobble, rock, detritus and sediment deposits rains;
- Land with excess moisture at all times; strong acid or salt lands;
- Land polluted with chemicals or oil;
- Land occupied by mining, industrial waste dumps;
- Land with affected or destroyed biocenoze;
- Unproductive land.

Degraded land that can be improved through afforestation, shall be constituted in perimeters of improvement.

Inventorying degraded lands is an obligation, that won't end until after the completion of the improvement actions.

Developed in 2010 it's considering expanding the areas of forests to reduce the impact of climate change and desertification risk, the risk of floods etc.

In the period 2013-2016 afforestation of 75,000 ha will be as such:

- 4000 hectares of degraded land taken by NFD - ROMSILVA from SDA and purchased;
- 4000 hectares of degraded land owned by individuals and local councils;
- 40,000 ha of degraded agricultural land owned by associations of owners, territorial units, administrative units, units of worship;
- 2300 ha of protective forest belts.

In 2017-2020 period afforestation of 60.000 hectares will be as follows:

- 8,000 ha of degraded lands taken by NFD - ROMSILVA from SDA and purchased;
- 8,000 ha of degraded land held by individuals and local councils;
- 40,000 ha of degraded agricultural land owned by associations of owners, territorial units, administrative units, units of worship;
- 4000 hectares of protective forest belts.

In 2021-2030 period there will be afforestation of 158,000 hectares of land.

Increasing the areas occupied by forests during the period 2013-2030 with 293,000 ha requires a financial effort which will be covered from the State budget, from the Fund for the improvement of the Land Fund with the Forestry Department, foreign funds destination referred to in measure 221 of the National Plan for Rural Development, Environmental Fund.

Within the framework of national sustainable development strategy, emphasizes:

- The improvement of the methods of use of agricultural and forest lands of the conservative type
  a) Promoting technologies for the conservation and enhancement of carbon sequestration in arable soils.
  b) Planning at the regional level of the results of the use of land resources.
  c) Implementation of the principles of the green economy.
- Best use of forest resources and private sector
  d) Support for the private sector regarding the production of biomass and energy-resources integration
- National policies and programmes of the European Union
  e) To promote integrated land planning
  f) To promote integrated inter-sectoral policies (energy resources)

g) To support interdisciplinary research financed from national programmes and support national policies (or in negotiation at national and international level).

Increasing the areas occupied with forest through National program of Afforestation, with a surface of 422,000 ha, requires a particularly financial effort, during the period 2010-2035 of 3,519,600 thou lei, of which:

- 1,117,200 thou lei from the State budget and from the Fund for the improvement of the forestry fund department;
- 394,400 thou lei from foreign funds – Measure 221 from the National Program of Rural Development (NPRD);
- 2,008,000 thou lei from the Fund of the environment.

To this amount must be added to the expenses for the upkeep of plantations over a period of 4-6 years, until the closure, which stands at about 6,400,000 thou lei for the entire period, depending on the work set at the annual control.

The total value of the work of afforestation, until the closure, on a 422 thou hectares amounts to approximately 9,919,600 thou lei.

Through the implementation of the National Programme of expanding forest areas, will reduce the impact of climate change and the risk of desertification, especially in areas with deficient in forests, will improve the surface leakage and will diminish the risk of floods, landslides, erosion, lakes warping, will be introduced the major areas economy large areas of land, will improve the pedoclimatic conditions for agricultural crops- in the areas covered by forest protection curtains, it will be created ecological corridors, will be created alternative resources for population and jobs -solid bases of sustainable development in rural areas.

IV.C.5. Waste Sector

Waste management is one of Romania's current issues. The integrated approach in waste management (waste collection, transport, treatment, reuse and disposal activities), includes the construction of waste disposal installations, together with measures for prevention of waste generation and waste recycling, in accordance with the principles hierarchy: preventing waste generation and the negative impact thereof, waste recovery by recycling, reuse and safety disposal of waste, when recovery is no longer possible.

The responsibility for the waste management activities shall fall with the generators thereof, in accordance with the "polluter pays" principle, or, as appropriate, with the producers, in accordance with the "producer responsibility" principle.

Considerable efforts are required for compliance with the EU legislation on waste management in force, as well as of future requirements.

National, regional and county waste management plans were drafted in order to meet the objectives on waste management.

According with Directive 1999/31/EC on the landfill of waste, Member States shall reduce, by 2016, the volume of stored biodegradable waste at approx. 35%, compared to the level registered in 1995, which shall lead to the significant reduction of methane emissions. Furthermore, methane shall be collected in deposits and, if possible, shall be used for energy generation.

The national legislation on the collection, treatment and storage of municipal waste, in line with the EU directives and decisions is presented in Table IV_4.

Table IV_ 4 *Legislation on the generation, collection, transport, treatment and storage of municipal waste*

Directives/ Decisions	National Regulations
Directive no. 2006/12/EC on waste	Law no. 211/2011 on the regime of waste (Official Journal no. 837/25.11. 2011)
	National Strategy on Waste Management and the National Waste Management Plan *(Official Journal no. 954/18.10.2004)* GD 358/2007 amending Annex no. 2 "The National Waste Management Plan" of GD no. 1470/2004 approving the National Waste Management Strategy and the National Waste Management Plan *(Official Journal no. 271/24.04.2007)* MO (Ministry Order) no.951/2007 approving the Methodology on drafting regional and county waste management plans. *(Official Journal no. 497/25.07.2007*)
Directive no. 99/31/EC on the landfill of waste	GD no. 349/2005 on the landfill of waste (Official Journal no.*394 as of 10 May 2005)*
	Order of the Ministry of Environment and Sustainable Development no.757/2004 approving the technical regulations on waste storage (Official Journal no.86, din 26.01.2005), supplemented and amended by Order no. 1230/2005 (Official Journal no.1101 as of 7.12.2005)
Directive no. 94/62/EC on packaging and packaging waste, with further amendments	GD no.621/2005 on packaging and packaging waste (Official Journal no.639 of 20/07/2005) GD no.1872 as of 21 December, 2006 and GD no. 247 as of 27 March 2011, amending and supplementing GD no.621/2005 on the management of packaging and packaging waste
	Law no. 292/2007 (Official Journal no. 758 as of 08.11.2007.), GEO no. 37/2008 (Official Journal no. 336 as of 30.04.2008.), GD no. 25/2008 (Official Journal no. 628/29.08. 2008), Law no. 329/2009 (Official Journal no. 761/9.11.2009) , GEO 15/2010 (Official Journal no. 192/26.03. 2010), Law no. 167/2010 (Official Journal no. 504/20.07. 2010) GEO no. 115/2010 (Official Journal 862/22 December 2010), GEO 71/2011 (Official Journal no. 637/6.09. 2011)
Resolution no. 2000/532/EC, amended by Resolution no. 2001/119 establishing a list of wastes*	GD no. 856 din 16 august, 2002 on the records of waste management and approving the list of wastes, including hazardous waste (Official Journal no. 659 as of 5 September 2002)

Romania committed to implement the EU legislation concerning waste management till the accession date (01.01.2007), with the following derogations on this chapter, included in "Romania's position document Chapter 22 - Environmental protection":

- Directive no. 94/62/EC on packaging and packaging waste - transition period till 2013;
- Directive no. 99/31/EC on the landfill of waste - transition period till 2017;

- Council Directive no. 2000/76/EC on the incineration of waste - transition period till 2009.

The National Development Plan 2007 – 2013 (NDP) also considered the following aims:

- Improving living standards by ensuring the public utility services at the required quality and quantity standards, in the water and waste sectors, by developing the water and waste water infrastructure systems in the concerned localities and creating/consolidating regional related companies, and by developing integrated waste management systems (waste collection, transport, treatment/disposal in the concerned localities; closure non-compliant landfills).

- Improving the environmental management sectorial systems, focus on: the development of specific water and waste management systems, and of natural resource management systems (conservation of biological diversity, ecological reconstruction of damaged systems, prevention and intervention in case of natural risks – particularly floods), as well as on the improvement of the air protection infrastructure.

According with the National Strategy for the Sustainable Development of Romania (2013 – 2020 – 2030), the strategic directions related to the waste management are:

- The rational correlation of the development objectives, including the investment programs, with the capacity of supporting the natural capital;

- Using the best economic and ecologic available technologies, in public fund investment decisions; the firm introduction of eco-efficiency criteria in all production or service activities;

- Forecasting the climate change effects and drafting both long term adaptation solutions, and inter-sectorial contingency measures, including alternative solution portfolios for crisis situations generated by natural and anthropic processes.

Solid waste storage

The following measures are established at EU and national level in order to reduce waste landfill:

- Prioritization of the efforts in the waste management field in line with the waste hierarchy;

- Increasing the recycling rate and improving the quality of recycled materials, working closely with the business sector and companies with the main activity waste recovery;

- Promoting the recovery of packaging waste.

For the biodegradable waste, the total amount of biodegradable waste deposited shall continuously decrease, by:

- Reducing the amount of biodegradable waste to 35% of the total amount, gravimetrically expressed, produced in 1995, until 2016;
- Reducing the amount of biodegradable waste by recycling and processing (minimizing the waste organic material in order to reduce the amount of levigate and biogas from the storage);
- Reducing the amount of paper waste and cardboard for 60% of the total, gravimetrically expressed, produced in 1995, until 2016.

The most important measure to reduce GHG emissions from non-compliant landfills is foreseen by GD 349/2005 regarding the waste disposal, transposing the Directive 99/31/EC regarding the waste disposal, namely: Appendix no. 5 "Calendar of cessation/ termination of service or compliance for the existing landfills – table 5.1 – non-compliant landfills class "b" of the urban area that cease the storage."

According to this calendar, until 2017, 41 non-compliant landfills will have to cease their activity during 2013-2017.

Wastewater treatment

The national policy to reduce GHG emissions, in line with EU legislation, implies the adoption of policies and measures at sector level, for assuring the target established at the national level by the Decision no. 406/2009/EC.

In order to prevent the pollution of surface water with the wastewater from anthropogenic sources, the legislation in force shall be follow. This legislation concerns mainly the quality indicators of the wastewater discharged in the environment.

The basis of the EU legislation in the field of the wastewater is the Directive 91/271/ECC concerning the treatment of the urban wastewater, amended and supplemented by the Directive 98/15/EC. The Directive 91/271/ECC was fully transposed into the Romanian legislation by the GD no. 188/2002 approving some rules concerning the conditions for discharge of wastewater into the aquatic environment, amended and supplemented by the GD no. 352/2005. The GD no. 188/2002 contains the following key annex related to collection, transport, treatment and disposal of wastewater:

- Annex 1. Technical rules for collection, treatment and discharge of urban waste, NTPA – 011;
- Annex 2. Standard on wastewater discharge conditions in the local sewerage networks and direct in treatment plants, NTPA – 002;
- Annex 3. Standard on setting pollutants limits for urban and industrial wastewater discharged into the natural receptors, NTPA – 001.

The main objective of the Directive 91/271/EEC is to protect the environment from the negative effects of the discharges of urban waste and waste water from certain industrial sectors (mainly the processing and manufacturing of the food industry production).

In Romania, the EU legislation in the field of wastewater treatment and discharge into the aquatic environment was implemented during the period 2002-2005, but, further implementation steps are required to fully comply with the requirements of the Directive.

Considering both the location of Romania in the basin of the Danube and the basin of the Black Sea, as well as the necessity to protect the environment in these areas, Romania declared its entire territory as sensitive area. This decision is reflected in the fact that the agglomerations with more than 10.000 equivalent inhabitants should provide an urban wastewater infrastructure to allow the advanced treatment, especially with regards to the nutrients nitrogen and phosphorus. The secondary treatment (biological level) is a general rule for the agglomerations which are smaller than 10.000 equivalent inhabitants.

The terms of implementation of the Directive vary and depend on the size of the agglomeration and its impact on the receiving waters. The final transition period for the implementation of the Directive was set on December 31st 2018, with intermediate deadlines for the collection and treatment of the waste water.

The measures to limit and/or reduce GHG emissions arising from the wastewater treatment are the following:

- Increase the degree of connection to the sewerage and waste water services
- Construction of new wastewater treatment plants;
- Rehabilitation and upgrading of the existing wastewater treatment plants;
- Use of modern technology with lower power consumption;
- Automation of the wastewater treatment plants operation, with beneficial implications for their optimal functioning, i.e. avoiding methane emission;

IV.C.6 Cross-cutting Policies and Measures

The policies and measures for all NIR sectors are presented in the subchapters IV.1- IV.7

An overview of all cross-cutting policies and measures, including the affected sectors is presented in the table IV_5.

Table IV_ 5 *Cross-sectoral policies and measures*

Policy and Measure	**Sector affected**					
	Energy supply	**Energy demand**	**Industry**	**Transport**	**Agriculture and Forestry**	**Waste**
National Action Plan on Efficient Energy	Yes	Yes	Yes	Yes	Yes	
National Action Plan for Renewable Energy	Yes	Linkage			Yes	
Emission Trading Scheme	Yes		Yes			
Promotion for combined heat and power (CHP)	Yes	Linkage	Linkage			
Climate and energy Fund	Yes	Yes				
Eco –Design Directive	Yes	Yes	Likage			
Implementation of biofuels Directive	Linkage			Yes	Yes	
Green Electricity Investment Scheme	Yes	Linkage			Yes	
Water Framework Directive	Yes	Yes	Linkage			

The policies and measures considered in the WEM scenario for reducing the GHG emissions are presented in table IV_6 ÷ IV_7

Table IV_ 6 *Policies and measures to reduce GHG emissions, considered in scenario with measures*

No.	Policy/ Measure	Objective	GHG	ETS/ non-ETS	Type of policy instrument	Implementation Status	Entities responsible for implementing the policy	Estimated effect of the policy and measures on GHG emissions (kt CO_2 equivalent)			
								2015	**2020**	**2025**	**2030**
ENERGY SECTOR											
1	GD 1069/2007 Romania's Energy Strategy for 2007 – 2020	The future evolution of energy sector with main objectives: energy security, sustainable development, competitiveness. This strategy presents energy consumption up to 2030 in Romania and the measures for to cover this consumption. This strategy will be update taking into consideration the economic crisis.	CO_2	ETS/ non-ETS	Planning	Implemented	Ministry of Economy and Finance	1,000.050	8,336.868	8,336.868	11,279.292
2	GD 890/2003 Energy Roadmap	Focus on the energy sector	CO_2	ETS/ non-ETS	Planning	Implemented	Ministry of Economy and Trade	IE[1]	IE[1]	IE[1]	IE[1]
3	GD 1460/2008 National Strategy for Sustainable Development of Romania. 2013 – 2020 - 2030 Horizon	The future evolution of energy sector, of industrial sector, of agriculture and forestry, of rural development of the transport sector. This strategy will be update taking into consideration new social and economic conditions.	GHG	ETS/non-ETS	Planning	Implemented	Ministry of Economy and Finance, Ministry of Environment and Sustainable Development, Ministry of Interior and Administrative Reform	6,837.180	7,599.000	9,116.350	12,756.340
4	National Renewable Energy Action Plans	Promotion of energy from renewable sources by types of technologies: hydro, photovoltaic, wind and biomass	CO_2	non-ETS	Planning	Implemented	Ministry of Economy, Trade and Business Environment	3,132.046	4,766.726	5,709.119	6,048.316
5	GD 1535/2003 Strategy on the capitalization of renewable energy resources	The evaluation of the potential of the various form of the renewable energy sources and the forecast of the renewable use up to 2015	CO_2	ETS/non-ETS	Planning	Implemented	Ministry of Economy and Trade, Ministry of Agriculture, Forests, Waters and Environment	IE[2]	NA	NA	NA

No.	Policy/ Measure	Objective	GHG	ETS/ non-ETS	Type of policy instrument	Implementation Status	Entities responsible for implementing the policy	Estimated effect of the policy and measures on GHG emissions (kt CO_2 equivalent)			
								2015	2020	2025	2030
6	GD 219/2007 Directive 2004/8/EC on the promotion of cogeneration based on a useful heat demand in the internal energy market	Establishes the legal framework for the promotion and development of high efficiency cogeneration; promote energy saving primary aims to increase energy efficiency and improve security of energy supply; establish support schemes and guarantees of origin for electricity produced in high efficiency cogeneration; reporting EC in 2008, the first national report on the potential for high efficiency cogeneration	CO_2	ETS/non-ETS	Planning	Implemented	Ministry of Economy and Trade, Ministry of Administrations and Interior	47.500	NA	NA	NA
7	GD 22/2008 transposition of Directive 2006/32/EC on energy end-use efficiency and energy services	Measures to improve energy efficiency and energy requirement for end-users. Efficient use of heating and air conditioning systems. Use of measurement apparatus for control of energy consumption. Efficient use of company cars etc.	CO_2	ETS/non-ETS	Planning	Implemented	Ministry of Economy and Finance, Ministry of Interior and Administrative Reform, Ministry of Development, Public Works and Dwellings, Ministry of Transport	94.910	691.760	852.750	1,164.410
8	GD 462/2006 for the appoval of the "Heating 2006-2015 heat and comfort" National Program	National Program" Heating 2006-2015", has the aim to increase the efficiency of District Heating Systems, rehabilitation of District Heating System and rehabilitation of buildings.	CO_2	ETS/non-ETS	Planning	Implemented	Ministry of Economy and Trade, Ministry of Administrations and Interior	47.500	NA	NA	NA
9	GD 780/2006 establishing the greenhouse gas emission allowance trading scheme, amended by GD 133/2010, GD 399/2010, GD 1300/2010 and the subsequent legislation	Establishing the greenhouse gas emission allowance trading scheme.	CO_2	EU ETS	Economic	Implemented	Ministry of Environment and Water, Ministry of Economy and Trade, Ministry of Administration and Interior	7,000.000	15,000.000	NA	NA

No.	Policy/ Measure	Objective	GHG	ETS/ non-ETS	Type of policy instrument	Implementation Status	Entities responsible for implementing the policy	Estimated effect of the policy and measures on GHG emissions (kt CO_2 equivalent)			
								2015	2020	2025	2030
10	The second National Plan on Energy Efficiency for 2011-2020	The primary energy saving measures Established measures for primary energy savings (removal from service of production capacities, achieving thermal power new modern coal, promotion of high-efficiency cogeneration, refurbishment / modernization of district heating supply, reducing losses in transmission and distribution networks for electricity, heat and natural gas). Establishing the measures to increase energy efficiency in the service sector and final energy savings. Establishing the measures to increase energy efficiency in the public sector (thermal insulation and ventilation in buildings in the public sector, increased efficiency in public lighting, promoting the use of appliances and energy efficient lamps in the public sector). Establishing the strategy for increasing the number of buildings with almost zero energy consumption.	CO_2	ETS/non-ETS	Planning	Implemented	Ministry of Economy, Ministry of Internal Affairs, Ministry of Transport	284.720	955.660	NA	NA
11	GD 882/2004 National Strategy on the heating supply of localities via district generation and distribution systems	Establishing the future evolution of the heat supply of the localities taking into consideration Directive 93/76/EC, Directive 2003/87/EC, Directive 2004/8/EC, Directive 2001/77/EC	CO_2	ETS/non-ETS	Planning	Implemented	Ministry of Economy and Trade, Ministry of Administrations and Interior	IE[3]	NA	NA	NA
12	The improvement of the handling coal	The decrease of methane emissions	CH_4	ETS/non-ETS	Planning	Implemented	Mining Companies	110.470	145.680	151.470	35.370
13	The improvement for the oil and gas sectors	The decrease of fugitive emissions of CH_4	CH_4	ETS/non-ETS	Planning	Implemented	Oil and gas companies	1,540.770	1,025.430	942.690	696.990

No.	Policy/ Measure	Objective	GHG	ETS/ non-ETS	Type of policy instrument	Implementation Status	Entities responsible for implementing the policy	Estimated effect of the policy and measures on GHG emissions (kt CO_2 equivalent)			
								2015	2020	2025	2030
14	The improvement for the oil and gas sectors	The decrease of fugitive emissions of CO_2	CO_2	ETS/non-ETS	Planning	Implemented	Oil and gas companies	72.250	81.000	66.240	56.250
15	The development of the power sector for to cover electricity and heat demand produced in cogeneration	The main objectives are energy security (diversify energy resources) sustainable development (increasing energy efficiency, promoting energy production from renewable resources, promoting high efficiency cogeneration plants, rational and efficient use of primary energy resources) competitiveness (developing market for electricity, natural gas, uranium, green certificates, greenhouse gas emission permits)	CO_2	EU ETS	Regulatory/ Planning	Implemented	Ministry of Economy, Ministry of Internal Affairs	IE[3]	175.725	373.076	345.441
16	Law no. 114/2013 approving GEO no. 64/2011 on the geological storage of carbon dioxide	Reduction of CO2 emissions using CCS Technologies	CO_2	ETS	Regulatory	Implemented	Ministry of Economy, Ministry of Environment and Climate Change	0.000	0.000	0.000	0.000
17	GD 1043/2007 transposition of Directive 2005/32/EC	The establishment a framework for setting of ecodesign requirements for energy-using product	CO_2	non-ETS	Regulatory	Implemented	Ministry of Economy and Finance	IE[4]	IE[4]	IE[4]	IE[4]
	Manufacturing Industries and Construction										
18	The modernization of industrial sector	The reduction of energy intensity	CO_2	ETS/non-ETS	Planning	Implemented	Ministry of Economy and Industry Enterprises	485.148	520.042	583.733	621.383
19	Commitments up to 2020 for non ETS sector	The reduction of GHG emissions for non-ETS sectors	CO_2	non-ETS	Regulatory	Not implemented	Ministry of Economy, Ministry of Environment and Climate Change, Ministry of Transport, Ministry of Agriculture and Sustainable	53.366	57.205	64.211	68.352

No.	Policy/ Measure	Objective	GHG	ETS/ non-ETS	Type of policy instrument	Implementation Status	Entities responsible for implementing the policy	Estimated effect of the policy and measures on GHG emissions (kt CO_2 equivalent)			
								2015	2020	2025	2030
							Development, Ministry of Interior and Affairs				
	Transport Sector										
20	The modernization of transport sector	The decrease of energy consumption and the emissions with the followings measures: the use of biofuels and bioliquids in accordance with GD no 935/2011, new cars in accordance with EC Regulation no 443/2009, new clean passanger cars in accordance with EO no 40/2001 ammended by EO no 9/2013, encouraging forms of alternative transport (cycling etc), increasing the degree of using public transportation, the use new vehicles with low consumption and emissions, the use of intermodal transport etc.	CO_2	non-ETS	Planning	Implemented	Ministry of Transport	144.270	302.874	331.449	660.575

No.	Policy/ Measure	Objective	GHG	ETS/ non-ETS	Type of policy instrument	Implementation Status	Entities responsible for implementing the policy	Estimated effect of the policy and measures on GHG emissions (kt CO_2 equivalent)			
								2015	2020	2025	2030
21	GEO 40/2011 transposition of Directive 2009/33/EC	The purpose of this ordinance is to promote and stimulate the market of clean and efficient energy vehicles and improving transport sector's contribution to EU policies on the environment, climate and energy. Stipulate the obligation to take into account the purchase of road transport vehicles of energy and environmental impact throughout their life. Aspects to be considered for the evaluation of operational energy and environmental impacts include at least the following: a) energy b) CO_2 c) NOx, NMHC and particulate matter.	CO_2	non-ETS	Planning	Implemented	Ministry of Transport	IE[5]	IE[5]	IE[5]	IE[5]
22	GO 7/2010 transposition of Directive 2010/40/EU on the framework for the deployment of ITS in the field of road transport and for interfaces with other modes of transport	Establishes classification of roads, vehicle categories and the weight and speed limits.	CO_2	non-ETS	Planning	Implemented	Ministry of Transport	IE[5]	IE[5]	IE[5]	IE[5]
23	GD 928/2012 concerning the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions	Introducing a mechanism to monitor and reduce greenhouse gas emissions	All	non-ETS	Regulatory	Implemented	Ministry of Economy, Trade and Business Environment, Ministry of Environment and Forests, Ministry of Agriculture and Rural Development	IE[5]	IE[5]	IE[5]	IE[5]
	Services Sector										

No.	Policy/ Measure	Objective	GHG	ETS/ non-ETS	Type of policy instrument	Implementation Status	Entities responsible for implementing the policy	Estimated effect of the policy and measures on GHG emissions (kt CO_2 equivalent)			
								2015	2020	2025	2030
24	The modernization of services sector	The decrease of energy consumption with the following measures: the heating upgrade of the buildings, the compulsion to enforce the provisions of EU efficiency standards for new buildings, the efficiency of lighting systems, the use of low energy lamps, new equipments with low energy consumption etc.	CO_2	ETS/non-ETS	Planning	Implemented	Ministry of Regional Development and Public Administration, Ministry of Economy	3.390	197.131	75.377	204.992
	Residential Sector										
25	The modernization of residential sector	The decrease of energy consumption with the following measures: the heating upgrade of the blocks of flats, the compulsion to enforce the provisions of EU efficiency standards for new buildings, the efficiency of lighting systems, the use of low energy lamps, the use of new equipments with low energy consumptions etc.	CO_2	ETS/non-ETS	Planning	Implemented	Ministry of Regional Development and Public Administration	122.705	396.271	316.866	330.008
	Agriculture Sector										
26	The modernization of agriculture sector	The reduction of energy intensity due to concentration of agricultural land and to use of BAT in irrigation installations and new equipments	CO_2	non-ETS	Planning	Implemented	Ministry of Agriculture and Rural Development	41.159	73.199	140.011	145.883
SOLVENT AND OTHER PRODUCTS USE SECTOR											
AGRICULTURE SECTOR											
28	The improvement of quality of nutrition for cattle, sheep and goats	Use the practice of Common Agricultural Policy	CH_4	ETS/non-ETS	Planning	Implemented	Owners of livestock farms	0.000	767.550	1,433.460	2,356.410
29	The improvement of manure management	The decrease of methane emissions from livestock	CH_4	ETS/non-ETS	Planning	Implemented	Owners of livestock farms	211.257	205.167	261.027	335.367

No.	Policy/ Measure	Objective	GHG	ETS/ non-ETS	Type of policy instrument	Implementation Status	Entities responsible for implementing the policy	Estimated effect of the policy and measures on GHG emissions (kt CO_2 equivalent)			
								2015	2020	2025	2030
30	Order 1182/2005 of Ministry of Environmental and Sustainable Development and Ministry of Agriculture and Rural Development for approval Agricultural good practice code for the protection of waters against pollution caused by nitrates from agricultural sources	Agricultural good practice code	N_2O	ETS/non-ETS	Regulatory/ Planning	Implemented	Ministry of Environment and Water, Ministry of Agriculture and Rural Development	930.000	1,550.000	1,550.000	3,199.200
31	GD 964/2000 transposition of Directive 91/676/EEC concerning the protection water against pollution caused by nitrates from agricultural sources	Approving the Action plan for protection of waters against pollution caused by nitrates from agricultural sources. Romania shall re-examine, revise or supplement at least once every 4 years the list of areas vulnerable to nitrates, appointed to consider the changes and factors resulting from the previous appointment	N_2O	non-ETS	Regulatory	Implemented	Ministry of Waters, Forests and Environmental Protection, Ministry of Agriculture and Food	IE[6]	IE[6]	IE[6]	IE[6]
LULUCF											
32	The improvement of land use	The increase of annual harvest wood as of the ore-1989 period. Afforestation of degraded lands 5kha/year(including revegetation and forest belts). Implementation of "no-till" practices for 30% of the area of arable land (in rotation) per year from 2015-2030	CO_2	ETS/non-ETS	Planning	Implemented	Ministry of Environment and Climate Change, The Autonomous Direction of Forests, Private owners	6,618.054	5,121.428	12,907.024	15,185.648
WASTE SECTOR											

No.	Policy/ Measure	Objective	GHG	ETS/ non-ETS	Type of policy instrument	Implementation Status	Entities responsible for implementing the policy	Estimated effect of the policy and measures on GHG emissions (kt CO_2 equivalent)			
								2015	2020	2025	2030
33	The improvement of the management of the solid waste	The recovering of CH4 emissions resulted from the wastes deposits in compliant landfill , the improvement of the degree of the utilization, the achievement of the compliance deposits of the wastes.	CH_4	ETS/non-ETS	Planning	Implemented	Companies that manage landfill of waste	1111.32	1408.68	1600.41	1874.04
34	Law no. 211/2011 on the regime of waste	Establishes the necessary measures to protect the environment and human health by preventing or reducing the adverse impacts of the generation and management of waste and by reducing overall impacts of resource use and increasing the efficiency of their use.	CH_4	non-ETS	Planning	Implemented	Ministry of Environment and Forests, Ministry of Economy, Trade and Business Environment, Ministry of Interior, Ministry of Agriculture and Rural Development and Local government authorities	IE[7]	IE[7]	IE[7]	IE[7]
35	National Strategy on Waste Management and the National Waste Management Plan (Official Journal no. 954/18.10.2004)	GD 358/2007 amending Annex no. 2 "The National Waste Management Plan" of GD no. 1470/2004 approving the National Waste Management Strategy and the National Waste Management Plan (Official Journal no. 271/24.04.2007). MO (Ministry Order) no.951/2007 approving the Methodology on drafting regional and county waste management plans. (Official Journal no. 497/25.07.2007)	CH_4	non-ETS	Planning	Implemented	Ministry of Environment and Water, Ministry of Economy and Trade, Ministry of Interior, Ministry of Agriculture, Forests and Rural Development, Ministry of Transport, Construction and Tourism	IE[7]	IE[7]	IE[7]	IE[7]

No.	Policy/ Measure	Objective	GHG	ETS/ non-ETS	Type of policy instrument	Implementation Status	Entities responsible for implementing the policy	Estimated effect of the policy and measures on GHG emissions (kt CO_2 equivalent)			
								2015	2020	2025	2030
36	GD no. 349/2005 on the landfill of waste (Official Journal no.394 as of 10 May 2005)	Establishing the legal framework for the activities of waste disposal, both for the realization, operation, monitoring, closure and monitoring post closure of new deposits, as well as the operation, closure and post-closure monitoring of of deposits in terms of environmental protection and public health. Establishing the requirements and operational and technical measures to prevent waste storage or reduce as far as possible negative effects on the environment and human health arising landfill. Stipulates the procedure for issuance of and environmental permit for the landfill of waste generation	CH_4	non-ETS	Planning	Implemented	Ministry of Environment and Water, Ministry of Economy and Trade, Ministry of Administration and Interior	IE[7]	IE[7]	IE[7]	IE[7]
37	GD no. 621/2005 on packaging and packaging waste (Official Journal no.639 of 20/07/2005)	Stipulates the procedure for Issuance of and Environmental permit for the landfill of waste generation. Packages are classified according to Romanian standards or national of the Member States of the European Union. Establishing the targets for recovery or incineration at waste incineration plants with energy recovery and the recycling of packaging waste to be achieved at national level.	CH_4	non-ETS	Planning	Implemented	Ministry of Environment and Water, Ministry of Economy and Trade, Ministry of Administration and Interior	IE[7]	IE[7]	IE[7]	IE[7]
38	The Improvement of the wastewater treatment	A more efficient treatment of sewage and commercial water	CH_4	ETS/non-ETS	Planning	Implemented	Ministry of Administration and Interior, Economic operators	226.170	663.390	942.690	1,297.590

Legend:

IE[1]	The energy roadmap drawn up in 2003 as a basis for energy chapter in the accession negotiations to the EU includes an overview of the energy sector in Romania in the present and for the future, the market model, the energy policy (energy competitive, the role of ANRE, OPCOM), the privatization process, the restructuring, the power plant development in the period 2003-2015, the power plant closing programme, the electrification, regional market. Due to socio - economic development and to political evolution after accession in Romania were updated the policies and measures. This was taken into account in determining the emission reduction projections presented in item 1 of Table IV-5.
IE[2]	The GD. no 1535/2003 assesses the potential of renewable and forecast their use by 2015. The forecast of use of these resources achieved at 2003 level is outdated in the new conditions of NREAP presented at item 4 in Table IV-5 for which values were indicated.
IE[3]	Item 11 - GD. no. 882/2004 – The approved strategy was focused on two time horizons 2007 and 2017 imposed on one hand the objective of Romania's EU integration and on the other hand by the time they attain the objectives and commitments in the accession documents to the EU. The second horizon 2007 - 2017, subject to the achievement possibilities and rhythm of investment in the sector has been influenced by the general trend of the economy hit hard by the economic crisis extended, by the opening of the market for district heating, etc. In these circumstances the effects of measures cannot be evaluated given the impossibility of their application in accordance with the strategy. He made an update of the measures, which led to reductions estimates are included in item 10 of Table IV-5.
IE[3]	Item 15 - Development of the energy sector to meet the demand of electricity and heat produced in cogeneration considering the measures taken during 2015 to 2030. The reduction's estimations for 2015 are included at item 10 of Table IV-5.
IE[4]	The GD. no. 1043/2007 transposes Directive 2005/32/EC indicating the ecodesign requirements for electricity using products. The application of these requirements in the future will help to reduce GHG emissions in the conditions of such products introduction in the Romania's with improved environmental performance throughout the life cycle and are market surveillance bodies of these products. For example, it should be noted that to achieve the forecasts for the residential and services sector was envisaged that it will comply with such requirements. The reduction's estimations are included at items 24 and 25 in Table IV-5.
IE[5]	Item 21 – GEO. no. 40/2011 - transposing Directive 2009/33/EC aimed at consumers shift to clean vehicles, which is an alternative to conventional vehicles using renewable fuels. General obligation for contracting authorities and operators defined in the Ordinance is considering the purchase of road transport vehicles of energy and environmental impact throughout its life, including energy consumption and emissions of CO_2, NOx, NMVOC and particles. The benefits are provided on the straight-and use of hybrid and electric vehicles. In determining GHG emission projections in the transport sector in assumptions and measures further action has been taken to purchase vehicles that meet GEO. So quantitative effect is reflected in the modernization of the transport sector (item 20 of Table IV-5).
	Item 22 - GO. no. 7/2010 - amends GO. no. 43/1997 regarding the roads regime and transposes Directive 2010/40/EU. The classification of roads, vehicle categories, their weight, speed, etc. imposed by this Ordinance were taken into account in determining the assumptions for assessing the GHG emissions in the transport sector (item 20 of Table IV-5).
	Item 23 – GD. no. 928/2012 - has set specifications based on health and environmental impacts of petrol and diesel used in vehicles with spark ignition engines, namely those equipped with compression ignition engines, taking into account the requirements specifications of this engine. Also, the GD presents the criteria for designation of suppliers responsible for monitoring and reporting of GHG emissions over the life cycle and specifies methods for calculating and reporting requirements. According to GD obligation of suppliers to reduce GHG emissions by 2020 in stages are set up. In setting the assumptions for the calculation of GHG emissions in the road transport sector have considered these obligations. So the effects of this GD are valued at modernizing of the transport sector (item 20 of Table IV-5).
IE[6]	The GD. no. 964/2000 approved the Action Plan to reduce water pollution caused by nitrates from agricultural sources. This plan aims to prevent nitrate pollution, rationalize the use of chemical fertilizers and organic compounds containing nitrites. Vulnerable areas are defined, the content framework needed to develop code of good agricultural practice for the use of farmers is specified the, etc. The reduction's estimations are included at item 30 in Table IV-5.
IE[7]	Item 34 - Law no. 211/2011 - presents the general framework of waste management, with responsibility for the ministries that implementing the law provisions. Also shows how to eliminate the waste, their properties, prevention of waste generation etc. All these details have been taken into account in determining the assumptions taken into account in determining the GHG emissions in the waste sector (item 33 in Table IV-5).
	Item 35 - Strategy developed by MEWM following the transposition of European legislation on waste management aimed to create the necessary framework for the development and implementation of an integrated waste management environmentally effective and economically. Also the principles and objectives, roles and responsibilities are presented. The strategy emphasizes that national and European objectives realization are achieved through practical involvement of the whole society represented by the central and local authorities, waste generators, professional associations, research institutions, civil society. The objectives set out in the strategy have been taken into account in determining the GHG emissions resulted in waste sector (item 33 in Table IV-5).
	Item 36 – GD. no. 349/2005 - aims to establish the legal framework for the operation of waste disposal for the realization, operation, monitoring, and closure and after closing the existing and new deposits. In this regard the deposits are prioritized, the state licensing procedures are set up, operation, monitoring, etc. This decision demonstrates the existence of different types of deposits under consideration to establish the GHG emission forecasts according to the methodology outlined in the report. The effects of this decision are evaluated at item 33 in Table IV-5.
	Item 37 – GD. no. 621/2005 - regulates the management of packaging and packaging waste in order to prevent or reduce environmental impacts. Applying this decision affects the amount of waste to be stored in the end. The effects of this decision are found at item 33 in Table IV-5.

The policies and measures for reducing GHG emissions in the WAM scenario, presented in table IV_7, considered all additional measures for complying with Romania target, established by EU.

Table IV_ 7 *Policies and measures to reduce GHG emissions, considered in scenario with additional measures*

No.	Policy/Measure	Objective	GHG	ETS/ non-ETS	Type of policy instrument	Implementation Status	Entities responsible for implementing the policy	Estimated effect of the policy and measures on GHG emissions (kt CO_2 equivalent)			
								2015	2020	2025	2030
ENERGY SECTOR											
1	National Renewable Energy Action Plans	Promotion of energy from renewable sources by types of technologies: hydro, photovoltaic, wind and biomass	CO_2	non-ETS	Planning	Planned	Ministry of Economy	0.000	0.000	2,035.000	4,098.000
2	The improvement of the handling coal	The decrease of methane emissions	CH_4	ETS/ non-ETS	Planning	Planned	Mining Companies	19.950	26.050	31.920	38.220
3	The improvement for the oil and gas sectors	The decrease of fugitive emissins of CH_4	CH_4	ETS/ non-ETS	Planning	Planned	Oil and gas companies	150.150	150.990	199.500	211.680
4	The improvement for the oil and gas sectors	The decrease of fugitive emissins of CO_2	CO_2	ETS/ non-ETS	Planning	Planned	Oil and gas companies	13.030	11.800	14.020	13.100
5	The development of the power sector for to cover electricity and heat demand produced in cogeneration	The main objectives are energy security (diversify energy resources) sustainable development (increasing energy efficiency, promoting energy production from renewable resources, promoting high efficiency cogeneration plants, rational and efficient use of primary energy resources) competitiveness (developing market for electricity, natural gas, uranium, green certificates, greenhouse gas emission permits)	CO_2	EU ETS	Regulatory/ Planning	Planned	Ministry of Economy, Ministry of Internal Affairs	0.000	390.967	126.859	584.049
Manufacturing Industries and Construction											
6	The modernization of industrial sector	The reduction of energy intensity	CO_2	ETS/ non-ETS	Planning	Planned	Ministry of Economy and Industry Enterprises	4.851	5.200	5.837	6.214
7	Commitments up to 2020 for non ETS sector	The reduction of GHG emissions for non-ETS sectors	CO_2	non-ETS	Regulatory	Planned	Ministry of Economy, Ministry of Environment and Climate Change, Ministry of Transport, Ministry of Agriculture and Sustainable Development, Ministry of Interior and Affairs	0.000	0.000	NA	NA
Transport sectors											

No.	Policy/Measure	Objective	GHG	ETS/ non-ETS	Type of policy instrument	Implementation Status	Entities responsible for implementing the policy	Estimated effect of the policy and measures on GHG emissions (kt CO_2 equivalent)			
								2015	2020	2025	2030
8	The modernization of transport sector	The decrease of energy consumption and the emissions with the followings measures: the use of biofuels and bioliquids in accordance with GD no 935/2011, new cars in accordance with EC Regulation no 443/2009, new clean passenger cars in accordance with EO no 40/2001 amended by EO no 9/2013, encouraging forms of alternative transport (cycling etc), increasing the degree of using public transportation, the use new vehicles with low consumption and emissions, the use of intermodal transport etc.	CO_2	non-ETS	Planning	Planned	Ministry of Transport	1,214.578	224.783	224.783	195.549
Services Sector											
9	The modernization of services sector	The decrease of energy consumption with the following measures: the heating upgrade of the buildings, the compulsion to enforce the provisions of EU efficiency standards for new buildings, the efficiency of lighting systems, the use of low energy lamps, new equipments with low energy consumption etc.	CO_2	ETS/non-ETS	Planning	Planned	Ministry of Regional Development and Public Administration, Ministry of Economy	36.236	63.996	105.783	63.996
Residential Sector											
10	The modernization of residential sector	The decrease of energy consumption with the following measures: the heating upgrade of the blocks of flats, the compulsion to enforce the provisions of EU efficiency standards for new buildings, the efficiency of lighting systems, the use of low energy lamps, the use of new equipments with low energy consumptions etc.	CO_2	ETS/ non-ETS	Planning	Planned	Ministry of Regional Development and Public Administration	125.558	125.558	125.558	243.857
Agriculture sector											
11	The modernization of agriculture sector	The reduction of energy intensity due to concentration of agricultural land and to use of BAT in irrigation installations and new equipments	CO_2	non-ETS	Planning	Planned	Ministry of Agriculture and Rural Development	36.094	72.188	0.000	7.219

No.	Policy/Measure	Objective	GHG	ETS/ non-ETS	Type of policy instrument	Implementation Status	Entities responsible for implementing the policy	Estimated effect of the policy and measures on GHG emissions (kt CO_2 equivalent)			
								2015	2020	2025	2030
SOLVENT AND OTHER PRODUCTS USE SECTOR											
12	Using the best technology to use solvents and other products	Reduction of solvents and other products, providing quality products and services, environmental protection	CO_2	non-ETS	Planning	Implemented	Businesses in industry, construction, services, population	1.450	1.600	1.840	1.540
AGRICULTURE SECTOR											
13	The improvement of quality of nutrition for cattle, sheep and goats	Use the practice of Common Agricultural Policy	CH_4	ETS/ non-ETS	Planning	Planned	Owners of livestock farms	151.830	347.550	553.350	798.630
14	The improvement of manure management	The decrease of methane emissions from livestock	CH_4	ETS/ non-ETS	Planning	Planned	Owners of livestock farms	9.560	19.740	22,87	32,38
15	Order 1182/2005 of Ministry of Environmental and Sustainable Development and Ministry of Agriculture and Rural Development for approval Agricultural good practice code for the protection of waters against pollution caused by nitrates from agricultural sources	Agricultural good practice code	N_2O	ETS/ non-ETS	Regulatory/ Planning	Planned	Ministry of Environment and Water, Ministry of Agriculture and Rural Development	0.000	930.000	1,240.000	799.800
LULUCF											
16	The improvement of land use	The increase of annual harvest wood as of the ore-1989 period. Afforestation of degraded lands 5kha/year (including revegetation and forest belts). Implementation of "no-till" practices for 30% of the area of arable land (in rotation) per year from 2015-2030	CO_2	ETS/ non-ETS	Planning	Planned	Ministry of Environment and Climate Change, The Autonomous Regie of Forests, Private owners	258.486	-1,336.763	-1,509.836	-1,814.259
WASTE SECTOR											
17	The improvement of the stored solid waste	The recovering of CH_4 emissions resulted from the wates deposits compliant landfill	CH_4	ETS/ non-ETS	Planning	Planned	Companies that manage landfill of waste	222.180	281.820	395.850	375.060
18	The Improvement of the wastewater treatment	A more efficient treatment of sewage and commercial water	CH_4	ETS/ non-ETS	Planning	Planned	Ministry of Administration and Interior, Economic operators	189.840	158.340	142.590	107.940

IV.D. Policies and measures no longer in place

During the reporting period no policies and measures have expired or were abrogated, which may influence the GHG emissions trends. In 2013, the National Strategy on Climate Change 2013 – 2020 was developed.

V. PROJECTIONS AND THE TOTAL EFFECTS OF POLICIES AND MEASURES, AND SUPPLEMENTARY RELATING TO KYOTO PROTOCOL MECHANISM

V.A. Projections

V.A.1. Background and scenarios

The most recent GHG emission projections were elaborated in April 2013, considering the trends of key macro-economic, technological, demographical and other indicators related to the social-economic development of Romania.

The projections of GHG emissions were considered the following:

- The fifth National Communication of Romania;
- National Strategy for Climate Change for period 2009 - 2012;
- National Strategy for Climate Change for period 2013 - 2020;
- National Action Plan for Climate Change;
- National Allocation Plan for participation at EU ETS;
- The data and information related to GHG trend during the 1989 - 2011 period, included in the National inventories submitted by Romania to the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC);
- The development and planning strategies at national and sectoral level;
- The forecasts of the macroeconomic indicators resulting from the analysis of the Romanian Government's strategies and policies, adopted at a national and sectoral level in order to assure the economic and social development of the country.

The GHG projections for 2015, 2020, 2025, 2030 considered different scenarios related to the economic-social, demographic and technological evolution, in order to allow the highlight of the measures undertaken by Romania for implementing the EU Directive on environmental protection, and respecting its commitments as part of Kyoto Protocol.

The GHG emission projections are carried out for 3 scenarios, respectively:

- A "business as usual" (BAU) reference scenario – ***the scenario without measures (WOM);***
- A mitigation scenario, similar to the reference scenario in terms of the evolution of the economic-social and demographic indicators, containing mitigation policies and programs - ***the scenario with measures (WEM)***;
- A mitigation scenario with additional measures, similar to the mitigation scenario, containing additional emission mitigation measures - ***the scenario with additional measures (WAM)***.

The reference scenario, in terms of the evolution of the economic-social and demographic indicators, considered the impact of current economic crisis on the development of Romania.

The considered scenarios are based on social-economic assumptions, presented in subchapter V.A.3.

Considering that the projection horizon is 2015 - 2030, the reference year is 2011, for which the National Inventory of Greenhouse Gas Emissions is realized and submitted to the UNFCCC, according with Romania's obligations.
The GHG emission projections are based on assumptions related to macroeconomic indicators with high uncertainty on horizon until 2030, because of the economic crisis at nationally and globally level and the lack of updated 2030 strategy on industry, agriculture, transport, etc. Thus, economic development is a dominant factor affecting the results projected.

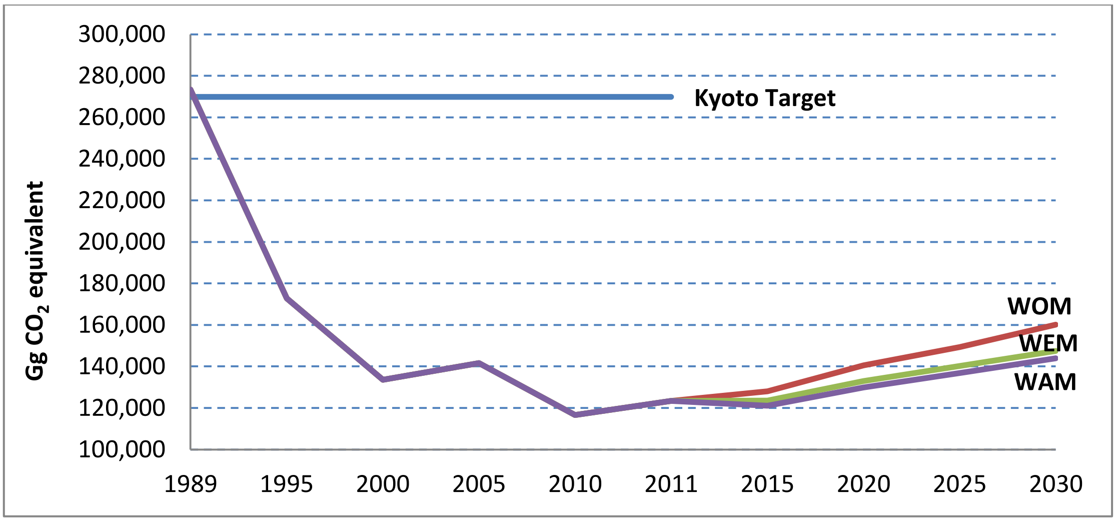
In order to analyse the sensitivity of projections of GHG emissions in the given assumptions there are developed scenarios on the minimum and maximum economic recovery, compared to baseline scenario for which projections were made.

In the subchapter V.D.8 are presented the sensitivity of underlying assumption and uncertainty made for energy sector and LULUCF sector.

V.A.2. Total GHG emission projections

The total GHG emissions projections are presented in the table V_1 – V_3 for scenario "without measures" (WOM)," scenario with measures" (WEM) and scenario "with additional measures" (WAM), for each sector (Energy – CRF1, Industrial Processes - CRF2, Solvents and Other Products Use - CRF3, Agriculture – CRF4, Land Use, Land – Use Change and Forestry LULUCF - CRF5, Waste - CRF6).

Figure V_A_1 presents the GHG emissions evolution in the period 1989-2030 for all scenarios (WOM, WEM, WAM). Romania achieved the target established through the Kyoto protocol for the period 2008-2012.



Figure_V_A_ 1 *Evolution of the GHG emissions*

According with the results presented in the table V_1, in WOM scenario, the GHG emissions are expected to increase between 2011 and 2015 with a medium rate of 0.93% and between 2011 and 2020 with a medium rate of 1.46%.

According with the results presented in the table V_2, in WEM scenario, the GHG emissions are expected to increase between 2011 and 2020 with a medium rate of 0.83%.

In the WAM scenario, table V_3, the GHG emissions are expected to increase between 2011 and 2020 with a medium rate of 0.58%.

Table V_ 1 *Evolution of the total GHG emissions for "Without Measures" (WOM) scenario, 1989 – 2030*

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Realised according to NIR					Forecasted			
	1989	2008	2009	2010	2011	2015	2020	2025	2030
	Gg $CO_{2equiv.}$								
1.Total Energy	**191,809.14**	**95,965.23**	**82,877.82**	**79,624.01**	**86,320.46**	**85,815.45**	**91,858.83**	**94,264.85**	**98,363.39**
A. Fuel Combustion Activities	168,575.49	86,368.06	74,087.78	71,176.23	77,767.49	76,683.53	81,670.97	82,878.78	85,321.44
1. Energy Industries	74,355.62	42,308.75	35,660.69	33,162.82	36,621.90	31,767.45	31,963.89	31,471.36	31,327.27
a. Public Electricity and Heat Production	IE	36,017.46	30,863.45	27,843.72	32,078.62	25,683.67	25,174.09	24,670.21	24,503.61
b. Petroleum Refining	IE	4,115.63	3,395.11	3,636.53	3,076.86	4,199.14	4,686.45	4,694.28	4,709.82
c. Manufacture of Solid Fuels and Other Energy Industries	IE	2,175.66	1,402.13	1,682.58	1,466.42	1,884.64	2,103.35	2,106.87	2,113.84
2. Manufacturing Industries and Construction	70,076.86	17,943.05	12,842.43	13,207.96	15,761.24	15,691.60	17,356.83	17,933.26	18,573.73
3. Transport	7,574.06	15,253.36	15,079.10	14,300.12	14,577.72	16,841.77	18,629.06	19,247.73	20,638.16
4. Other sectors	14,384.51	9,999.05	10,194.29	10,192.24	10,203.15	12,016.38	13,291.59	13,733.01	14,223.47
a. Commercial/Institutional	IE	2,140.10	2,344.39	2,390.71	2,085.01	3,260.41	3,606.42	3,726.19	3,859.27
b. Residential	IE	7,225.74	6,953.29	6,905.28	7,118.38	7,756.47	8,579.60	8,864.53	9,181.12
c. Agriculture/Forestry/Fisheries	IE	633.21	896.61	896.25	999.76	999.50	1,105.57	1,142.29	1,183.08
5. Other	2,184.45	863.84	311.27	313.08	603.48	366.33	429.60	493.42	558.80
B. Fugitive Emissions from Fuels	**23,233.65**	**9,597.17**	**8,790.05**	**8,447.77**	**8,552.97**	**9,131.92**	**10,187.87**	**11,386.07**	**13,041.95**
1. Solid Fuels	5,541.38	1,048.80	903.62	761.40	879.17	994.19	1,215.22	1,485.39	1,890.00
2. Oil and Natural Gas	17,692.38	8,548.37	7,886.42	7,686.37	7,673.79	8,137.73	8,972.65	9,900.68	11,151.95
C. 1. International Bunkers	862.00	882.49	594.58	665.08	529.77	510.80	591.04	648.37	709.92
C.1.A. Aviation	IE	474.58	443.17	495.49	390.65	339.96	381.91	400.76	434.86
C.1.B. Marine	IE	407.91	151.41	169.60	139.12	170.84	209.13	241.41	275.06
2. Industrial Processes	**35,466.12**	**17,945.58**	**11,253.06**	**12,414.25**	**12,605.14**	**14,977.88**	**18,335.09**	**21,346.61**	**24,290.79**
A. Mineral Products	10,669.97	6,621.08	4,710.40	4,608.34	4,880.99	6,269.30	8,051.82	9,997.83	12,078.99
B. Chemical Industry	11,074.48	4,958.80	2,218.85	3,731.16	4,257.36	4,468.62	4,790.03	5,376.67	5,820.46
C. Metal Production	13,721.66	5,459.11	3,613.32	3,374.52	3,019.02	3,693.58	4,795.90	5,082.12	5,255.46
D. Other Production	NE								
E. Production of Halocarbons and SF_6	NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
F. Consumption of Halocarbons and SF_6	NE,NO	906.60	710.48	700.23	447.76	546.38	697.34	889.99	1,135.88
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Products Use	**645.80**	**135.14**	**122.33**	**124.74**	**125.61**	**132.54**	**147.48**	**170.97**	**206.02**
4. Agriculture	**40,734.14**	**20,753.53**	**20,353.84**	**18,760.94**	**18,941.46**	**20,517.38**	**23,267.26**	**26,277.94**	**29,841.67**
A. Enteric Fermentation	17,995.02	9,196.13	9,005.48	7,895.17	7,875.61	8,092.35	8,914.92	9,699.06	10,692.78
B. Manure Management	4,137.83	2,330.00	2,133.60	1,840.64	1,802.71	1,974.26	2,252.37	2,563.11	2,913.52
C. Rice Cultivation	62.12	14.99	27.93	18.75	19.16	19.11	19.11	19.11	19.11
D. Agricultural Soils	18,376.70	9,072.23	9,063.31	8,868.57	9,072.49	10,251.70	11,891.60	13,791.90	15,996.00
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agriculture Residues	162.46	140.18	123.51	137.80	171.50	179.96	189.26	204.76	220.26
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. LAND USE, LAND-USE CHANGE AND FORESTRY (LULUCF)	**-21,512.67**	**-24,312.00**	**-28,254.61**	**-25,830.81**	**-25,304.94**	**-26,644.25**	**-28,028.19**	**-21,983.23**	**-18,872.80**
A. Forest Land	-18,982.53	-24,578.42	-25,057.85	-24,754.96	-23,353.01	-25,392.36	-26,252.17	-21,573.98	-18,408.11
B. Cropland	-5,801.39	-3,544.26	-4,329.53	-2,314.24	-3,199.47	-2,620.44	-3,056.97	-1,930.57	-2,146.13
C. Grassland	-609.78	1,251.73	146.04	155.88	132.62	37.19	-67.42	229.40	361.46
D. Wetlands	-214.50	-285.99	-45.38	-125.61	-130.10	-201.59	-197.87	-218.37	-192.69
E. Settlements	4,125.22	680.39	384.04	419.46	409.76	494.37	506.01	520.62	499.43
F. Other Land	-29.70	2,164.54	648.07	788.66	835.26	1,038.57	1,040.23	989.67	1,013.25
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
6. Waste	**4,670.31**	**5,677.92**	**5,703.17**	**5,715.62**	**5,366.48**	**6,532.17**	**6,901.14**	**7,217.19**	**7,491.91**
A. Solid Waste Disposal on Land	1,254.79	2,781.30	2,883.01	2,925.89	2,475.64	3,571.89	3,799.11	3,983.28	4,121.04
B. Waste-water Handling	3,415.52	2,888.04	2,812.42	2,778.89	2,880.28	2,948.57	3,088.71	3,218.76	3,353.64
C. Waste Incineration	NE,NA	8.59	7.73	10.83	10.56	11.70	13.31	15.15	17.23
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total GHG emissions (without LULUCF)	**273,325.51**	**140,477.41**	**120,310.22**	**116,639.55**	**123,359.15**	**127,975.42**	**140,509.80**	**149,277.56**	**160,193.77**
Total GHG emissions (with LULUCF)	**251,812.84**	**116,165.41**	**92,055.61**	**90,808.75**	**98,054.21**	**101,331.17**	**112,481.61**	**127,294.34**	**141,320.97**

Table V_ 2 *Evolution of the total GHG emissions for "With Measures" (WEM) scenario, 1989 – 2030*

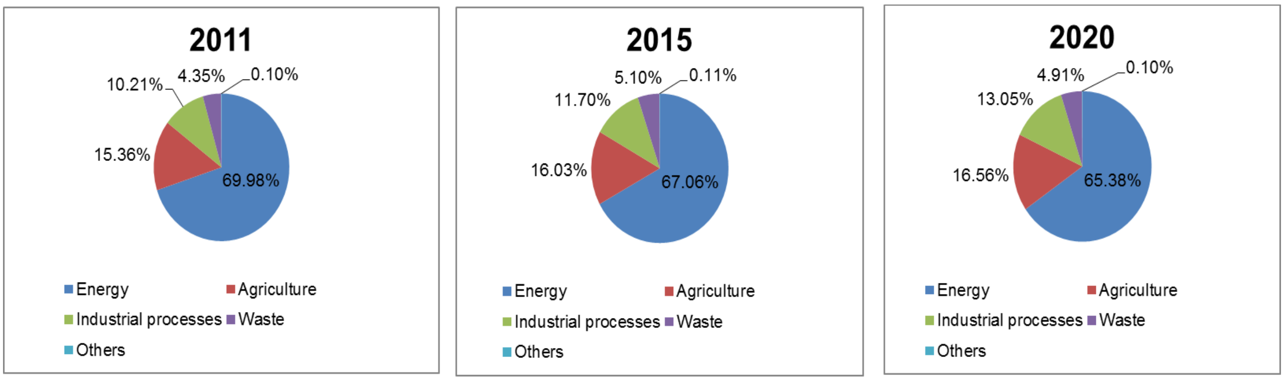
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Realised according to NIR					Forecasted			
	1989	2008	2009	2010	2011	2015	2020	2025	2030
	Gg $CO_{2\ equiv.}$								
1.Total Energy	**191,809.14**	**95,965.23**	**82,877.82**	**79,624.01**	**86,320.46**	**84,326.23**	**89,450.61**	**91,683.29**	**95,557.19**
A. Fuel Combustion Activities	168,575.49	86,368.06	74,087.78	71,176.23	77,767.49	76,209.00	80,518.04	81,457.53	83,380.75
1. Energy Industries	74,355.62	42,308.75	35,660.69	33,162.82	36,621.90	31,767.45	31,963.89	31,096.51	30,980.19
a. Public Electricity and Heat Production	IE	36,017.46	30,863.45	27,843.72	32,078.62	25,683.67	25,174.09	24,295.36	24,156.53
b. Petroleum Refining	IE	4,115.63	3,395.11	3,636.53	3,076.86	4,199.14	4,686.45	4,694.28	4,709.82
c. Manufacture of Solid Fuels and Other Energy Industries	IE	2,175.66	1,402.13	1,682.58	1,466.42	1,884.64	2,103.35	2,106.87	2,113.84
2. Manufacturing Industries and Construction	70,076.86	17,943.05	12,842.43	13,207.96	15,761.24	15,530.91	17,185.11	17,762.95	18,334.34
3. Transport	7,574.06	15,253.36	15,079.10	14,300.12	14,577.72	16,695.78	18,322.78	18,912.53	19,973.92
4. Other sectors	14,384.51	9,999.05	10,194.29	10,192.24	10,203.15	11,848.52	12,616.67	13,192.11	13,533.50
a. Commercial/Institutional	IE	2,140.10	2,344.39	2,390.71	2,085.01	3,257.00	3,408.50	3,650.43	3,653.39
b. Residential	IE	7,225.74	6,953.29	6,905.28	7,118.38	7,633.31	8,176.15	8,540.37	8,843.46
c. Agriculture/Forestry/Fisheries	IE	633.21	896.61	896.25	999.76	958.21	1,032.02	1,001.30	1,036.65
5. Other	2,184.45	863.84	311.27	313.08	603.48	366.33	429.60	493.42	558.80
B. Fugitive Emissions from Fuels	**23,233.65**	**9,597.17**	**8,790.05**	**8,447.77**	**8,552.97**	**8,117.23**	**8,932.57**	**10,225.76**	**12,176.44**
1. Solid Fuels	5,541.38	1,048.80	903.62	761.40	879.17	883.68	1,065.54	1,333.92	1,764.63
2. Oil and Natural Gas	17,692.38	8,548.37	7,886.42	7,686.37	7,673.79	7,233.55	7,867.03	8,891.84	10,411.81
C. 1. International Bunkers	862.00	882.49	594.58	665.08	529.77	507.91	584.98	635.54	696.71
C.1.A. Aviation	IE	474.58	443.17	495.49	390.65	337.07	375.85	394.13	421.65
C.1.B. Marine	IE	407.91	151.41	169.60	139.12	170.84	209.13	241.41	275.06
2. Industrial Processes	**35,466.12**	**17,945.58**	**11,253.06**	**12,414.25**	**12,605.14**	**14,296.23**	**17,604.41**	**20,526.45**	**23,417.72**
A. Mineral Products	10,669.97	6,621.08	4,710.40	4,608.34	4,880.99	6,269.30	8,051.82	9,997.83	12,078.99
B. Chemical Industry	11,074.48	4,958.80	2,218.85	3,731.16	4,257.36	3,786.97	4,059.35	4,556.51	4,947.39
C. Metal Production	13,721.66	5,459.11	3,613.32	3,374.52	3,019.02	3,693.58	4,795.90	5,082.12	5,255.46
D. Other Production	NE								
E. Production of Halocarbons and SF_6	NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
F. Consumption of Halocarbons and SF_6	NE,NO	906.60	710.48	700.23	447.76	546.38	697.34	889.99	1,135.88
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Products Use	**645.80**	**135.14**	**122.33**	**124.74**	**125.61**	**130.36**	**144.20**	**165.55**	**192.23**
4. Agriculture	**40,734.14**	**20,753.53**	**20,353.84**	**18,760.94**	**18,941.46**	**19,587.38**	**20,882.51**	**23,111.78**	**23,970.01**
A. Enteric Fermentation	17,995.02	9,196.13	9,005.48	7,895.17	7,875.61	8,104.53	8,147.37	8,265.60	8,336.37
B. Manure Management	4,137.83	2,330.00	2,133.60	1,840.64	1,802.71	1,962.08	2,185.17	2,380.41	2,597.47
C. Rice Cultivation	62.12	14.99	27.93	18.75	19.16	19.11	19.11	19.11	19.11
D. Agricultural Soils	18,376.70	9,072.23	9,063.31	8,868.57	9,072.49	9,321.70	10,341.60	12,241.90	12,796.80
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agriculture Residues	162.46	140.18	123.51	137.80	171.50	179.96	189.26	204.76	220.26
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. LAND USE, LAND-USE CHANGE AND FORESTRY (LULUCF)	**-21,512.67**	**-24,312.00**	**-28,254.61**	**-25,830.81**	**-25,304.94**	**-17,695.90**	**-19,192.52**	**-11,406.93**	**-9,128.30**
A. Forest Land	-18,982.53	-24,578.42	-25,057.85	-24,754.96	-23,353.01	-14,103.51	-15,068.92	-8,645.58	-6,303.89
B. Cropland	-5,801.39	-3,544.26	-4,329.53	-2,314.24	-3,199.47	-4,960.94	-5,404.55	-4,282.67	-4,505.86
C. Grassland	-609.78	1,251.73	146.04	155.88	132.62	37.19	-67.42	229.40	361.46
D. Wetlands	-214.50	-285.99	-45.38	-125.61	-130.10	-201.59	-197.87	-218.37	-192.69
E. Settlements	4,125.22	680.39	384.04	419.46	409.76	494.37	506.01	520.62	499.43
F. Other Land	-29.70	2,164.54	648.07	788.66	835.26	1,038.57	1,040.23	989.67	1,013.25
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
6. Waste	**4,670.31**	**5,677.92**	**5,703.17**	**5,715.62**	**5,366.48**	**5,194.68**	**4,829.07**	**4,674.09**	**4,320.28**
A. Solid Waste Disposal on Land	1,254.79	2,781.30	2,883.01	2,925.89	2,475.64	2,460.57	2,390.43	2,382.87	2,247.00
B. Waste-water Handling	3,415.52	2,888.04	2,812.42	2,778.89	2,880.28	2,722.40	2,425.32	2,276.07	2,056.05
C. Waste Incineration	NE,NA	8.59	7.73	10.83	10.56	11.70	13.31	15.15	17.23
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total GHG emissions (without LULUCF)	**273,325.51**	**140,477.41**	**120,310.22**	**116,639.55**	**123,359.15**	**123,534.87**	**132,910.80**	**140,161.15**	**147,457.43**
Total GHG emissions (with LULUCF)	**251,812.84**	**116,165.41**	**92,055.61**	**90,808.75**	**98,054.21**	**105,838.97**	**113,718.29**	**128,754.23**	**138,329.13**

Table V_ 3 *Evolution of the total GHG emissions for "with additional measures (WAM) scenario, 1989 – 2030*

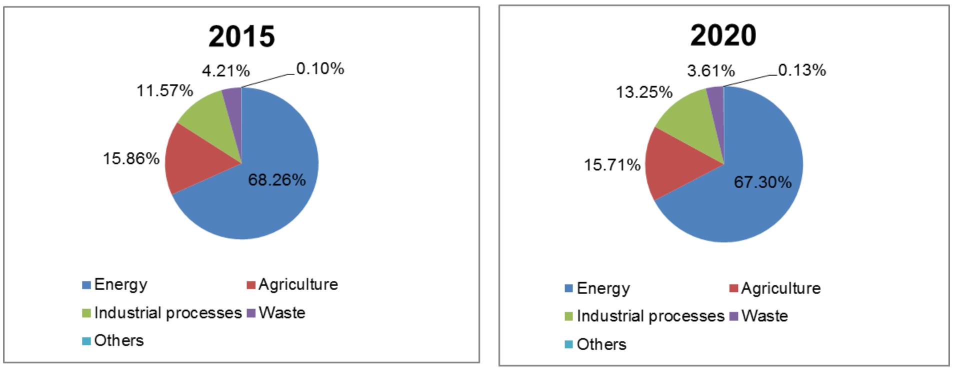
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Realised according to NIR					Forecasted			
	1989	2008	2009	2010	2011	2015	2020	2025	2030
	Gg $CO_{2\ Equiv.}$								
1.Total Energy	**191,809.14**	**95,965.23**	**82,877.82**	**79,624.01**	**86,320.46**	**82,550.33**	**88,217.64**	**90,612.44**	**93,955.14**
A. Fuel Combustion Activities	168,575.49	86,368.06	74,087.78	71,176.23	77,767.49	74,616.23	79,469.91	80,632.12	82,041.70
1. Energy Industries	74,355.62	42,308.75	35,660.69	33,162.82	36,621.90	31,767.45	31,571.07	30,969.05	30,393.37
a. Public Electricity and Heat Production	IE	36,017.46	30,863.45	27,843.72	32,078.62	25,562.61	24,664.46	24,053.99	23,458.62
b. Petroleum Refining	IE	4,115.63	3,395.11	3,636.53	3,076.86	4,199.14	4,686.45	4,694.28	4,709.82
c. Manufacture of Solid Fuels and Other Energy Industries	IE	2,175.66	1,402.13	1,682.58	1,466.42	1,884.64	2,103.35	2,106.87	2,113.84
2. Manufacturing Industries and Construction	70,076.86	17,943.05	12,842.43	13,207.96	15,761.24	15,365.54	17,019.73	17,524.36	18,095.75
3. Transport	7,574.06	15,442.54	15,264.23	14,470.08	14,753.37	15,466.93	18,095.49	18,685.24	19,776.20
4. Other sectors	14,384.51	9,999.05	10,194.29	10,192.24	10,203.15	11,649.98	12,354.02	12,960.04	13,217.58
a. Commercial/Institutional	IE	2,140.10	2,344.39	2,390.71	2,085.01	3,220.58	3,344.26	3,544.21	3,589.14
b. Residential	IE	7,225.74	6,953.29	6,905.28	7,118.38	7,507.47	8,050.30	8,414.53	8,599.05
c. Agriculture/Forestry/Fisheries	IE	633.21	896.61	896.25	999.76	921.93	959.45	1,001.30	1,029.39
5. Other	2,184.45	863.84	311.27	313.08	603.48	366.33	429.60	493.42	558.80
B. Fugitive Emissions from Fuels	**23,233.65**	**9,597.17**	**8,790.05**	**8,447.77**	**8,552.97**	**7,934.10**	**8,747.73**	**9,980.32**	**11,913.44**
1. Solid Fuels	5,541.38	1,048.80	903.62	761.40	879.17	863.73	1,043.49	1,302.00	1,726.41
2. Oil and Natural Gas	17,692.38	8,548.37	7,886.42	7,686.37	7,673.79	7,070.37	7,704.24	8,678.32	10,187.03
C. 1. International Bunkers	862.00	882.49	594.58	665.08	529.77	483.62	580.48	631.04	692.80
C.1.A. Aviation	IE	474.58	443.17	495.49	390.65	312.78	371.35	389.63	417.74
C.1.B. Marine	IE	407.91	151.41	169.60	139.12	170.84	209.13	241.41	275.06
2. Industrial Processes	**35,466.12**	**17,945.58**	**11,253.06**	**12,414.25**	**12,605.14**	**14,296.23**	**17,604.41**	**20,526.45**	**23,417.72**
A. Mineral Products	10,669.97	6,621.08	4,710.40	4,608.34	4,880.99	6,269.30	8,051.82	9,997.83	12,078.99
B. Chemical Industry	11,074.48	4,958.80	2,218.85	3,731.16	4,257.36	3,786.97	4,059.35	4,556.51	4,947.39
C. Metal Production	13,721.66	5,459.11	3,613.32	3,374.52	3,019.02	3,693.58	4,795.90	5,082.12	5,255.46
D. Other Production	NE								
E. Production of Halocarbons and SF_6	NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
F. Consumption of Halocarbons and SF_6	NE,NO	906.60	710.48	700.23	447.76	546.38	697.34	889.99	1,135.88
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Products Use	**645.80**	**135.14**	**122.33**	**124.74**	**125.61**	**128.91**	**142.60**	**163.70**	**190.70**
4. Agriculture	40,734.14	**20,753.53**	**20,353.84**	**18,760.94**	**18,941.46**	**19,386.62**	**19,537.97**	**21,391.51**	**22,490.23**
A. Enteric Fermentation	17,995.02	9,196.13	9,005.48	7,895.17	7,875.61	7,952.70	7,799.82	7,712.25	7,537.74
B. Manure Management	4,137.83	2,330.00	2,133.60	1,840.64	1,802.71	1,913.15	2,118.18	2,453.49	2,716.12
C. Rice Cultivation	62.12	14.99	27.93	18.75	19.16	19.11	19.11	19.11	19.11
D. Agricultural Soils	18,376.70	9,072.23	9,063.31	8,868.57	9,072.49	9,321.70	9,411.60	11,001.90	11,997.00
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agriculture Residues	162.46	140.18	123.51	137.80	171.50	179.96	189.26	204.76	220.26
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. LAND USE, LAND-USE CHANGE AND FORESTRY (LULUCF)	**-21,512.67**	**-24,312.00**	**-28,254.61**	**-25,830.81**	**-25,304.94**	**-17,954.39**	**-17,855.75**	**-9,897.09**	**-7,314.04**
A. Forest Land	-18,982.53	-24,578.42	-25,057.85	-24,754.96	-23,353.01	-13,630.51	-13,081.98	-6,559.43	-3,985.54
B. Cropland	-5,801.39	-3,544.26	-4,329.53	-2,314.24	-3,199.47	-5,692.42	-6,054.73	-4,858.98	-5,009.95
C. Grassland	-609.78	1,251.73	146.04	155.88	132.62	37.19	-67.42	229.40	361.46
D. Wetlands	-214.50	-285.99	-45.38	-125.61	-130.10	-201.59	-197.87	-218.37	-192.69
E. Settlements	4,125.22	680.39	384.04	419.46	409.76	494.37	506.01	520.62	499.43
F. Other Land	-29.70	2,164.54	648.07	788.66	835.26	1,038.57	1,040.23	989.67	1,013.25
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
6. Waste	**4,670.31**	**5,677.92**	**5,703.17**	**5,715.62**	**5,366.48**	**4,782.66**	**4,388.91**	**4,135.65**	**3,837.28**
A. Solid Waste Disposal on Land	1,254.79	2,781.30	2,883.01	2,925.89	2,475.64	2,238.39	2,108.61	1,987.02	1,871.94
B. Waste-water Handling	3,415.52	2,888.04	2,812.42	2,778.89	2,880.28	2,532.56	2,266.98	2,133.48	1,948.11
C. Waste Incineration	NE,NA	8.59	7.73	10.83	10.56	11.70	13.31	15.15	17.23
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total GHG emissions (without LULUCF)	**273,325.51**	**140,477.41**	**120,310.22**	**116,639.55**	**123,359.15**	**121,144.74**	**129,891.53**	**136,829.75**	**143,891.06**
Total GHG emissions (with LULUCF)	**251,812.84**	**116,165.41**	**92,055.61**	**90,808.75**	**98,054.21**	**103,190.35**	**112,035.77**	**126,932.66**	**136,577.02**

The contribution of different sectors from total GHG emissions, in 2011, 2015 and 2020, for WOM scenario and WEM scenario, are presented in the figure V_A_.2. In all years and scenario, the contribution of energy sector from total GHG emissions is the highest (about 65÷70%), followed by contribution of agriculture sector (about 15÷16%).

a. WOM scenario



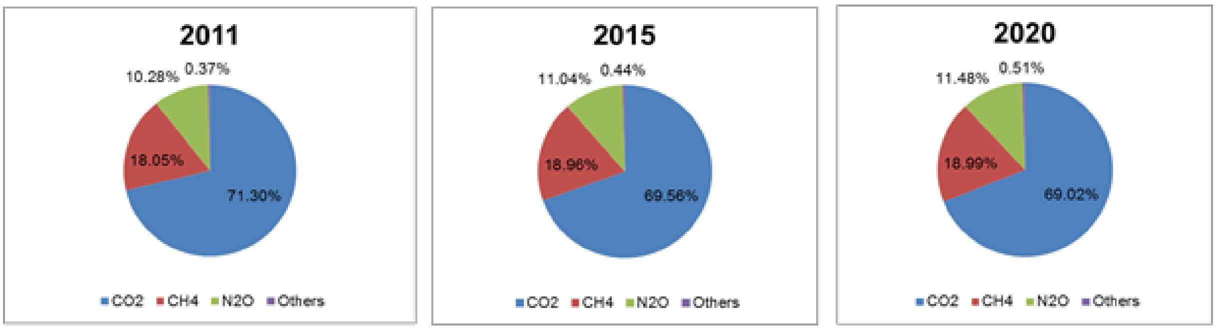
b. WEM scenario



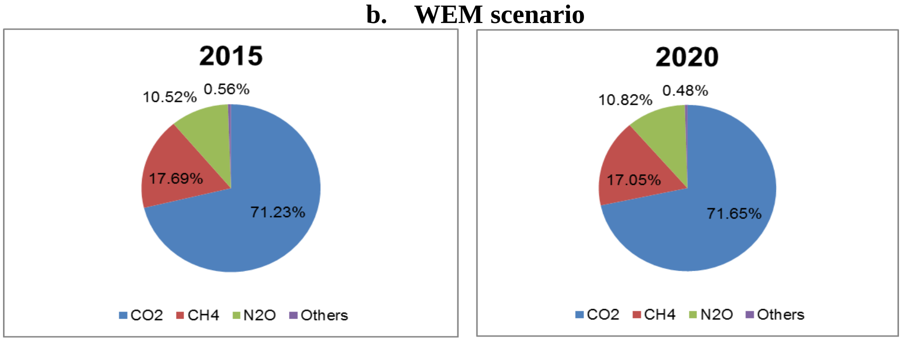
Figure_V_A_ 2 *The contribution of the sectors at the GHG emissions*

The contribution of different gases (CO_2, CH_4, N_2O, HFC, PFC, SF_6) related to the total GHG emissions are presented in the figure V_A_3. In all years and in all scenarios the contribution of the CO_2 emissions is highest at the total GHG emissions (about 69 ÷ 72%) followed by the contribution of CH_4 emissions (about 17÷19%).

a. WOM scenario



b. WEM scenario



c. WAM scenario

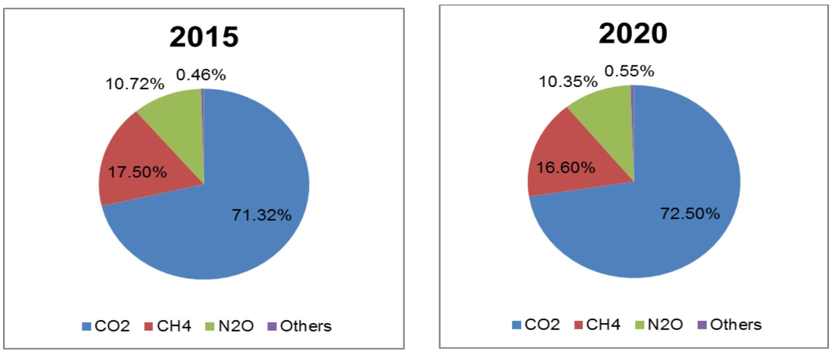


Figure V_A_ 3 *The contribution of various gases at total GHG emissions*

In the energy sector, in 2015, the combustion of the fuels (CRF1.A) generated the biggest quantities of GHG emissions, about 90% of total GHG emissions and the fugitive emissions from fuel processing (CRF1.B) generated only about 10% of total GHG emissions. The contribution of the various subsectors at the GHG emissions due to the combustion of the fuels in 2015 and 2020, in WEM scenario, is presented in the figure V_A_4.

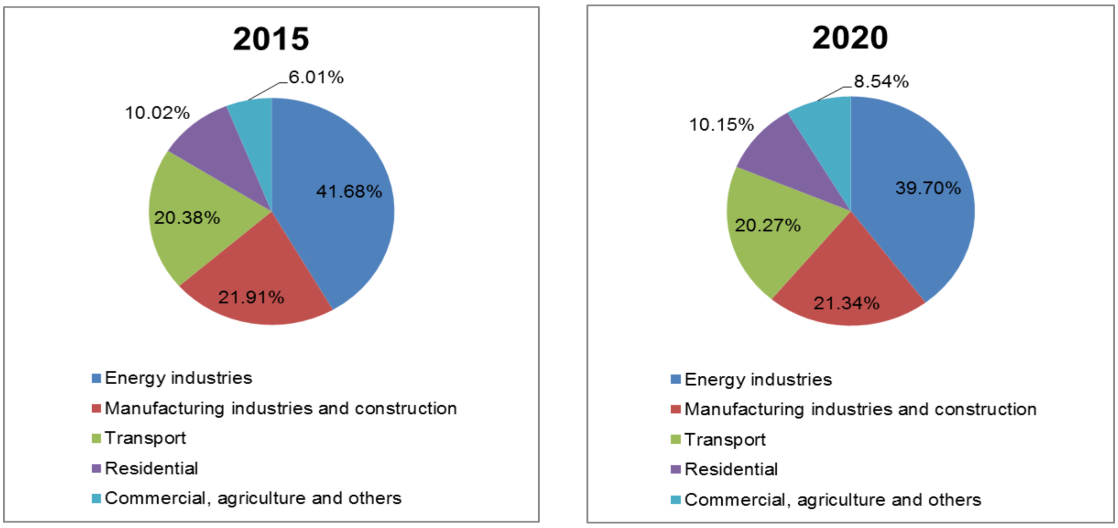


Figure V_A_ 4 *The contribution of different subsectors at GHG emissions due to the combustion of the fuels*

The projections of CO_2 emissions for WOM scenario, WEM scenario and WAM scenario, during the period 2011 ÷ 2030, are presented in the tables V_4 ÷ V_6.

***Table V_ 4** Evolution of the CO_2 emissions for WOM scenario, 1989÷2030*

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Realised according to NIR					Forecasted			
	1989	2008	2009	2010	2011	2015	2020	2025	2030
	Gg CO_2								
1.Total Energy	**169,024.41**	**85,491.60**	**73,238.56**	**70,267.42**	**76,903.63**	**75,747.25**	**80,575.27**	**81,720.59**	**84,083.74**
A. Fuel Combustion Activities	167,624.54	84,767.81	72,556.22	69,615.58	76,257.39	75,097.25	79,925.27	81,070.59	83,433.74
1. Energy Industries	74,118.64	42,155.77	35,526.92	33,037.88	36,474.64	31,636.70	31,834.42	31,344.24	31,200.90
a. Public Electricity and Heat Production	67,383.87	35,875.96	30,737.77	27,728.15	31,939.19	25,562.61	25,055.43	24,553.92	24,388.11
b. Petroleum Refining	4,780.44	4,109.13	3,389.69	3,630.33	3,071.77	4,192.60	4,679.15	4,686.97	4,702.48
c. Manufacture of Solid Fuels and Other Energy Industries	1,954.32	2,170.67	1,399.46	1,679.41	1,463.68	1,881.49	2,099.84	2,103.35	2,110.31
of which under ETS:		40,962.76	34,521.51	32,102.91	35,442.41	30,741.38	30,933.50	30,457.20	30,317.92
2. Manufacturing Industries and Construction	69,841.84	17,855.46	12,775.16	13,128.88	15,663.12	15,631.01	17,289.81	17,864.01	18,502.01
of which under ETS:		10,954.33	7,837.56	8,054.57	9,609.32	9,589.62	10,607.30	10,959.57	11,350.98
3. Transport	7,520.25	15,064.18	14,893.98	14,130.17	14,402.08	16,645.88	18,412.39	19,023.87	20,398.13
4. Other sectors	13,968.97	8,875.05	9,088.98	9,047.75	9,175.37	10,883.66	12,038.66	12,438.47	12,882.70
a. Commercial/Institutional	NO	2,134.34	2,338.22	2,384.41	2,079.09	3,251.34	3,596.39	3,715.82	3,848.53
b. Residential	8,280.80	6,116.62	5,863.59	5,775.36	6,104.91	6,644.97	7,350.15	7,594.25	7,865.48
c. Agriculture/Forestry/Fisheries	5,688.17	624.09	887.16	887.97	991.38	987.34	1,092.12	1,128.39	1,168.69
5. Other	2,174.84	817.34	271.19	270.90	542.18	300.00	350.00	400.00	450.00
B. Fugitive Emissions from Fuels	1,399.87	723.79	682.34	651.84	646.24	650.00	650.00	650.00	650.00
1. Solid Fuels									
2. Oil and Natural Gas	NA	723.79	682.34	651.84	646.24	650.00	650.00	650.00	650.00
C. 1. International Bunkers	854.47	497.03	470.09	525.62	414.84	383.42	443.75	469.98	508.26
C.1.A. Aviation	854.47	414.21	439.44	491.76	387.13	332.92	368.25	380.48	407.96
C.1.B. Marine	IE,NA,NO	82.82	30.65	33.87	27.71	50.50	75.50	89.50	100.30
of which under ETS:						332.92	368.25	380.48	407.96
2. Industrial Processes	**25,871.61**	**14,458.66**	**10,003.64**	**10,536.06**	**10,923.08**	**13,132.15**	**16,242.67**	**18,888.49**	**21,453.82**
of which under ETS:		10,843.99	7,502.73	7,902.05	8,192.31	11,645.59	14,404.00	16,750.32	19,025.25
A. Mineral Products	10,669.97	6,621.08	4,710.40	4,608.34	4,880.99	6,269.30	8,051.82	9,997.83	12,078.99
B. Chemical Industry	4,829.53	2,393.81	1,686.92	2,561.05	3,033.99	3,180.42	3,409.18	3,826.70	4,142.55
C. Metal Production	10,372.10	5,443.77	3,606.32	3,366.67	3,008.10	3,682.43	4,781.67	5,063.96	5,232.28
D. Other Production	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Production of Halocarbons and SF_6									
F. Consumption of Halocarbons and SF_6									
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Products Use	**645.80**	**135.14**	**122.33**	**124.74**	**125.61**	**132.54**	**147.48**	**170.97**	**206.02**
4. Agriculture									
A. Enteric Fermentation									
B. Manure Management									
C. Rice Cultivation									
D. Agricultural Soils									
E. Prescribed Burning of Savannas									
F. Field Burning of Agriculture Residues									
G. Other									
5. LAND USE, LAND-USE CHANGE AND FORESTRY (LULUCF)	**-21,512.67**	**-24,314.98**	**-28,257.94**	**-25,834.09**	**-25,308.41**	**-26,644.30**	**-28,028.25**	**-21,983.28**	**-18,872.85**
A. Forest Land	-18,982.52	-24,578.46	-25,057.91	-24,754.97	-23,353.17	-25,392.40	-26,252.22	-21,574.03	-18,408.17
B. Cropland	-5,801.39	-3,547.19	-4,332.81	-2,317.52	-3,202.77	-2,620.44	-3,056.98	-1,930.57	-2,146.13
C. Grassland	-609.78	1,251.73	146.04	155.88	132.62	37.19	-67.42	229.40	361.46
D. Wetlands	-214.50	-285.99	-45.38	-125.61	-130.10	-201.59	-197.87	-218.37	-192.69
E. Settlements	4,125.22	680.39	384.04	419.46	409.76	494.37	506.01	520.62	499.43
F. Other Land	-29.70	2,164.54	648.07	788.66	835.26	1,038.57	1,040.23	989.67	1,013.25
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
6. Waste	**NA,NE,NO**	**8.59**	**7.73**	**10.83**	**10.56**	**11.70**	**13.31**	**15.15**	**17.23**
A. Solid Waste Disposal on Land	NA	NA	NA	NA	NA	NA	NA	NA	NA
B. Waste-water Handling									
C. Waste Incineration	NE,NO	8.59	7.73	10.83	**10.56**	**11.70**	**13.31**	**15.15**	**17.23**
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total CO_2 emissions	**174,029.15**	**100,093.99**	**83,372.26**	**80,939.05**	**87,962.88**	**89,023.65**	**96,978.73**	**100,795.20**	**105,760.81**
of which under ETS:		**62,761.08**	**49,861.80**	**48,059.52**	**53,244.04**	**52,309.52**	**56,313.04**	**58,547.57**	**61,102.11**

***Table V_ 5** Evolution of the CO_2 emissions for WEM scenario, 1989 ÷ 2030*

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Realised according to NIR					Forecasted			
	1989	2008	2009	2010	2011	2015	2020	2025	2030
	Gg CO_2								
1.Total Energy	**169,024.41**	**85,491.60**	**73,238.56**	**70,267.42**	**76,903.63**	**75,203.68**	**79,354.96**	**80,248.25**	**82,115.18**
A. Fuel Combustion Activities	167,624.54	84,767.81	72,556.22	69,615.58	76,257.39	74,625.93	78,785.07	79,664.49	81,508.33
1. Energy Industries	74,118.64	42,155.77	35,526.92	33,037.88	36,474.64	31,636.70	31,834.42	30,971.17	30,855.46
a. Public Electricity and Heat Production	67,383.87	35,875.96	30,737.77	27,728.15	31,939.19	25,562.61	25,055.43	24,180.85	24,042.67
b. Petroleum Refining	4,780.44	4,109.13	3,389.69	3,630.33	3,071.77	4,192.60	4,679.15	4,686.97	4,702.48
c. Manufacture of Solid Fuels and Other Energy Industries	1,954.32	2,170.67	1,399.46	1,679.41	1,463.68	1,881.49	2,099.84	2,103.35	2,110.31
of which under ETS:		40,962.76	34,521.51	32,102.91	35,442.41	30,741.38	30,933.50	30,094.68	29,982.25
2. Manufacturing Industries and Construction	69,841.84	17,855.46	12,775.16	13,128.88	15,663.12	15,471.21	17,119.08	17,694.69	18,263.50
of which under ETS:		10,954.33	7,837.56	8,054.57	9,609.32	9,491.59	10,502.56	10,855.69	11,204.65
3. Transport	7,520.25	15,064.18	14,893.98	14,130.17	14,402.08	16,501.61	18,109.51	18,692.42	19,737.55
4. Other sectors	13,968.97	8,875.05	9,088.98	9,047.75	9,175.37	10,716.41	11,372.06	11,906.21	12,201.82
a. Commercial/Institutional	NO	2,134.34	2,338.22	2,384.41	2,079.09	3,247.95	3,399.25	3,640.45	3,643.54
b. Residential	8,280.80	6,116.62	5,863.59	5,775.36	6,104.91	6,522.27	6,953.88	7,277.39	7,535.47
c. Agriculture/Forestry/Fisheries	5,688.17	624.09	887.16	887.97	991.38	946.18	1,018.92	988.38	1,022.81
5. Other	2,174.84	817.34	271.19	270.90	542.18	300.00	350.00	400.00	450.00
B. Fugitive Emissions from Fuels	1,399.87	**723.79**	**682.34**	**651.84**	**646.24**	**577.75**	**569.89**	**583.76**	**606.85**
1. Solid Fuels									
2. Oil and Natural Gas	NA	723.79	682.34	651.84	646.24	577.75	569.89	583.76	606.85
C. 1. International Bunkers	854.47	497.03	470.09	525.62	414.84	380.53	437.69	463.35	495.05
C.1.A. Aviation	854.47	414.21	439.44	491.76	387.13	330.03	362.19	373.85	394.75
C.1.B. Marine	IE,NA,NO	82.82	30.65	33.87	27.71	50.50	75.50	89.50	100.30
of which under ETS:						330.03	362.19	373.85	394.75
2. Industrial Processes	**25,871.61**	**14,458.66**	**10,003.64**	**10,536.06**	**10,923.08**	**12,647.00**	**15,722.62**	**18,304.76**	**20,832.44**
of which under ETS:		10,843.99	7,502.73	7,902.05	8,192.31	11,215.36	13,942.82	16,232.66	18,474.21
A. Mineral Products	10,669.97	6,621.08	4,710.40	4,608.34	4,880.99	6,269.30	8,051.82	9,997.83	12,078.99
B. Chemical Industry	4,829.53	2,380.62	1,671.10	2,542.69	3,020.38	2,695.27	2,889.13	3,242.97	3,521.17
C. Metal Production	10,372.10	5,443.77	3,606.32	3,366.67	3,008.10	3,682.43	4,781.67	5,063.96	5,232.28
D. Other Production	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Production of Halocarbons and SF_6									
F. Consumption of Halocarbons and SF_6									
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Products Use	**645.80**	**135.14**	**122.33**	**124.74**	**125.61**	**130.36**	**144.20**	**165.55**	**192.23**
4. Agriculture									
A. Enteric Fermentation									
B. Manure Management									
C. Rice Cultivation									
D. Agricultural Soils									
E. Prescribed Burning of Savannas									
F. Field Burning of Agriculture Residues									
G. Other									
5. LAND USE, LAND-USE CHANGE AND FORESTRY (LULUCF)	**-21,512.67**	**-24,314.98**	**-28,257.94**	**-25,834.09**	**-25,308.41**	**-17,695.95**	**-19,192.57**	**-11,406.98**	**-9,128.35**
A. Forest Land	-18,982.52	-24,578.46	-25,057.91	-24,754.97	-23,353.17	-14,103.56	-15,068.97	-8,645.63	-6,303.94
B. Cropland	-5,801.39	-3,547.19	-4,332.81	-2,317.52	-3,202.77	-4,960.94	-5,404.55	-4,282.67	-4,505.86
C. Grassland	-609.78	1,251.73	146.04	155.88	132.62	37.19	-67.42	229.40	361.46
D. Wetlands	-214.50	-285.99	-45.38	-125.61	-130.10	-201.59	-197.87	-218.37	-192.69
E. Settlements	4,125.22	680.39	384.04	419.46	409.76	494.37	506.01	520.62	499.43
F. Other Land	-29.70	2,164.54	648.07	788.66	835.26	1,038.57	1,040.23	989.67	1,013.25
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
6. Waste	**NA,NE,NO**	**8.59**	**7.73**	**10.83**	**10.56**	**11.70**	**13.31**	**15.15**	**17.23**
A. Solid Waste Disposal on Land	NA	NA	NA	NA	NA	NA	NA	NA	NA
B. Waste-water Handling									
C. Waste Incineration	NE,NO	8.59	7.73	10.83	10.56	11.70	13.31	15.15	17.23
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total CO_2 emissions	**174,029.15**	**100,093.99**	**83,372.26**	**80,939.05**	**87,962.88**	**87,992.75**	**95,235.10**	**98,733.71**	**103,157.08**
of which under ETS:		**62,761.08**	**49,861.80**	**48,059.52**	**53,244.04**	**51,778.37**	**55,741.07**	**57,556.89**	**60,055.87**

***Table V_ 6** Evolution of the CO_2 emissions for WAM scenario, 1989 ÷ 2030*

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Realised according to NIR					Forecasted			
	1989	2008	2009	2010	2011	2015	2020	2025	2030
	Gg CO_2								
1.Total Energy	**169,024.41**	**85,491.60**	**73,238.56**	**70,267.42**	**76,903.63**	**73,613.65**	**78,301.13**	**79,413.68**	**80,769.84**
A. Fuel Combustion Activities	167,624.54	84,767.81	72,556.22	69,615.58	76,257.39	73,048.93	77,743.04	78,843.94	80,176.09
1. Energy Industries	74,118.64	42,155.77	35,526.92	33,037.88	36,474.64	31,636.70	31,443.45	30,844.31	30,271.41
a. Public Electricity and Heat Production	67,383.87	35,875.96	30,737.77	27,728.15	31,939.19	25,562.61	24,664.46	24,053.99	23,458.62
b. Petroleum Refining	4,780.44	4,109.13	3,389.69	3,630.33	3,071.77	4,192.60	4,679.15	4,686.97	4,702.48
c. Manufacture of Solid Fuels and Other Energy Industries	1,954.32	2,170.67	1,399.46	1,679.41	1,463.68	1,881.49	2,099.84	2,103.35	2,110.31
of which under ETS:		40,962.76	34,521.51	32,102.91	35,442.41	30,741.38	30,553.60	29,971.41	29,414.73
2. Manufacturing Industries and Construction	69,841.84	17,855.46	12,775.16	13,128.88	15,663.12	15,306.67	16,954.54	17,457.13	18,025.93
of which under ETS:		10,954.33	7,837.56	8,054.57	9,609.32	9,390.64	10,401.61	10,709.95	11,058.91
3. Transport	7,520.25	15,253.36	15,079.10	14,300.12	14,577.72	15,287.04	17,884.73	18,467.63	19,542.00
4. Other sectors	13,968.97	8,875.05	9,088.98	9,047.75	9,175.37	10,518.52	11,110.32	11,674.87	11,886.75
a. Commercial/Institutional	NO	2,134.34	2,338.22	2,384.41	2,079.09	3,211.72	3,335.26	3,534.66	3,579.54
b. Residential	8,280.80	6,116.62	5,863.59	5,775.36	6,104.91	6,396.71	6,828.32	7,151.83	7,291.61
c. Agriculture/Forestry/Fisheries	5,688.17	624.09	887.16	887.97	991.38	910.09	946.74	988.38	1,015.59
5. Other	2,174.84	817.34	271.19	270.90	542.18	300.00	350.00	400.00	450.00
B. Fugitive Emissions from Fuels	1,399.87	**723.79**	**682.34**	**651.84**	**646.24**	**564.72**	**558.09**	**569.74**	**593.75**
1. Solid Fuels									
2. Oil and Natural Gas	NA	723.79	682.34	651.84	646.24	564.72	558.09	569.74	593.75
C. 1. International Bunkers	854.47	497.03	470.09	525.62	414.84	356.24	433.19	458.85	491.14
C.1.A. Aviation	854.47	414.21	439.44	491.76	387.13	305.74	357.69	369.35	390.84
C.1.B. Marine	IE,NA,NO	82.82	30.65	33.87	27.71	50.50	75.50	89.50	100.30
of which under ETS:						305.74	357.69	369.35	390.84
2. Industrial Processes	**25,871.61**	**14,458.66**	**10,003.64**	**10,536.06**	**10,923.08**	**12,647.00**	**15,722.62**	**18,304.76**	**20,832.44**
of which under ETS:		10,843.99	7,502.73	7,902.05	8,192.31	11,215.36	13,942.82	16,232.66	18,474.21
A. Mineral Products	10,669.97	6,621.08	4,710.40	4,608.34	4,880.99	6,269.30	8,051.82	9,997.83	12,078.99
B. Chemical Industry	4,829.53	2,393.81	1,686.92	2,561.05	3,033.99	2,695.27	2,889.13	3,242.97	3,521.17
C. Metal Production	10,372.10	5,443.77	3,606.32	3,366.67	3,008.10	3,682.43	4,781.67	5,063.96	5,232.28
D. Other Production	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Production of Halocarbons and SF_6									
F. Consumption of Halocarbons and SF_6									
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Products Use	**645.80**	**135.14**	**122.33**	**124.74**	**125.61**	**128.91**	**142.60**	**163.70**	**190.70**
4. Agriculture									
A. Enteric Fermentation									
B. Manure Management									
C. Rice Cultivation									
D. Agricultural Soils									
E. Prescribed Burning of Savannas									
F. Field Burning of Agriculture Residues									
G. Other									
5. LAND USE, LAND-USE CHANGE AND FORESTRY (LULUCF)	**-21,512.67**	**-24,314.98**	**-28,257.94**	**-25,834.09**	**-25,308.41**	**-17,954.43**	**-17,855.81**	**-9,897.14**	**-7,314.09**
A. Forest Land	-18,982.52	-24,578.46	-25,057.91	-24,754.97	-23,353.17	-13,630.55	-13,082.04	-6,559.48	-3,985.59
B. Cropland	-5,801.39	-3,547.19	-4,332.81	-2,317.52	-3,202.77	-5,692.42	-6,054.73	-4,858.98	-5,009.95
C. Grassland	-609.78	1,251.73	146.04	155.88	132.62	37.19	-67.42	229.40	361.46
D. Wetlands	-214.50	-285.99	-45.38	-125.61	-130.10	-201.59	-197.87	-218.37	-192.69
E. Settlements	4,125.22	680.39	384.04	419.46	409.76	494.37	506.01	520.62	499.43
F. Other Land	-29.70	2,164.54	648.07	788.66	835.26	1,038.57	1,040.23	989.67	1,013.25
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
6. Waste	**NA,NE,NO**	**8.59**	**7.73**	**10.83**	**10.56**	**11.70**	**13.31**	**15.15**	**17.23**
A. Solid Waste Disposal on Land	NA	NA	NA	NA	NA	NA	NA	NA	NA
B. Waste-water Handling									
C. Waste Incineration	NE,NO	8.59	7.73	10.83	10.56	11.70	13.31	15.15	17.23
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total CO_2 emissions	**174,029.15**	**100,093.99**	**83,372.26**	**80,939.05**	**87,962.88**	**86,401.26**	**94,179.66**	**97,897.29**	**101,810.20**
of which under ETS:		**62,761.08**	**49,861.80**	**48,059.52**	**53,244.04**	**51,653.13**	**55,255.73**	**57,283.37**	**59,338.69**

The projections of CH_4 emissions for WOM scenario, WEM scenario and WAM scenario, during the period 2011 ÷ 2030, are presented in the tables V_7 ÷ V_9.

Table V_ 7 *Evolution of the CH_4 emissions for WOM scenario 1989 ÷ 2030*

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Realised according to NIR					Forecasted			
	1989	2008	2009	2010	2011	2015	2020	2025	2030
	Gg CH_4								
1.Total Energy	1,065.56	**473.51**	**435.47**	**422.21**	**423.79**	**455.16**	**511.07**	**570.40**	**651.80**
A. Fuel Combustion Activities	26.06	51.07	49.49	51.07	47.37	51.35	56.98	59.25	61.80
1. Energy Industries	1.38	0.64	0.55	0.55	0.60	0.57	0.57	0.57	0.56
a. Public Electricity and Heat Production	1.22	0.48	0.43	0.41	0.49	0.43	0.42	0.41	0.41
b. Petroleum Refining	0.11	0.10	0.08	0.09	0.07	0.09	0.11	0.11	0.11
c. Manufacture of Solid Fuels and Other Energy Industries	0.05	0.07	0.04	0.04	0.04	0.04	0.05	0.05	0.05
2. Manufacturing Industries and Construction	5.89	1.85	1.42	1.65	1.98	1.35	1.49	1.54	1.59
3. Transport	1.63	2.13	2.07	1.79	1.73	1.97	2.18	2.26	2.42
4. Other sectors	17.03	44.67	43.89	45.44	40.79	44.96	49.74	51.39	53.22
a. Commercial/Institutional	NO	0.20	0.22	0.22	0.20	0.31	0.34	0.35	0.37
b. Residential	16.09	44.13	43.33	44.93	40.30	44.23	48.93	50.55	52.36
c. Agriculture/Forestry/Fisheries	0.94	0.34	0.34	0.29	0.28	0.42	0.47	0.48	0.50
5. Other	0.12	1.77	1.56	1.64	2.27	2.50	3.00	3.50	4.00
B. Fugitive Emissions from Fuels	1,039.30	422.44	385.98	371.14	376.42	403.81	454.09	511.15	590.00
1. Solid Fuels	263.88	49.94	43.03	36.26	41.87	47.34	57.87	70.73	90.00
2. Oil and Natural Gas	775.63	372.50	342.95	334.88	334.55	356.47	396.22	440.42	500.00
C. 1. International Bunkers	0.01	5.66	2.09	2.36	1.93	2.08	2.29	2.59	2.96
C.1.A. Aviation	0.01	0.07	0.03	0.03	0.02	0.04	0.06	0.08	0.10
C.1.B. Marine	IE,NA,NE	5.59	2.06	2.33	1.91	2.04	2.23	2.51	2.86
2. Industrial Processes	**4.90**	**1.68**	**0.72**	**0.85**	**0.65**	**0.68**	**0.73**	**0.82**	**0.89**
A. Mineral Products	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA, NE	NA, NE	NA, NE	NA, NE
B. Chemical Industry	4.90	1.68	0.72	0.85	0.65	0.68	0.73	0.82	0.89
C. Metal Production	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA, NE	NA, NE	NA, NE	NA, NE
D. Other Production									
E. Production of Halocarbons and SF_6									
F. Consumption of Halocarbons and SF_6									
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Products Use									
4. Agriculture	**951.80**	**482.15**	**469.59**	**410.67**	**410.32**	**421.38**	**463.46**	**503.64**	**553.77**
A. Enteric Fermentation	856.91	437.91	428.83	375.96	375.03	385.35	424.52	461.86	509.18
B. Manure Management	86.31	38.54	35.06	28.96	28.31	29.06	31.97	34.81	37.62
C. Rice Cultivation	2.96	0.71	1.33	0.89	0.91	0.91	0.91	0.91	0.91
D. Agricultural Soils	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agriculture Residues	5.71	4.99	4.37	4.86	6.06	6.06	6.06	6.06	6.06
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. LAND USE, LAND-USE CHANGE AND	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
A. Forest Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Cropland	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
F. Other Land	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
6. Waste	**193.85**	**237.34**	**239.80**	**241.71**	**225.16**	**278.33**	**295.38**	**310.58**	**323.80**
A. Solid Waste Disposal on Land	59.75	132.44	137.29	139.33	117.89	170.09	180.91	189.68	196.24
B. Waste-water Handling	134.10	104.90	102.51	102.38	107.28	108.24	114.47	120.90	127.56
C. Waste Incineration	NE	NE	NE	NE	NE	NE	NE	NE	NE
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total CH_4 emissions	**2,216.11**	**1,194.68**	**1,145.58**	**1,075.45**	**1,059.91**	**1,155.55**	**1,270.64**	**1,385.43**	**1,530.25**

***Table V_ 8** Evolution of the CH_4 emissions for WEM scenario, 1989 ÷ 2030*

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Realised according to NIR					Forecasted			
	1989	2008	2009	2010	2011	2015	2020	2025	2030
	Gg CH_4								
1.Total Energy	1,065.56	**473.51**	**435.47**	**422.21**	**423.79**	**410.23**	**454.71**	**517.88**	**612.19**
A. Fuel Combustion Activities	26.06	51.07	49.49	51.07	47.37	51.30	56.58	58.83	61.35
1. Energy Industries	1.38	0.64	0.55	0.55	0.60	0.57	0.57	0.56	0.56
a. Public Electricity and Heat Production	1.22	0.48	0.43	0.41	0.49	0.43	0.42	0.40	0.40
b. Petroleum Refining	0.11	0.10	0.08	0.09	0.07	0.09	0.11	0.11	0.11
c. Manufacture of Solid Fuels and Other Energy Industries	0.05	0.07	0.04	0.04	0.04	0.04	0.05	0.05	0.05
2. Manufacturing Industries and Construction	5.89	1.85	1.42	1.65	1.98	1.33	1.47	1.52	1.58
3. Transport	1.63	2.13	2.07	1.79	1.73	1.96	2.15	2.22	2.36
4. Other sectors	17.03	44.67	43.89	45.44	40.79	44.94	49.39	51.03	52.85
a. Commercial/Institutional	NO	0.20	0.22	0.22	0.20	0.31	0.32	0.34	0.34
b. Residential	16.09	44.13	43.33	44.93	40.30	44.22	48.61	50.23	52.02
c. Agriculture/Forestry/Fisheries	0.94	0.34	0.34	0.29	0.28	0.42	0.46	0.45	0.49
5. Other	0.12	1.77	1.56	1.64	2.27	2.50	3.00	3.50	4.00
B. Fugitive Emissions from Fuels	1,039.30	422.44	385.98	371.14	376.42	358.93	398.13	459.05	550.84
1. Solid Fuels	263.88	49.94	43.03	36.26	41.87	42.08	50.74	63.52	84.03
2. Oil and Natural Gas	775.63	372.50	342.95	334.88	334.55	316.85	347.39	395.53	466.81
C. 1. International Bunkers	0.01	5.66	2.09	2.36	1.93	2.08	2.29	2.59	2.96
C.1.A. Aviation	0.01	0.07	0.03	0.03	0.02	0.04	0.06	0.08	0.10
C.1.B. Marine	IE,NA,NE	5.59	2.06	2.33	1.91	2.04	2.23	2.51	2.86
2. Industrial Processes	**4.90**	**1.68**	**0.72**	**0.85**	**0.65**	**0.58**	**0.62**	**0.69**	**0.75**
A. Mineral Products	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA, NE	NA, NE	NA, NE	NA, NE
B. Chemical Industry	4.90	1.68	0.72	0.85	0.65	0.58	0.62	0.69	0.75
C. Metal Production	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA, NE	NA, NE	NA, NE	NA, NE
D. Other Production									
E. Production of Halocarbons and SF_6									
F. Consumption of Halocarbons and SF_6									
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Products Use									
4. Agriculture	**951.80**	**482.15**	**469.59**	**410.67**	**410.32**	**421.38**	**423.71**	**426.68**	**426.51**
A. Enteric Fermentation	856.91	437.91	428.83	375.96	375.03	385.93	387.97	393.60	396.97
B. Manure Management	86.31	38.54	35.06	28.96	28.31	28.48	28.77	26.11	22.57
C. Rice Cultivation	2.96	0.71	1.33	0.89	0.91	0.91	0.91	0.91	0.91
D. Agricultural Soils	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agriculture Residues	5.71	4.99	4.37	4.86	6.06	6.06	6.06	6.06	6.06
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. LAND USE, LAND-USE CHANGE AND FORESTRY (LULUCF)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
A. Forest Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Cropland	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
F. Other Land	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
6. Waste	**193.85**	**237.34**	**239.80**	**241.71**	**225.16**	**214.64**	**196.71**	**189.48**	**172.77**
A. Solid Waste Disposal on Land	59.75	132.44	137.29	139.33	117.89	117.17	113.83	113.47	107.00
B. Waste-water Handling	134.10	104.90	102.51	102.38	107.28	97.47	82.88	76.01	65.77
C. Waste Incineration	NE	NE	NE	NE	NE	NE	NE	NE	NE
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total CH_4 emissions	**2,216.11**	**1,194.68**	**1,145.58**	**1,075.45**	**1,059.91**	**1,046.83**	**1,075.75**	**1,134.73**	**1,212.22**

Table V_ 9 *Evolution of the CH_4 emissions for WAM scenario,1989 ÷ 2030*

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Realised according to NIR					Forecasted			
	1989	2008	2009	2010	2011	2015	2020	2025	2030
	Gg CH_4								
1.Total Energy	1,065.56	**473.51**	**435.47**	**422.21**	**423.79**	**401.95**	**446.40**	**506.79**	**600.21**
A. Fuel Combustion Activities	26.06	51.07	49.49	51.07	47.37	51.12	56.51	58.76	61.27
1. Energy Industries	1.38	0.64	0.55	0.55	0.60	0.57	0.57	0.56	0.55
a. Public Electricity and Heat Production	1.22	0.48	0.43	0.41	0.49	0.43	0.41	0.40	0.39
b. Petroleum Refining	0.11	0.10	0.08	0.09	0.07	0.09	0.11	0.11	0.11
c. Manufacture of Solid Fuels and Other Energy Industries	0.05	0.07	0.04	0.04	0.04	0.04	0.05	0.05	0.05
2. Manufacturing Industries and Construction	5.89	1.85	1.42	1.65	1.98	1.32	1.46	1.51	1.56
3. Transport	1.63	2.13	2.07	1.79	1.73	1.81	2.12	2.19	2.34
4. Other sectors	17.03	44.67	43.89	45.44	40.79	44.92	49.36	51.00	52.82
a. Commercial/Institutional	NO	0.20	0.22	0.22	0.20	0.30	0.31	0.33	0.34
b. Residential	16.09	44.13	43.33	44.93	40.30	44.21	48.60	50.22	52.00
c. Agriculture/Forestry/Fisheries	0.94	0.34	0.34	0.29	0.28	0.41	0.45	0.45	0.49
5. Other	0.12	1.77	1.56	1.64	2.27	2.50	3.00	3.50	4.00
B. Fugitive Emissions from Fuels	1,039.30	**422.44**	**385.98**	**371.14**	**376.42**	**350.83**	**389.89**	**448.03**	**538.94**
1. Solid Fuels	263.88	49.94	43.03	36.26	41.87	41.13	49.69	62.00	82.21
2. Oil and Natural Gas	775.63	372.50	342.95	334.88	334.55	309.70	340.20	386.03	456.73
C. 1. International Bunkers	0.01	5.66	2.09	2.36	1.93	2.08	2.29	2.59	2.96
C.1.A. Aviation	0.01	0.07	0.03	0.03	0.02	0.04	0.06	0.08	0.10
C.1.B. Marine	IE,NA,NE	5.59	2.06	2.33	1.91	2.04	2.23	2.51	2.86
2. Industrial Processes	**4.90**	**1.68**	**0.72**	**0.85**	**0.65**	**0.58**	**0.62**	**0.69**	**0.75**
A. Mineral Products	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA, NE	NA, NE	NA, NE	NA, NE
B. Chemical Industry	4.90	1.68	0.72	0.85	0.65	0.58	0.62	0.69	0.75
C. Metal Production	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA, NE	NA, NE	NA, NE	NA, NE
D. Other Production									
E. Production of Halocarbons and SF_6									
F. Consumption of Halocarbons and SF_6									
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Products Use									
4. Agriculture	**951.80**	**482.15**	**469.59**	**410.67**	**410.32**	**411.82**	**403.97**	**403.81**	**394.13**
A. Enteric Fermentation	856.91	437.91	428.83	375.96	375.03	378.70	371.42	367.25	358.94
B. Manure Management	86.31	38.54	35.06	28.96	28.31	26.15	25.58	29.59	28.22
C. Rice Cultivation	2.96	0.71	1.33	0.89	0.91	0.91	0.91	0.91	0.91
D. Agricultural Soils	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agriculture Residues	5.71	4.99	4.37	4.86	6.06	6.06	6.06	6.06	6.06
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. LAND USE, LAND-USE CHANGE AND FORESTRY (LULUCF)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
A. Forest Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Cropland	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
F. Other Land	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
6. Waste	**193.85**	**237.34**	**239.80**	**241.71**	**225.16**	**195.02**	**175.75**	**163.84**	**149.77**
A. Solid Waste Disposal on Land	59.75	132.44	137.29	139.33	117.89	106.59	100.41	94.62	89.14
B. Waste-water Handling	134.10	104.90	102.51	102.38	107.28	88.43	75.34	69.22	60.63
C. Waste Incineration	NE	NE	NE	NE	NE	NE	NE	NE	NE
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total CH_4 emissions	**2,216.11**	**1,194.68**	**1,145.58**	**1,075.45**	**1,059.91**	**1,009.37**	**1,026.74**	**1,075.13**	**1,144.86**

The projections of N_2O emissions for WOM scenario, WEM scenario and WAM scenario, for the period 2011 ÷ 2030, are presented in the tables V_10 ÷ V_12.

Table V_ 10 *Evolution of the N_2O emissions for WOM scenario, 1989 ÷ 2030*

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Realised according to NIR					Forecasted			
	1989	2008	2009	2010	2011	2015	2020	2025	2030
	Gg N_2O								
1.Total Energy	**1.32**	**1.71**	**1.59**	**1.58**	**1.67**	**1.64**	**1.78**	**1.83**	**1.91**
A. Fuel Combustion Activities	1.30	1.70	1.59	1.57	1.66	1.64	1.77	1.82	1.90
1. Energy Industries	0.67	0.45	0.39	0.37	0.43	0.38	0.38	0.37	0.37
a. Public Electricity and Heat Production	0.63	0.42	0.38	0.34	0.42	0.36	0.35	0.35	0.34
b. Petroleum Refining	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
c. Manufacture of Solid Fuels and Other	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
2. Manufacturing Industries and	0.36	0.16	0.12	0.14	0.18	0.10	0.12	0.12	0.12
3. Transport	0.06	0.47	0.46	0.43	0.45	0.50	0.55	0.57	0.61
4. Other sectors	0.19	0.60	0.59	0.61	0.55	0.61	0.67	0.69	0.72
a. Commercial/Institutional	NO	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
b. Residential	0.15	0.59	0.58	0.60	0.54	0.59	0.65	0.67	0.70
c. Agriculture/Forestry/Fisheries	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
5. Other	0.02	0.03	0.02	0.02	0.04	0.04	0.05	0.06	0.08
B. Fugitive Emissions from Fuels	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**
1. Solid Fuels									
2. Oil and Natural Gas	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
C. 1. International Bunkers	0.02	0.86	0.26	0.29	0.24	0.27	0.32	0.40	0.45
C.1.A. Aviation	0.02	0.19	0.01	0.01	0.01	0.02	0.04	0.06	0.08
C.1.B. Marine	IE,NA,NO	0.67	0.25	0.28	0.23	0.25	0.28	0.32	0.37
2. Industrial Processes	**19.81**	**8.16**	**1.67**	**3.72**	**3.90**	**4.11**	**4.40**	**4.94**	**5.35**
A. Mineral Products	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA, NE	NA, NE	NA, NE	NA, NE
B. Chemical Industry*	19.81	8.16	1.67	3.72	3.90	4.11	4.40	4.94	5.35
C. Metal Production	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Other Production									
E. Production of Halocarbons and SF_6									
F. Consumption of Halocarbons and SF_6									
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Products Use	NE								
4. Agriculture	**66.92**	**34.29**	**33.85**	**32.70**	**33.31**	**37.64**	**43.66**	**50.65**	**58.75**
A. Enteric Fermentation									
B. Manure Management	7.50	4.91	4.51	3.98	3.90	4.40	5.10	5.91	6.85
C. Rice Cultivation									
D. Agricultural Soils	59.28	29.27	29.24	28.61	29.27	33.07	38.36	44.49	51.60
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agriculture Residues	0.14	0.11	0.10	0.12	0.14	0.17	0.20	0.25	0.30
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. LAND USE, LAND-USE CHANGE AND FORESTRY (LULUCF)	**0.00**	**0.01**	**0.01**	**0.01**	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**
A. Forest Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Cropland	IE,NO	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
F. Other Land	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
6. Waste	**1.93**	**2.21**	**2.13**	**2.03**	**2.02**	**2.18**	**2.21**	**2.19**	**2.18**
A. Solid Waste Disposal on Land									
B. Waste-water Handling	1.93	2.21	2.13	2.03	2.02	2.18	2.21	2.19	2.18
C. Waste Incineration	NE,NO	NE	NE	NE	NE	NE	NE	NE	NE
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total N_2O emissions	**89.98**	**46.37**	**39.25**	**40.04**	**40.91**	**45.57**	**52.05**	**59.61**	**68.19**

*Note: * Starting with 2013, N_2O emissions from the chemical industry is under the EU ETS*

Table V_ 11 ***Evolution*** *of the N_2O emissions for WEM scenario, 1989 ÷ 2030*

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Realised according to NIR					Forecasted			
	1989	2008	2009	2010	2011	2015	2020	2025	2030
	Gg N_2O								
1.Total Energy	**1.32**	**1.71**	**1.59**	**1.58**	**1.67**	**1.64**	**1.76**	**1.81**	**1.89**
A. Fuel Combustion Activities	1.30	1.70	1.59	1.57	1.66	1.63	1.76	1.80	1.88
1. Energy Industries	0.67	0.45	0.39	0.37	0.43	0.38	0.38	0.37	0.36
a. Public Electricity and Heat Production	0.63	0.42	0.38	0.34	0.42	0.36	0.35	0.34	0.34
b. Petroleum Refining	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
c. Manufacture of Solid Fuels and Other Energy Industries	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
2. Manufacturing Industries and Construction	0.36	0.16	0.12	0.14	0.18	0.10	0.11	0.12	0.12
3. Transport	0.06	0.47	0.46	0.43	0.45	0.49	0.54	0.56	0.60
4. Other sectors	0.19	0.60	0.59	0.61	0.55	0.61	0.67	0.69	0.72
a. Commercial/Institutional	NO	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
b. Residential	0.15	0.59	0.58	0.60	0.54	0.59	0.65	0.67	0.70
c. Agriculture/Forestry/Fisheries	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
5. Other	0.02	0.03	0.02	0.02	0.04	0.04	0.05	0.06	0.08
B. Fugitive Emissions from Fuels	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**
1. Solid Fuels		NA	NA	NA	NA	0.00	0.00	0.00	0.00
2. Oil and Natural Gas	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
C. 1. International Bunkers	0.02	0.86	0.26	0.29	0.24	0.27	0.32	0.38	0.45
C.1.A. Aviation	0.02	0.19	0.01	0.01	0.01	0.02	0.04	0.06	0.08
C.1.B. Marine	IE,NA,NO	0.67	0.25	0.28	0.23	0.25	0.28	0.32	0.37
2. Industrial Processes	**19.81**	**8.16**	**1.67**	**3.72**	**3.90**	**3.48**	**3.73**	**4.19**	**4.55**
A. Mineral Products	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA, NE	NA, NE	NA, NE	NA, NE
B. Chemical Industry*	19.81	8.16	1.67	3.72	3.90	3.48	3.73	4.19	4.55
C. Metal Production	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Other Production									
E. Production of Halocarbons and SF_6									
F. Consumption of Halocarbons and SF_6									
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Products Use	NE								
4. Agriculture	**66.92**	**34.29**	**33.85**	**32.70**	**33.31**	**34.64**	**38.66**	**45.65**	**48.43**
A. Enteric Fermentation									
B. Manure Management	7.50	4.91	4.51	3.98	3.90	4.40	5.10	5.91	6.85
C. Rice Cultivation									
D. Agricultural Soils	59.28	29.27	29.24	28.61	29.27	30.07	33.36	39.49	41.28
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agriculture Residues	0.14	0.11	0.10	0.12	0.14	0.17	0.20	0.25	0.30
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. LAND USE, LAND-USE CHANGE AND FORESTRY (LULUCF)	**0.00**	**0.01**	**0.01**	**0.01**	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**
A. Forest Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Cropland	IE,NO	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
F. Other Land	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
6. Waste	**1.93**	**2.21**	**2.13**	**2.03**	**2.02**	**2.18**	**2.21**	**2.19**	**2.18**
A. Solid Waste Disposal on Land									
B. Waste-water Handling	1.93	2.21	2.13	2.03	2.02	2.18	2.21	2.19	2.18
C. Waste Incineration	NE,NO	NE	NE	NE	NE	NE	NE	NE	NE
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total N_2O emissions	**89.98**	**46.37**	**39.25**	**40.04**	**40.91**	**41.94**	**46.37**	**53.84**	**57.05**

*Note: * Starting with 2013, N_2O emissions from the chemical industry is under the EU ETS*

***Table V_ 12** Evolution of the N_2O emissions for WAM scenario, 1989 ÷ 2030*

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Realised according to NIR					Forecasted			
	1989	2008	2009	2010	2011	2015	2020	2025	2030
	Gg N_2O								
1.Total Energy	**1.32**	**1.71**	**1.59**	**1.58**	**1.67**	**1.60**	**1.75**	**1.79**	**1.87**
A. Fuel Combustion Activities	1.30	1.70	1.59	1.57	1.66	1.59	1.74	1.79	1.87
1. Energy Industries	0.67	0.45	0.39	0.37	0.43	0.38	0.37	0.36	0.36
a. Public Electricity and Heat Production	0.63	0.42	0.38	0.34	0.42	0.36	0.35	0.34	0.33
b. Petroleum Refining	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
c. Manufacture of Solid Fuels and Other Energy Industries	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
2. Manufacturing Industries and Construction	0.36	0.16	0.12	0.14	0.18	0.10	0.11	0.11	0.12
3. Transport	0.06	0.47	0.46	0.43	0.45	0.46	0.54	0.55	0.60
4. Other sectors	0.19	0.60	0.59	0.61	0.55	0.61	0.67	0.69	0.71
a. Commercial/Institutional	NO	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
b. Residential	0.15	0.59	0.58	0.60	0.54	0.59	0.65	0.67	0.69
c. Agriculture/Forestry/Fisheries	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
5. Other	0.02	0.03	0.02	0.02	0.04	0.04	0.05	0.06	0.08
B. Fugitive Emissions from Fuels	**0.01**	0.01	0.01	0.01	0.01	**0.01**	**0.01**	**0.01**	**0.01**
1. Solid Fuels		NA	NA	NA	NA	0.00	0.00	0.00	0.00
2. Oil and Natural Gas	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
C. 1. International Bunkers	0.02	0.86	0.26	0.29	0.24	0.27	0.32	0.38	0.45
C.1.A. Aviation	0.02	0.19	0.01	0.01	0.01	0.02	0.04	0.06	0.08
C.1.B. Marine	IE,NA,NO	0.67	0.25	0.28	0.23	0.25	0.28	0.32	0.37
2. Industrial Processes	**19.81**	**8.16**	**1.67**	**3.72**	**3.90**	**3.48**	**3.73**	**4.19**	**4.55**
A. Mineral Products	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA, NE	NA, NE	NA, NE	NA, NE
B. Chemical Industry*	19.81	8.16	1.67	3.72	3.90	3.48	3.73	4.19	4.55
C. Metal Production	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Other Production									
E. Production of Halocarbons and SF_6									
F. Consumption of Halocarbons and SF_6									
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Products Use	NE								
4. Agriculture	**66.92**	**34.29**	**33.85**	**32.70**	**33.31**	**34.64**	**35.66**	**41.65**	**45.85**
A. Enteric Fermentation									
B. Manure Management	7.50	4.91	4.51	3.98	3.90	4.40	5.10	5.91	6.85
C. Rice Cultivation									
D. Agricultural Soils	59.28	29.27	29.24	28.61	29.27	30.07	30.36	35.49	38.70
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agriculture Residues	0.14	0.11	0.10	0.12	0.14	0.17	0.20	0.25	0.30
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. LAND USE, LAND-USE CHANGE AND FORESTRY (LULUCF)	**0.00**	**0.01**	**0.01**	**0.01**	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**
A. Forest Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Cropland	IE,NO	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
F. Other Land	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
6. Waste	**1.93**	**2.21**	**2.13**	**2.03**	**2.02**	**2.18**	**2.21**	**2.19**	**2.18**
A. Solid Waste Disposal on Land									
B. Waste-water Handling	1.93	2.21	2.13	2.03	2.02	2.18	2.21	2.19	2.18
C. Waste Incineration	NE,NO	NE	NE	NE	NE	NE	NE	NE	NE
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total N_2O emissions	**89.98**	**46.37**	**39.25**	**40.04**	**40.91**	**41.90**	**43.35**	**49.83**	**54.45**

*Note: * Starting with 2013, N_2O emissions from the chemical industry is under the EU ETS*

The projections of HFCs, PFCs and SF_6 emissions for the period 2011 - 2030 are presented in the table V_13.

***Table V_ 13** Evolution of the HFCs, PFCs and SF_6 emissions for the period 1989 ÷ 2030*

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Realised according to NIR					Forecasted			
	1989	2008	2009	2010	2011	2015	2020	2025	2030
Total emissions of HFCs, PFCs, SF_6 in Gg CO_2 equivalent	**3,349.56**	**921.94**	**717.49**	**708.07**	**458.68**	**557.53**	**711.57**	**908.15**	**1,159.06**
HFCs emissions	**NA,NE,NO**	**890.27**	**703.10**	**695.05**	**440.55**	**540.80**	**690.22**	**880.91**	**1,124.29**
2. INDUSTRIAL PROCESSES		**890.27**	**703.10**	**695.05**	**440.55**	**540.80**	**690.22**	**880.91**	**1,124.29**
A. Mineral Products									
B. Chemical Industry	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
C. Metal Production	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
3. Aluminium production									
D. Other Production									
E. Production of Halocarbons and SF_6	NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
F. Consumption of Halocarbons and SF_6	NE,NO	890.27	703.10	695.05	440.55	540.80	690.22	880.91	1,124.29
1. Refrigeration and Air Conditioning Equipment		762.01	600.80	590.81	206.48	250.50	329.62	415.21	537.14
2. Foam Blowing		83.82	66.08	64.99	22.71	28.80	36.60	46.50	59.10
3. Fire Extinguishers		9.77	7.70	7.57	2.65	3.80	4.90	6.30	8.00
4. Aerosols/ Metered Dose Inhalers		30.55	24.09	23.69	8.28	10.50	13.50	17.20	21.85
5. Solvents		NO	NO	NO	NO	NO	NO	NO	NO
6. Other applications using ODS subtitutes		NO	NO	NO	NO	NO	NO	NO	NO
7. Semiconductor Manufacture		NO	NO	NO	NO	NO	NO	NO	NO
8. Electrical Equipment		0.05	NO	0.00	NO	NO	NO	NO	NO
9. Other		4.08	4.43	8.00	200.43	247.20	305.60	395.70	498.20
Other non-specified		4.08	4.43	8.00	200.43	247.20	305.60	395.70	498.20
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
PFCs emissions									
2. INDUSTRIAL PROCESSES	**3,349.56**	**15.34**	**7.00**	**7.93**	**10.92**	**11.15**	**14.23**	**18.16**	**23.18**
A. Mineral Products									
B. Chemical Industry		NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
C. Metal Production	3,349.56	15.34	7.00	7.84	10.92	11.15	14.23	18.16	23.18
3. Aluminium production*	3,349.56	15.34	7.00	7.84	10.92	11.15	14.23	18.16	23.18
D. Other Production									
E. Production of Halocarbons and SF_6	NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
F. Consumption of Halocarbons and SF_6	NE,NO	0.00	NA,NO	0.08	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
1. Refrigeration and Air Conditioning Equipment		0.00	NO	0.08	NO	NO	NO	NO	NO
2. Foam Blowing		NO	NO	NO	NO	NO	NO	NO	NO
3. Fire Extinguishers		NO	NO	NO	NO	NO	NO	NO	NO
4. Aerosols/ Metered Dose Inhalers		NO	NO	NO	NO	NO	NO	NO	NO
5. Solvents		NO	NO	NO	NO	NO	NO	NO	NO
6. Other applications using ODS subtitutes		NO	NO	NO	NO	NO	NO	NO	NO
7. Semiconductor Manufacture		NO	NO	NO	NO	NO	NO	NO	NO
8. Electrical Equipment		NO	NO	NO	NO	NO	NO	NO	NO
9. Other		NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Other non-specified		NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
SF6 emissions									
2. INDUSTRIAL PROCESSES	**NA,NE,NO**	**16.33**	**7.38**	**5.09**	**7.21**	**5.58**	**7.12**	**9.08**	**11.59**
A. Mineral Products									
B. Chemical Industry	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
C. Metal Production	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
3. Aluminium production									
D. Other Production									
E. Production of Halocarbons and SF_6	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Consumption of Halocarbons and SF_6	NE,NA	16.33	7.38	5.09	7.21	5.58	7.12	9.08	11.59
1. Refrigeration and Air Conditioning Equipment		0.01	NO	NO	NO	NO	NO	NO	NO
2. Foam Blowing		NO	NO	NO	NO	NO	NO	NO	NO
3. Fire Extinguishers		3.35	3.35	3.35	3.35	2.35	3.05	3.90	5.05
4. Aerosols/ Metered Dose Inhalers		NO	NO	NO	NO	NO	NO	NO	NO
5. Solvents		NO	NO	NO	NO	NO	NO	NO	NO
6. Other applications using ODS subtitutes		NO	NO	NO	NO	NO	NO	NO	NO
7. Semiconductor Manufacture		NO	NO	NO	NO	NO	NO	NO	NO
8. Electrical Equipment		0.61	1.30	1.75	2.00	1.00	2.00	2.60	3.50
9. Other		12.36	2.74	NO	1.86	2.23	2.07	2.58	3.04
Other non-specified		12.36	2.74	NO	1.86	2.23	2.07	2.58	3.04
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA

*Note: * Starting with 2013, PFCs emissions from aluminium production is under the EU ETS*

V.A.3. Key Underlying Variables

The GHG emissions projections for the period 2015 ÷ 2030 are based on common assumptions related to the main parameters, such as the population and economic growth. Furthermore, there were also considered the interaction between the sectors concerning the energy demand, transport demand, social demand, etc.

For defining the assumptions regarding the evolution of Romania within the 2013 - 2030 period, a SWOT analysis for the 1989 ÷ 2012 period was performed, according to the following:

- Economic development;
- Demographic development;
- Social development;
- Structural adjustment of the economy;
- Structural adjustment of the industry;
- Technologic upgrade and decrease of the energy intensity in industry, agriculture, constructions;
- Development and upgrade of the transport sector;
- Development and upgrade of the services sector;
- Development and upgrade of the habiting conditions.

The evolution of the main macroeconomic and energetic indicators, used for GHG emissions prognosis, is presented in the table V_14.

Table V_ 14 *Evolution of the macroeconomic and energy indicators within 2000 ÷ 2030*

Indicator	M.U	2000	2005	2010	2011	2015	2020	2025	2030
Gross Domestic Product	Billion Euro $_{2010}$	83.45	110.19	124.4	127.13	135.98	159.2	184.5	203.7
GDP growth rate	%	2.40	5.72	2.46	2.19	1.70	3.20	2.99	2.00
Population	Thousands persons	22,435	21,624	21,431	21,354	21,180	20,800	20,322	19,753
GDP/person	Euro$_{2010}$/ persons	3720	5096	5805	5953	6420	7654	9079	10312
Primary energy consumption	10^6toe	36.37	37.86	34.82	35.65	35.43	38.86	39.50	40.58
Primary energy intensity	toe/10^3 Euro$_{2010}$	0.436	0.344	0.280	0,280	0.261	0.244	0.214	0.199
Final energy consumption	10^6 toe	22.165	25.206	22.739	22.750	24.500	27.100	28.000	29.000
Final energy intensity	toe/10^3 Euro$_{2010}$	0.266	0.229	0.183	0.179	0.180	0.170	0.152	0.142
Primary energy consumption /person	toe/person	1,621	1,754	1,694	1,669	1.673	1.868	1.944	2.054

Gross consumption of electricity	TWh	51.94	59.41	60.98	62.22	62.9	71.6	79.4	86.4
Gross consumption of electricity per person	kWh/person	2315	2747	2845	2914	2970	3442	3907	4374

The assumptions related to Romania macroeconomic development after 2013, considering the continuation of the structural modifications correlated with similar EU directions, are presented in the table V_15.

Table V_ 15 *Evolution of the Gross value added structure in 2011÷2030, in %*

Indicator	**2011**	**2015**	**2020**	**2025**	**2030**
TOTAL GVA out of which:	100	100	100	100	100
Industry	33.02	31.5	30.0	29.0	28.5
Agriculture	7.48	7.1	6.5	5.8	5.0
Constructions	9.76	10.0	10.0	10.0	10.0
Services	49.74	51.4	53.5	55.2	56.5

The emissions projections are based on economic scenario achieved, considering the current financial and economic crisis in EU and worldwide, which has an important impact on the Romania economy. So, Romania will have in 2013 an increase of GDP of about 2.2%, due to ending the recession period in 2012.

The assumptions related to international import prices of coal, natural gas, oil and carbon price for the period 2015÷2030 are presented in table V_16.

Table V_ 16 *Evolution of international fuel prices and carbon price in period 2015÷2030*

	U.M	**2015**	**2020**	**2025**	**2030**
International coal import prices	€ (2010)/boe	22.00	22.60	23.70	24.00
International oil import prices	€ (2010)/boe	86.00	88.50	89.20	93.10
International gas import prices	€ (2010)/boe	53.80	64.50	58.90	64.50
Carbon price (not required but recommended)	€ (2010 price)/t CO2	10.00	17.00	27.00	37.00

Differences to the fifth National Communication

The Romania economic development is strongly linked to the worldwide and EU economic development, and complex international environment affected by the global economic-financial crisis.

It is important to underline that the fifth National Communication was achieved on the basis of economic scenarios which didn't consider the deep transformations in economic and social conditions, due to world crisis.

So, considering the achievements in the period 2010÷2013, the assumptions of macroeconomic and energy indicators used for the GHG emissions projections for the period 2010 ÷ 2020 are optimist. In these conditions, the GHG projections emissions for the period 2015 ÷ 2020 is expected to be overestimated.

For this reason, in the present report, the economic and technical scenarios, the additional policies and measures considered are revised. For the projection, in order to reduce the uncertainties, the last reported data were considered for the base year (2011), submitted to

UNFCCC. The improvement obtained in achievement of the Romanian Inventory Report will ensure an important support in projection activity, in special for non-energy sectors.

V.A.4. Emission projections by sector and by gas

V.A.4.1 Sector Energy (CRF Source Category 1)

The sector energy covers the subsectors *1.A The Fuel Combustion, 1.B Fugitive Emissions, 1.C International bunker*.

In the table V_17 are presented the projected GHG emissions for Energy sector, by gas, for two scenarios (WEM, WAM).

Subchapter V.D.2.1 presents in details the key hypotheses to determine these emissions taking into consideration adopted policies and measure.

Table V_ 17 *The projections of GHG emissions for Energy sector, by gas*

	Emissions, in Gg CO_2 equiv.				
	2011	**Scenario with measures**		**Scenario with additional measures**	
		2015	**2020**	**2015**	**2020**
CO_2	76,903.03	75,203.68	79.354.96	73,613.65	78,361.13
CH_4	8,899.59	8,614.83	9548,91	8,440.95	9,374.4
N_2O	517.7	508.4	545.6	496.0	542.5
TOTAL	**86,320.46**	**84,326.23**	**89,450.61**	**82,550.33**	**88,217.64**

In the scenario WEM, the GHG emissions from Energy sector will decrease by 2.4% in the period 2011÷2015 and will increase by 6% between 2015÷2020. GHG emissions are expected to reach 89.5 Tg $CO_{2\ equiv}$, in 2020. The major contribution for emissions decreasing during the period 2011 ÷ 2015 is mainly due to the sector energy industries, as a result of the achievement of the renewable programme. The major contribution to the increasing emissions in the period 2015 ÷ 2020 is made by the subsectors manufacturing industries and transport.

In the scenario WAM, the emissions will decrease by 4.5% in the period 2011 ÷ 2015 and will increase by 6.8% in the period 2015 ÷ 2020. GHG emissions are expected to reach 88.2 Tg $CO_{2\ echiv}$, in 2020.

The projected GHG emissions for subsector "Combustion Fuel" (1.A), for different subsectors, are presented in the table V_18.

Subchapter V.D.2 presents in details the key hypotheses to determine these emissions taking into consideration adopted policies and measures for energy sector (development of the electricity generation sector, energy consumption in manufacturing industries and construction, transport sector, commercial sector, residential sector, agriculture sector)

***Table V_ 18** The projections of GHG emissions for subsector "Fuel Combustion"*

	Emissions, in Gg CO_2 equiv.				
	2011	Scenario with measures		Scenario with additional measures	
		2015	2020	2015	2020
Energy industries (1.A.1)	36,621.90	31,767.45	31,963.89	31,767.45	31,571.07
Manufacturing industries and construction (1.A.2)	15,761.24	15,530.91	17,185.11	15,365.54	17,019.73
Transport (1.A.3)	14,577.72	16,695.78	18,322.78	15,466.93	18,095.49
Commercial (1.A.4.a)	2,085.01	3,257.00	3,408.50	3,220.58	3,344.26
Residential (1.A.4.a)	7,118.38	7,633.31	8,176.15	7,507.47	8,050.30
Agriculture (1.A.4.a)	999.76	958.21	1,032.02	921.93	959.45
Other (1.A.5)	603.48	366.33	429.60	366.33	429.60
TOTAL	**77,767.49**	**76,209.00**	**80,518.04**	**74,616.23**	**79,469.91**

Differences to the fifth National Communication

The GHG emissions projections submitted in the fifth communication are overestimated, as a result of neglecting the impact of economic crisis and the implementation of the programmes for efficient use of energy and for using the renewable resources. So, GHG emissions of energy industries (1.A.1) are about 80 Tg $CO_{2\ equiv.}$ in the fifth communication, in comparison with 31.8Tg $CO_{2\ equiv.}$, as part of this communication.

V.A.4.2 Subsector Manufacturing Industries and Construction (CRF Source Category 1.A.2)

The projected GHG emissions for subsector Manufacturing Industries and Construction, by gas, for two scenarios (WEM, WAM) are presented in the table V_19.

***Table V_ 19** The projections of GHG emissions for Manufacturing Industries and Construction sector, by gas*

	Emissions, in Gg CO_2 equiv.				
	2011	Scenario with measures		Scenario with additional measures	
		2015	2020	2015	2020
CO_2	15,663.12	15,471.21	17,119.08	15,306.67	16,954.54
CH_4	41.58	27.93	30.87	27.76	30.77
N_2O	55.8	31.0	34.1	31.11	34.42
TOTAL	**15,761.24**	**15,530.91**	**17,185.11**	**15,365.54**	**17,019.73**

In the scenario WEM, the GHG emissions from Manufacturing Industries and Construction subsector will decrease by 1.5% in the period 2011÷2015 and will increase by 10.6% between 2015 ÷ 2020. GHG emissions are expected to reach 17.2 Tg $CO_{2\ equiv.}$ in 2020. The major contribution to the decreasing of emissions in the period 2011÷ 2015 is the result of implementation of the energy efficiency programmes and the restructuring of industries due to the crisis. The major contribution to the increasing emissions in the period 2015 ÷ 2020 is the beginning of economic growth.

In the scenario WAM, the emissions will decrease by 3.0% in the period 2011 ÷ 2015 and will increase by 10.8% in the period 2015 ÷ 2020.GHG emissions are expected to reach 16.9Tg CO_2 equiv. in 2020.

Differences to the fifth National Communication

The GHG emissions projections submitted in the fifth communication are overestimated, as a result of neglecting the impact of economic crisis and the implementation of the programmes for efficient use of energy.

V.A.4.3 Subsector Transport (CRF Source Category 1.A.3)

The projected GHG emissions for Transport subsector, by gas, for two scenarios (WEM, WAM) are presented in the table V_20.

Table V_ 20 *The projections of GHG emissions for Transport sector, by gas*

	Emissions, in Gg CO_2 equiv.				
	2011	**Scenario with measures**		**Scenario with additional measures**	
		2015	**2020**	**2015**	**2020**
CO_2	14,402.08	16,501.61	18,109.51	15,287.04	17,884.73
CH_4	36.33	41.09	45.11	38.07	44.56
N_2O	139.5	153.08	168.15	141.82	166.20
TOTAL	**14,577.72**	**16,695.78**	**18,322.78**	**15,466.93**	**18,095.49**

In the scenario WEM, the GHG emissions from Transport subsector will increase by 14.5% with the annual average rate of 3.45% in the period 2011 ÷ 2015 and will increase by 9.7% between 2015 ÷ 2020 with the annual average rate of 2.35%. GHG emissions are expected to reach 18.3 Tg CO_2 equiv. in 2020. The major contribution to the increasing emissions in the period 2011÷ 2020 is the beginning of economic growth. The different annual average rates between periods 2011÷ 2015 and 2016 ÷ 2020, reflect the modernization of the transport sector (new vehicles EURO 5, use of bio fuels, etc).

In the scenario WAM, the emissions will increase by 4.8% in the period 2011 ÷ 2015 and will increase by 17.0% in the period 2015 ÷ 2020. GHG emissions are expected to reach 17.9 Tg CO_2 equiv. in 2020.

Differences to the fifth National Communication

The GHG emissions projections submitted in the fifth communication are overestimated, as a result of neglecting the impact of economic crisis, the implementation of current programmes for the modernization of the transport sector and the efficient use of the fuels.

V.A.4.4 Subsector Others (CRF Source Category 1.A.4)

The projected GHG emissions for subsector Commercial (CRF 1.A.4.a), by gas, for two scenarios (WEM, WAM), are presented in the table V_21.

***Table V_ 21** The projections of GHG emissions for Commercial/Institutional subsector, by gas*

	Emissions, in Gg CO_2 equiv.				
	2011	**Scenario with measures**		**Scenario with additional measures**	
		2015	**2020**	**2015**	**2020**
CO_2	2,079.09	3,247.95	3,399.25	3,211.72	3,335.26
CH_4	4.19	6.49	6.72	6.39	6.57
N_2O	1.72	2.55	2.52	2.47	2.43
TOTAL	**2,085.01**	**3,257.00**	**3,408.50**	**3,220.58**	**3,344.26**

In the scenario WEM, the GHG emissions from Commercial/Institutional subsector will increase by 156.21% in the period 2011 ÷ 2015 and will increase by 4.7% between 2016 ÷ 2020 with the annual average rate of 1.15%. GHG emissions are expected to reach 3.4 Tg $CO_{2\ equiv}$. in 2020. The major contribution to the increasing emissions in the period 2011÷ 2015 is the beginning of economic growth.

In the scenario WAM, the emissions will increase by 154.40% in the period 2011 ÷ 2015 and will increase by 10.4% in the period 2015 ÷ 2020. GHG emissions are expected to reach 3.3 Tg $CO_{2\ equiv.}$ in 2020.

Differences to the fifth National Communication

The GHG emissions projection for this subsector is presented for the first time, considering the data reported in the NIR.

The projected GHG emissions for subsector Residential (CRF 1.A.4.b), by gas, for two scenarios (WEM, WAM), are presented in the table V_22.

***Table V_ 22** The projections of GHG emissions for Residential subsector, by gas*

	Emissions, in Gg CO_2 equiv.				
	2011	**Scenario with measures**		**Scenario with additional measures**	
		2015	**2020**	**2015**	**2020**
CO_2	6,104.91	6,522.27	6,953.88	6,396.71	6,828.32
CH_4	846.40	928.53	1,020.85	928.32	1,020.63
N_2O	167.08	182.51	201.42	182.44	201.35
TOTAL	**7,118.38**	**7,633.31**	**8,176.15**	**7,507.47**	**8,050.30**

In the scenario WEM, the GHG emissions from Residential subsector will increase by 7.2% in the period 2011 ÷ 2015 and will increase by 7.1% between 2016 ÷ 2020, with the annual average rate of 1.74%. GHG emissions are expected to reach 8,2 Tg $CO_{2\ equiv.}$ in 2020. The major contribution to the increasing emissions in the period 2011÷ 2020 is the beginning of economic growth and the increasing of life level.

In the scenario WAM, the emissions will increase by 5.4% in the period 2011 ÷ 2015 and will increase by 7.2% in the period 2015 ÷ 2020. GHG emissions are expected to reach 8.05 Tg $CO_{2\ equiv.}$ in 2020.

Differences to the fifth National Communication

The GHG emissions projection for this subsector is presented for the first time, considering the data reported in the NIR.

The projected GHG emissions for subsector Agriculture (CRF 1.A.4.c), by gas, for two scenarios (WEM, WAM), are presented in the table V_23.

Table V_ 23 *The projections of GHG emissions for Agriculture/Forest/Fisheries subsector, by gas*

	Emissions, in Gg CO_2 equiv.				
	2011	**Scenario with measures**		**Scenario with additional measures**	
		2015	**2020**	**2015**	**2020**
CO_2	991.38	946.18	1,018.92	910.09	946.74
CH_4	5.92	8.80	9.62	8.70	9.41
N_2O	2.46	3.22	3.48	3.13	3.31
TOTAL	**999.76**	**958.21**	**1,032.02**	**921.93**	**959.45**

In the scenario WEM, the GHG emissions for this subsector decrease by 4.3 % in the period 2011 ÷ 2015 and will increase by 7.7% between 2016 ÷ 2020. GHG emissions are expected to reach 1.0 Tg $CO_{2\ equiv.}$ in 2020. The major contribution to the increasing of emissions in the period 2015 ÷ 2020 is the economic growth.

In the scenario WAM, the emissions will decrease by 8.4% in the period 2011 ÷ 2015 and will increase by 4.1% in the period 2015 ÷ 2020. GHG emissions are expected to reach 0.96 Tg $CO_{2\ equiv.}$ in 2020.

Differences to the fifth National Communication

The GHG emissions projection for this subsector is presented for the first time, considering the data reported in the NIR.

In the table V_24 are presented the projected GHG emissions for Others subsector (CRF 1.A.4) by gas for two scenarios (WEM, WAM).

Table V_ 24 *The projections of GHG emissions for subsector Others, by gas*

	Emissions, in Gg CO_2 equiv.				
	2011	**Scenario with measures**		**Scenario with additional measures**	
		2015	**2020**	**2015**	**2020**
CO_2	9,175.38	10,716.40	11,372.05	10,518.52	11,110.32
CH_4	856.51	943.83	1037.19	943.41	1036.61
N_2O	171.26	188.29	207.43	188.05	207.09
TOTAL	**10,203.15**	**11,848.52**	**12,616.67**	**11,649.98**	**12,354.02**

In the scenario WEM, the GHG emissions from subsector Others will increase by 16.8% in the period 2011 ÷ 2015 and by 23.9% between 2015 ÷ 2020. GHG emissions are expected to reach 12.6 Tg $CO_{2\ equiv.}$ in 2020. The major contribution to the increasing emissions in the period 2011÷ 2020 is the beginning of economic growth and the increasing of level of life.

In the scenario WAM, the emissions will increase by 14.2% in the period 2011 ÷ 2015 and by 6.0% in the period 2015 ÷ 2020. GHG emissions are expected to reach 12.4 Tg CO_2 equiv. in 2020.

Differences to the fifth National Communication

The GHG emissions projections submitted in the fifth communication are overestimated, as a result of neglecting the impact of economic crisis and the implementation of the programmes for efficient use of energy.

The new methodology used for the GHG emissions projections by subsectors considered the impact of the measures adopted for modernization and restructuring.

V.A.4.5 Sector Industrial Processes (CRF Source Category 2)

The projected GHG emissions for Industrial Processes, by gas, for two scenarios (WEM, WAM) are presented in the table V_25.

Subchapter V.D.3 presents in details the assumptions related with the policies and measures adopted in different scenarios in industry sector.

Table V_ 25 *The projections of GHG emissions for Industrial Processes, by gas*

	Emissions, in Gg CO_2 equiv.				
	2011	**Scenario with measures**		**Scenario with additional measures**	
		2015	**2020**	**2015**	**2020**
CO_2	10,909.47	12,647.00	15,722.62	12,647.00	15,722.62
CH_4	13.58	12.11	12.98	12.11	12.98
N_2O	1,209.81	1,079.59	1,157.24	1,079.59	1,157.24
HFC	440.55	540.80	690.22	540.80	690.22
PFC	10.92	11.15	14.23	11.15	14.23
SF_6	7.21	5.58	7.12	5.58	7.12
TOTAL	**12,591.53**	**14,296.23**	**17,604.41**	**14,296.23**	**17,604.41**

In the scenario WEM, the GHG emissions from Industrial Processes will increase by 13,5% in the period 2011 ÷ 2015 and by 23.1% between 2015 ÷ 2020, with the annual average rate of 4.25%. GHG emissions are expected to reach 17.6 Tg CO_2 equiv. in 2020. The major contribution to the increasing emissions in the period 2011÷ 2015 is the beginning of economic growth.

The scenario WAM shows the same GHG emissions like in scenario WEM.

Differences to the fifth National Communication

The GHG emissions projections submitted in the fifth communication are overestimated, as a result of neglecting the impact of economic crisis and the implementation of the programmes related to the economic growth after this crisis.

The new methodology used for the achievement of the GHG emissions projections by subsectors (Mineral Products, Chemical Industry, Metal Production, Aluminium production, etc) can take into consideration the impact of the measures adopted for modernization and restructuring of these subsectors.

V.A.4.6 Sector Solvent and Other Product Use (CRF Source Category 3)

The projected GHG emissions for Solvent and other Product Use, by gas, for two scenarios (WEM, WAM), are presented in the table V_26.

Subchapter V.D.4 presents in details the assumptions related to the policies and measures adopted in different scenarios.

Table V_ 26 ***The projections of GHG emissions for Solvent and other Product Use, by gas***

	Emissions, in Gg CO_2 equiv.				
	2011	**Scenario with measures**		**Scenario with additional measures**	
		2015	**2020**	**2015**	**2020**
CO_2	125.61	130.36	144.20	128.91	142.60
CH_4	-	-	-	-	-
N_2O	-	-	-	-	-
TOTAL	**125.61**	**130.36**	**144.20**	**128.91**	**142.60**

In the scenario WEM, the GHG emissions from Solvent and Other Product Use will increase by 14.8% in the period 2011÷ 2020, with the annual average rate of 1.5%. GHG emissions are expected to reach 144.2 Gg $CO_{2\ equiv}$. in 2020.

Differences to the fifth National Communication

The GHG emissions projections submitted in the fifth communication are overestimated, as a result of neglecting the impact of economic crisis and the implementation of the programmes related to the economic growth after this crisis.

V.A.4.7 Sector Agriculture (CRF Source Category 4)

The projected GHG emissions for sector Agriculture, by gas, for two scenarios (WEM, WAM), are presented in the table V_27.

Subchapter V.D.5 presents in details the assumptions related to the policies and measures adopted in different scenarios.

Table V_ 27 The projections of GHG emissions for Agriculture, by gas

	Emissions, in Gg CO_2 equiv.				
	2011	**Scenario with measures**		**Scenario with additional measures**	
		2015	**2020**	**2015**	**2020**
CO_2	-	-	-	-	-
CH_4	8,616.63	8,848.98	8,897.91	8,648.22	8,483.37
N_2O	10,324.83	10,738.40	11,984.60	10,738.40	11,054.60
TOTAL	**18,941.46**	**19,587.38**	**20,882.51**	**19,386.62**	**19,537.97**

In the scenario WEM, the GHG emissions from sector Agriculture will increase by 10.2%, with the annual average rate of 1.1% in the period 2011 ÷ 2020. GHG emissions are expected to reach 20.9 Tg $CO_{2\ equiv.}$ in 2020.

In the scenario WAM, the emissions will increase by 3.1% in the period 2011 ÷ 2020. GHG emissions are expected to reach 19.5 Tg $CO_{2\ equiv.}$ in 2020.

Differences to the fifth National Communication

The GHG emissions projections submitted in the fifth communication are overestimated, as a result of neglecting the impact of economic crisis and the implementation of current programmes for the modernization of agriculture.

The new methodology used for the achievement of the GHG emissions projections by subsectors (Enteric Fermentation, Manure Management, etc) can take into consideration the impact of the measures adopted for modernization these subsectors.

V.D.4.8. Sector Land use, Land-use Change and Forestry (CRF Source Category 5)

The projected GHG emissions for Land use, Land-use Change and Forest, for two scenarios (WEM, WAM), are presented in the table V_28.

Subchapter V.D.6 presents in details the assumptions related with the policies and measures adopted in different scenarios.

Table V_ 28 *The projections of GHG emissions for Land use, Land-use Change and Forest*

	Emissions, in Gg CO_2 equiv.				
	2011	**Scenario with measures**		**Scenario with additional measures**	
		2015	**2020**	**2015**	**2020**
Forest Land	-23,353.01	-14,103.51	-15,068.92	-13,630.51	-13,081.98
Cropland	-3,199.47	-4,960.94	-5,404.55	-5,692.42	-6,054.73
Grassland	132.62	37.19	-67.42	37.19	-67.42
Wetlands	-130.10	-201.59	-197.87	-201.59	-197.87
Settlements	409.76	494.37	506.01	494.37	506.01
Other Land	835.26	1,038.57	1,040.23	1,038.57	1,040.23
TOTAL	**-25,304.94**	**-17,695.90**	**-19,192.52**	**-17,954.39**	**-17,855.75**

The net quantity of CO_2 absorbed is reduced each year under scenario S3-WAM and highest under scenario S1-WOM. Characteristic is the fact that over time, the annual intake decreases under all scenarios, but the general trend is decreasing even for S1-WOM.

This decrease is related to the reduction of current growth of the forests together with its aging (reinforced by the results of a simulation were provided no wood harvesting but the effect of aging decreases the annual absorption but reaches an annual level equivalent to S2-WEM and S3-WAM much later, around the years 2050÷2070) and that the age structure changes shortly by the appearance of large areas of forest in the youngest age class with very small growths.

In addition, increasing the harvest of wood result shortly in changes of the structure of forests and thus the annual growth is reduced, which explains the reduction of the net amount of CO_2 stored per year. In fact, immediately after the application of a higher annual harvest by about 50%, a reduction in the annual amount of the net average absorbed and stored in forests.

Reducing to zero the amount of annual net quantities would mean cutting the whole current forest growth that year, an unaccepted forestry practice given the exposure to non-sustainability through the structure of the forest fund. However, achieving this threshold by accident is not associated immediately with non-sustainability, but this risk is significant for maintaining yields at very close level or to a higher annual growth of the forest.

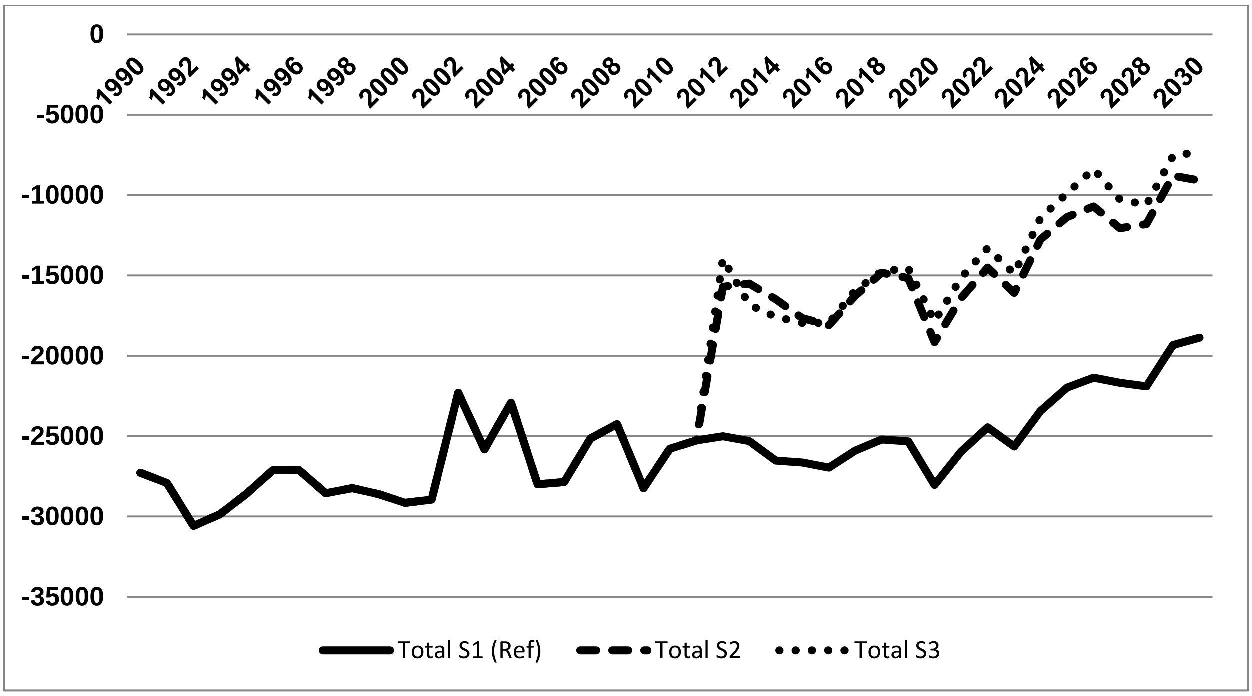


Figure V_A_ 5 *Graphical design of the three scenarios (S1-WOM, S2-WEM,S3-WAM) [Gg CO_{2eq}.]*

S-WEM and S-WAM scenarios depend on the increasing harvested wood volume from forests, heavily dependent on actions to strengthen national capacity of harvesting and processing of wood, opening of new forest roads, strengthening the capacity of the forestry regime, to clarify the objectives of production/protection, but also to communicate to the general public and explain the reasons of the need to increase the harvest. Such an option is sustained by the harvests before 1990 when the forests were managed more intensive but absolutely within the limits of sustainability. Deforestation is extremely reduced in the last 20 years, the annual average is about 200 hectares from 1990 till 2011, and as a result it is considered as not having a major contribution to the projections.

Differences to the fifth National Communication

The GHG emissions projections submitted in the fifth communication are overestimated in comparison with present projections.

The used methodology is changed for the achievement of the GHG emissions projections, considering all subcategories, in correlation with the data reported in the NIR.

V.D.4.9. Sector Waste (CRF Source Category 6)

The projected GHG emissions for sector Waste, by gas, for two scenarios (WEM, WAM), are presented in the table V_29.

Subchapter V.D.7 presents in details the assumptions related with the policies and measures adopted in different scenarios.

Table V_ 29 *The projections of GHG emissions for Waste sector, by gas*

	Emissions, in Gg CO_2 equiv.				
	2011	Scenario with measures		Scenario with additional measures	
		2015	2020	2015	2020
CO_2	10.56	11.70	13.31	11.70	13.31
CH_4	4,728.44	4,507.44	4,130.91	4,095.42	3,690.75
N_2O	627.48	675.53	684.84	675.53	684.84
TOTAL	**5,366.48**	**5,194.68**	**4,829.07**	**4,782.66**	**4,388.91**

In the scenario WEM, the GHG emissions from sector Waste will decrease by 11.1%, with the annual average rate of 1.18% in the period 2011÷ 2020. GHG emissions are expected to reach 4.8 Tg $CO_{2\ equiv.}$ in 2020.

In the scenario WAM, the emissions will decrease by 22.2% in the period 2011 ÷ 2020. GHG emissions are expected to reach 4.4 Tg $CO_{2\ equiv.}$ in 2020.

Differences to the fifth National Communication

The GHG emissions projections submitted in the fifth communication are overestimated, as a result of neglecting the impact of economic crisis and the implementation of the current programmes for waste management.

The new methodology used for the achievement of the GHG emissions projections by subsectors (Solid Waste Disposal on Land, Waste-water Handling) can take into consideration the impact of the measures adopted for modernization these subsectors.

V.B. Assessment of aggregate effects of policies and measures

Chapter 4 presents a comprehensive list of policies and measures included in the Romanian Strategy of Sustainable Development and Climate Change Strategy. Implemented and adopted policies and measures represent an important part of these strategies. It has to be mentioned, however, that the responsibilities for climate change mitigation are performed by different central authorities, which influence the coherent monitoring and evaluation of the effects of policies and measures.

The approach to establish the total effect of planned policies and measures is to take the difference of GHG emissions obtained in scenario WEM and ones obtained in scenario WOM.

The aggregated effect of planned policies and measures, by sectors and by gas, is presented in the table V_30

Table V_ 30 *Aggregate effect of planned policies and measures*

Sector	GAS	Aggregate effect, Gg $CO_{2\ echiv.}$	
		2015	**2020**
Energy	CO_2	534.57	1,327.02
	CH_4	943.53	1,183.56
	N_2O	-	-
	GHG	1,489.22	2,408.22
Industrial Processes	CO_2	485.15	520.05
	CH_4	2.1	2.31
	N_2O	195.3	207.7
	GHG	681.65	730.68
Agriculture	CO_2	-	-
	CH_4	-	834.75
	N_2O	930.0	1550,0
	GHG	930.0	2,384.75
Waste	CO_2	-	-
	CH_4	1,337.49	2,072.07
	N_2O	-	-
	GHG	1,337.49	2,072.07
TOTAL	**GHG**	**4,440.74**	**7,599.0**

V.C. Supplementary related to mechanism under article 6, 12 and 17 of the Kyoto Protocol

According to the most recent NIR (2013), Romania is achieving the target established through the Kyoto Protocol without making use of the provisions in Article 6, 12, or 17 of the previously mentioned Protocol; therefore, so far, the emissions reduction have happened only applying domestic policies and measures.

On the other hand, Romania successfully participates in the development of "Joint Implementation" projects based on the cooperation with different countries, as host country.

So far, Romania signed 10 Memorandum of Understanding with different Annex I countries (Switzerland, the Netherlands, Norway, Denmark, Austria, Sweden, France, Italy and Finland) as well with the World Bank for the Prototype Carbon Fund (PCF), establishing the legal framework for developing Joint Implementation projects. Under these Memorandums a number of 23 Jl projects have received the Letter of Approval, and they are currently in different stages of development (table V_31).

Table V_ 31 *List of Jl projects approved in Romania*

No. crt.	Jl projects	Project Type	Agreement
1	Afforestation of 7000 ha degraded agricultural lands	Afforestation	World Bank - PCF
2	"Sawdust 2000" - DHSs on biomass - Int. Buzăului, Vlahita Huedin, Gheorghieni, V.Domei	Fuel switching/ Renewable	Denmark
3	Geothermal energy use in DHSs of Oradea-area 2 and Beius	Renewable	Denmark
4	Rehabilitation of District Heating System in Fagaras	Energy Efficiency	Norway
5	Landfill gas recovery in Focşani city	Waste	Denmark
6	Landfill gas recovery in Targu Mureş city	Waste	Denmark
7	Landfill gas recovery in 4 cities (Oradea, Baia Mare, Satu Mare, Sf. Gheorghe)	Waste	Netherlands
8	Biomass use for energy production in Neamţ County	Renewable	Denmark
9	Modernization of 3 units in Porţile de Fier I Power Plant	Energy Efficiency	Netherlands
10	Modernization of 4 units in Porţile de Fier I Power Plant	Energy Efficiency	Netherlands
11	Upgrading of Alesd and Câmpulung cement plants	Energy Efficiency	Netherlands
12	Rehabilitation of CET Timişoara Sud	Energy Efficiency	Sweden
13	Improving efficiency for stearn boilers in Holboca CHP II laşi	Energy Efficiency	Denmark
14	Municipal Cogeneration at CET Targoviste	Energy Efficiency	Netherlands
15	Efficiency improvement in DHS of Dr. Turnu -Severin	Energy Efficiency	Denmark
16	Rehabilitation of Timişoara Centru CHP	Energy Efficiency	BERD
17	Emission Reduction of N_2O at SC Nitroporos SRL	Chemicals	Sweden
18	Emission Reduction of N_2O at SC Chemgas Holding Corporation SRL	Chemicals	Sweden
19	Emission Reduction of N_2O at SC Azomures SA	Chemicals	France
20	Emission Reduction of N_2O at SC Donau Chem SRL	Chemicals	Netherlands
21	Wind Park Casimcea-Alpha	Renewable	Austria
22	Wind Park Dorobantu	Renewable	Austria
23	Wind Park Babadag, Tulcea	Renewable	France

The total amount of emission reduction planned to be generated in the period 2008 ÷ 2012 by these projects is about 13 million tons of $CO_{2\ equivalent}$. The projects are mainly developed in the local authorities' area, such as: district heating systems (including the use of renewable energy sources –

sawdust and geothermal energy), closing up of urban waste landfills. These investments have a positive impact not only by GHG emissions reductions, but also for the environment generally or from social point of view (providing of comfortable conditions at reasonable prices).

In respect to Art. 17 of the Kyoto Protocol, Romanian Government adopted GD no. 432/2010 which represents institutional and legislative framework for the initiation and the development of „Green Investment Scheme" (GIS). GIS is a mechanism linking the sales of AAUs for implementation of projects and programs focusing on GHG emissions reduction and adaptation to climate change (so called „greening").

So, support scheme proposed by Romanian State and approved by European Commission is based on green certificates and compulsory quota. This support schema given from the end of year 2011 for solar and wind investments is the most generous from Europe.

In February 2013, Romanian Government modified. GD no. 432/2010 through GD no. 48/2013, taking into consideration the increased cost of the electricity. So, almost half of the increasing the electricity invoice (10% for 2013) is due to the support scheme for green investments.

V.D. Methodology used for the presented GHG emission projections

V.D.1 Introduction

The methodology for GHG projections relies both on historical data provided by the National GHG Inventory, for the period 1989÷2011 and on macroeconomic indicators forecasts, indicators considered in the Romanian Government's relevant strategies and for the socio-economic policies, considering the adopted EU Directives.

Taking into consideration that the Energy sector is the main GHG source, with approximately 70% from total emissions, according to the National GHG Inventory; therefore, the GHG projections were determined for Energy sector and non-energy sectors.

The GHG emissions projections and also the evaluation of alternatives to reduce the emissions is particularly difficult, and therefore are used special programs that allow to identify the sectors of importance to GHG emissions, in relation to economic and social development of the country.

Non-energy sectors of the economy that contribute to GHG emissions are:

- Forestry - in terms of atmospheric carbon sequestration options;
- Agriculture - to assess CH_4 emissions from livestock digestion and manure fermentation and N2O emissions from the application of nitrogen fertilizers;
- Industry - to assess emissions from industrial processes;
- Solvents and other products;

- Solid and liquid waste management for assessing the CH_4, N_2O and CO_2 emissions.

V.D.2. Methodology for the Energy sector

The GHG forecasts for the Energy sector were established considering the energy demand subsector (industry, transport, agriculture, household and commercial consumption) and the supplying sub-sector (primary energy resources extraction, conversion in refineries, thermo-electric power plants, thermal power plants, transport and distribution of energetic products to consumers).

The projections are based on calculations carried out using the ENPEP (Energy and Power Evaluation Program) programs package, developed by Argonne National laboratory of US Department of Energy (DOE) and distributed to Romania by the International Atomic Energy Agency (IAEA) to perform an integrated energy analysis, economic and environmental.

The software package includes 9 modules, presented in Figure V_D_5. The main modules used in the study are:

- MAED is a simulation model designed for evaluate medium and long-term demand for energy (motor fuel, fossil fuel, district heating, electricity, coke, feedstock) based on the macroeconomic indicators evolution;
- ELECTRIC - determines the electricity power plants development programme considering the Romanian Government's adopted policies on renewable energy resources use, on ensuring the energy security, on technological evolution and on international market fuel prices;
- BALANCE module – determines the balance between energy demand – supply the entire system, including all the demand sectors and the supply sectors (oil, gas, coal, electricity, renewable, etc.) for every year of the study;
- IMPACTS – estimates, for the energetic system determined using the BALANCE module and for the electro-energetic system determined using the ELECTRIC module, the impact on atmosphere, water, soil, the impact of the specific waste, the impact on materials and labour needed for the installations construction and exploitation, the impact on related employees risk and health.

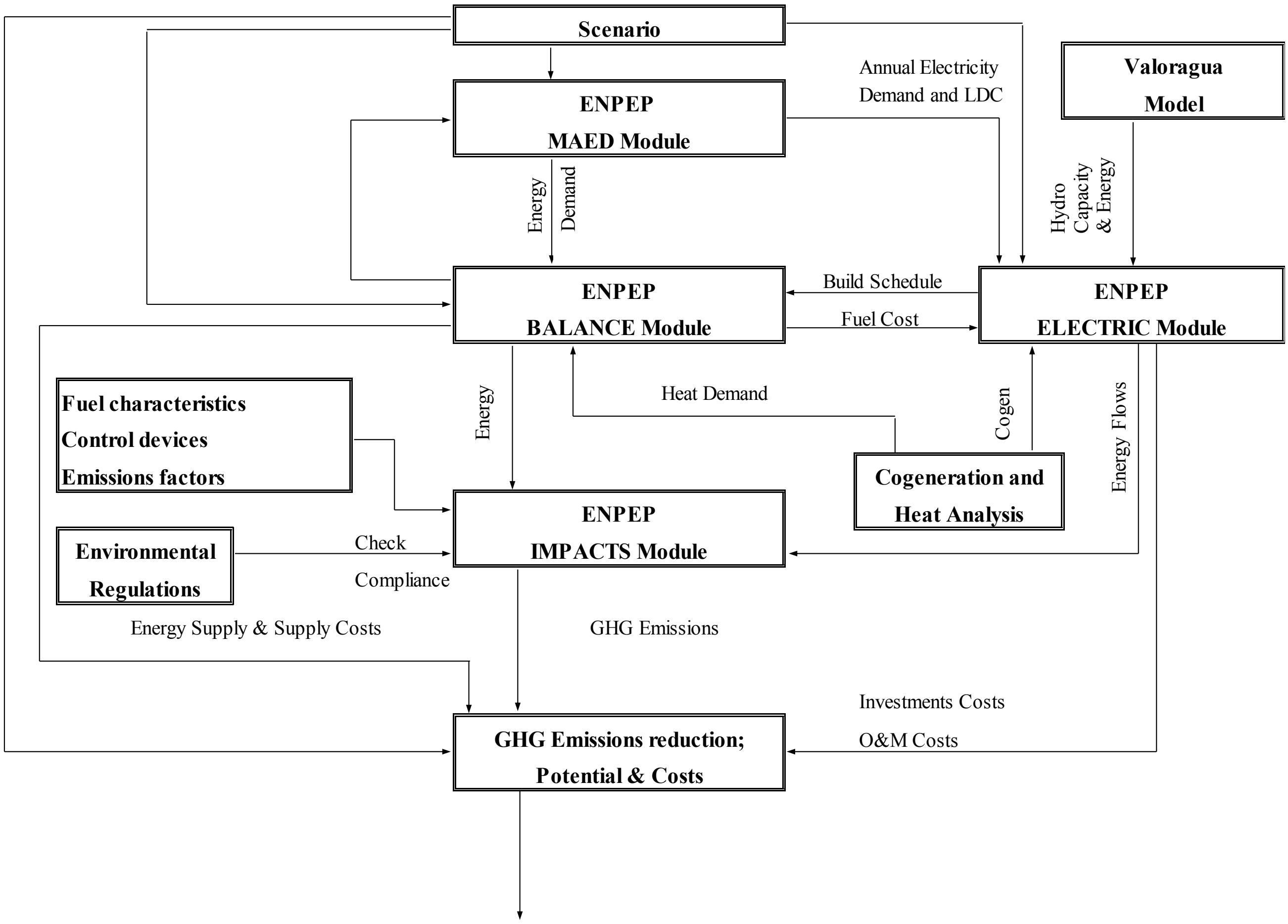


Figure V_D_ 1 *Integrated Modelling Framework for Assessment of GHG emissions and GHG Mitigation Options*

In order to allow the use of the modules package, a national energy balance has been prepared, considering the available or imported primary energy resources. Figure V_D_2 shows a simplified energy balance with four major elements:

- Primary energy resources;
- Primary energy resources conversion technologies;
- Transmission and distribution of energy products;
- Energy consumers

Each sector is modelled in detail, considering the technological processes and emission factors according to IPCC. Given this breakdown with the IMPACTS module the resulted GHG emissions are determined.

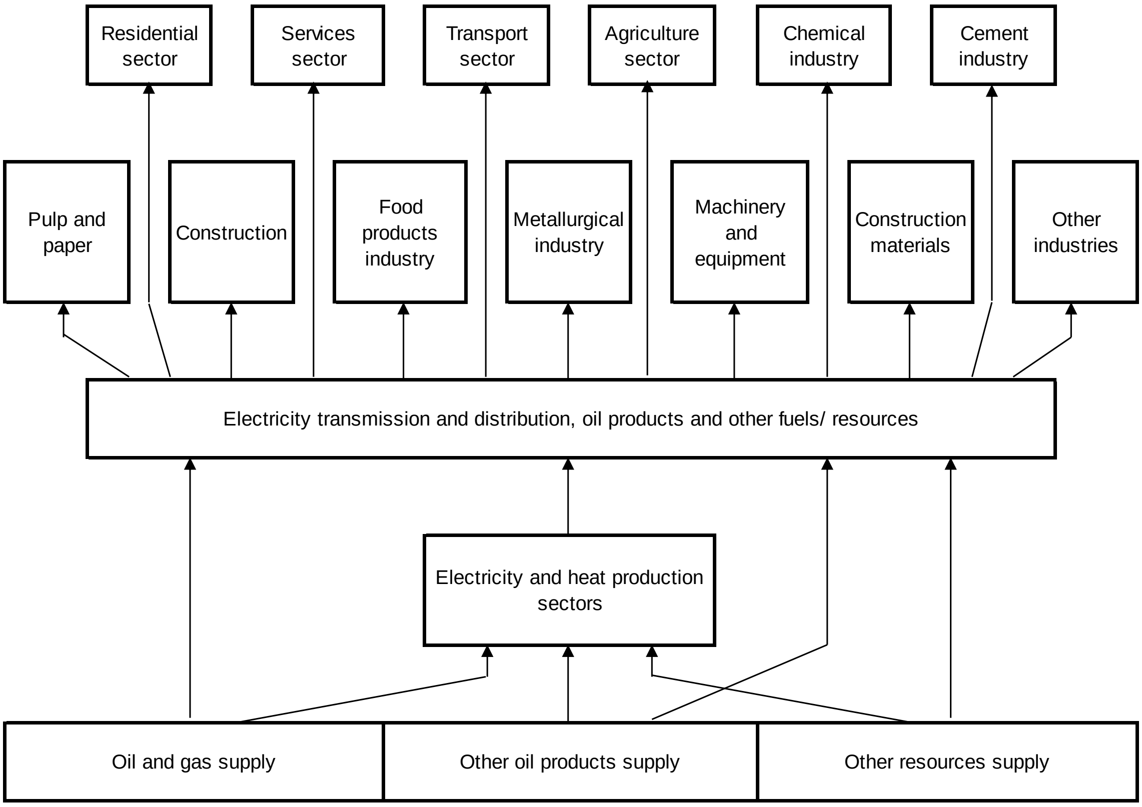


Figure V_D_ 2 *Romania's Energy Balance*

The software development ENPEP determine the total energy demand and energy types for the three scenarios without measures, with measures, and with additional measures as defined by IPCC sectors: electricity and heat production, refining, transport sector, industry, agriculture, construction, services, residential, etc., which allows the determination of GHG emission projections using emission factors defined by types of fuels.

V.D.2.1 Development of the electricity generation sector

In order to establish the program of development of the power plants for the period 2013 ÷ 2030, one considers the prognosis of the evolution of electric and thermal power consumption in cogeneration, the diversification of the resources of primary power, the reengineering and restoration, the modern technologies of production of electric and thermal power, the environment conditions.

The process of determining the structure of electricity generation during the period 2013 ÷ 2030 is extremely difficult due to the high degree of incertitude related to:

- The evolution of the electricity demand and of the rates of fuels on international markets;
- Conformity of the existent thermal-energetic groups to the environment conditions;

- The capacity of investors to implement the programs of investments stipulated in the National Plan of Investments, according to Article 10c of Directive 2009/29/CE, in the National Renewable Energy Action Plan (NREAP).

Due to this reason, different scenarios are examined related to the structure of electricity generation during the period 2013 ÷ 2030 with a view to consider different hypotheses related to the variations of key parameters influencing such structure.

The key hypotheses to define the scenarios are related to:

- Prognoses of the consumption of electricity;
- Diversification of the resources of primary energy used;
- Modern technologies of electricity and heating generation in cogeneration;
- Environment conditions;
- Situation of the energetic groups existent in NPS;
- Programs of investment of different companies in the country and abroad.

The calculations were performed considering the following values:

- % for the updating rate;
- 72 hours/10 year for the probability of loss of power (LOLP), representing the number of hours when power is not provided;
- 2.4 Euros/kWh for the cost of electricity not supplied, representing the margin cost of the electricity produced by a gas turbine of 90 MW for 24 hours/10 year.

In table V_32 is presented the scenarios updated in the sub-chapter.

The evolution of production of electricity during the period 2013 ÷ 2030 considered for determining the structure of the capacities of production within NPS, for the scenario of reference, is presented in table V_33.

Table V_ 32 Analysed scenarios

No.	Name of scenario	Characteristic hypothesis of scenario			
		Net generation of electricity covers the internal demand	**Fuel price**	**Achievement of investments**	**Fuel quantity**
1	**A.1 Reference**	From the table 5.33	average	In economic order	Without restrictions
2	**C.1**	From the table 5.33	average	Imposed hydro program HPP-345 MW	Without restrictions
3	**C.1.1**	From the table 5.33	average	Imposed hydro program HPP– 868 MW	Without restrictions
4	**C.2**	From the table 5.33	average	Imposed nuclear program Unit 3 and 4 NPP Cernavodă	Without restrictions
5	**C.3**	From the table 5.33	average	HPP-PS – 1000 MW from 2020	Without restrictions
6	**C.3.1**	From the table 5.33	average	HPP-PS – 500 MW up to 2030	Without restrictions
7	**C.3.2**	From the table 5.33	average	Imposed hydro program 868 MW, HPP-PS – 1000 MW	Without restrictions
8	**C.4**	From the table 5.33	average	Imposed wind power 3534 MW within the 2011 - 2020 period	Without restrictions
9	**C.4.1**	From the table 5.33	average	Imposed wind power 3534 MW (2011-2020), 1000 MW (2021 - 2030)	Without restrictions
10	**C.5**	From the table 5.33	average	Imposed thermal program 3050 MW in the period 2012-2020	Without restrictions
11	**C.6**	From the table 5.33	average	Imposed thermal power 3050 MW within the 2012 - 2020 period; imposed hydro power 868 MW, HPP-PS – 1000 MW	Without restrictions
12	**D.1**	From the table 5.33	average	Imposed thermal power	Consumption of lignite and bituminous coal from country according to the forecasted productions
13	**D.2**	From the table 5.33	average	Imposed thermo program Imposed hydro program Imposed wind program	Consumption of lignite and bituminous coal from country according to the forecasted productions

***Table V_ 33** Evolution of internal consumption and of the electricity generation within 2013 ÷ 2030 period*

Indicators	MU	2013	2014	2015	2020	2025	2030
Net electricity domestic consumption	TWh	61.9	63.3	64.9	73.8	82.3	89.9
Net electricity domestic consumption	TWh	57.06	58.41	59.9	68.1	75.9	83.0
Total of net electricity generation	TWh	60.1	61.4	62.9	71.6	79.4	86.4
Duration of use of peak power for the net domestic consumption	h/year	6210	6230	6200	6140	6070	6000
Peak power for net domestic consumption	MW	9188	9376	9661	11092	12509	13836

The reference scenario A.1 refers to the candidate power plant of all kinds (nuclear-electric, thermoelectric, hydroelectric, wind) in free competition, without restrictions, the selection order being the economic one for the inclusion in the load curve.

The scenario C.1 refers to a hydroenergetic program imposed during the period 2013÷2015, being installed groups with an overall power of 345 MW, the other candidate groups (nuclear-electric, thermoelectric, wind) being in free competition.

The scenario C.1.1 refers to a hydroenergetic program imposed during the period 2013 ÷ 2030 being installed groups with an overall power of 868 MW, out of which: 345 MW during the period 2013 ÷ 2015, 157 MW during the period 2016 ÷ 2020, 266 MW during the period 2021 ÷ 2025, 100 MW during the period 2026 ÷ 2030, the other groups being in free competition.

The scenario C.2 considers as restriction the limitation of the nuclear program only at CNE Cernavodă, being completed the groups 3 and 4, the other candidate groups being in free competition.

The scenario C.3 considers as restriction the achievement of the accumulation and pumping hydro power plant Tarniţa (HPP-PS) of 1000 MW with commissioning between 2019 ÷ 2020, the other candidate groups being in free competition.

The scenario C.3.1 considers, besides achievement HPP-PS Tarniţa of 1000 MW and the achievement of a new accumulation and pumping hydro power plant of 500 MW during the period 2025 ÷ 2030, the other candidate groups being in free competition.

The scenario C.3.2 considers the performance of HPP-PS of 1000 MW and a hydroenergetic program imposed of 868 MW during the period 2013 ÷ 2030, the other candidate groups being in free competition.

The scenario C.4 considers the performance of the wind program in conformity to NREAP, respectively: 2734 MW during the period 2011 ÷ 2015 and 800 MW during the period 2016 ÷ 2020, the other candidate groups being in free competition.

The scenario C.4.1 considers the performance of the wind program in conformity to NREAP and the performance of HPP-PS of 1000 MW, the other candidate groups being in free competition.

The scenario C.5 considers the performance of a thermal-energetic program during the period 2013 ÷ 2020, in conformity to the National Plan of Investments namely the installation of some new groups instead of those decommissioned, as follows:

- The group 500 MW on lignite, the supercritical parameters in Rovinari;
- The group 400 MW combined cycle with gas turbines in Fagăraş;
- The group 250 MW with gas turbines with fast start-up in Fântânele;
- The group 800 MW on coal from import, supercritical parameters in Brăila;
- The group 500 MW on lignite, supercritical parameters in Işalniţa;
- The group 200 MW on domestic coal, supercritical parameters in Paroşeni;
- The group 400 MW combined cycle with gas turbine in Iernut;

the other candidate groups being in free competition.

The scenario C.6 refers to a hydroenergetic program imposed of 3050 MW, the hydroenergetic program imposed of 868 MW and HPP-PS of 1000 MW, the other candidate groups being in free competition.

The scenario D.1 considers the achievement of thermal-energetic groups for the use of lignite and coal from the country in correlation with the prognoses of the productions of lignite and coal, the other candidate groups being in free competition.

The scenario D.2 considers the performance of a thermal-energetic, hydroenergetic, wind programs imposed, the other candidate groups being in free competition.

The analyses are performed considering both the incertitude related to the variation of the demand of electricity and thermal power and the evolution of rates on fuels. In table V_34 it is presented the prognosis of the rates of fuels during the period 2010 ÷ 2030, according to EC recommendations. The prognosis of the rates of fuels considered in the sensitivity analyses is presented in table V_35.

***Table V_ 34** Hypothesis on evolution of import fuels prices within the 2015 ÷ 2030 period, according to EC recommendations*

Fuel type	**Prices (in €2010/barrel equivalent oil)**			
	2015	**2020**	**2025**	**2030**
Crude oil	86.0	88.5	89.2	93.1
Natural gas	53.8	61.5	58.9	64.5
Coal	22.0	22.6	23.7	24.0
	Prices (in €2010/GJ)			
	2015	**2020**	**2025**	**2030**
Crude oil	15.05	15.50	15.62	16.30
Natural gas	9.42	10.77	10.32	11.39
Coal	3.85	3.96	4.15	4.20

Source: PROMETHEUS world energy modelling for the new EU reference scenario 2012, see E3M-Lab: 2012 PROMETHEUS WORLD ENERGY OUTLOOK Presentation for Member State consultation, Brussels 18/04/2012 (available on CIRCABC, CCC WG2)

***Table V_ 35** Fuel price forecasts for the period 2010 ÷ 2030*

Type of fuel	**MU**	**Scenario**	**Achieved price**	**Forecasted price**			
			2010	**2015**	**2020**	**2025**	**2030**
Natural gas	**Euro/GJ**	**Minimum**	6.77	7.00	9.71	10.35	11.01
		Maximum	-	7.96	11.06	11.80	12.06
		CE	-	9.42	10.77	10.32	11.39
Crude oil	**Euro/GJ**	**Minimum**	6.13	7.35	8.81	9.40	10.02
		Maximum	-				
		CE	-	15.05	15.50	15.62	16.30
Lignite	**Euro/GJ**	**Minimum**	1.64	1.58	1.51	1.625	1.755
		Maximum	-	2.08	2.36	2.68	2.89
		CE	-	-	-	-	-
Bituminous coal	**Euro/GJ**	**Minimum**	3.18	3.67	4.24	4.65	5.11
		Maximum	-	3.98	5.00	5.38	5.80
		CE	-	3.85	3.96	4.15	4.20

The program of development of the power plants proposed within the reference scenario results in the process of optimisation without restrictions, being a program with minimum costs. It must be emphasized the fact that such program is theoretical since it does no correspond to the realities from Romania and the conditions imposed in the European Union related to:

- Security of supply with electricity;
- Use of the individual resources of primary energy;
- Use of the resources of renewable power;
- Environmental protection.

Thus, during the period 2013 ÷ 2030 the imported quantity of fuels increases, decreasing significantly the degree of energetic independence (to around 20%). The program of development of electric substations during the period 2013 -÷ 2030 considers the installation of some groups totalizing a power of 10,239 MW namely:

- 1320 MW – corresponding to the groups 3 and 4 from CNE Cernavodă;
- 2400 MW – corresponding to 4 groups of 600 MW on coal from import;
- 2600 MW – corresponding to 2 nuclear groups of 1300 MW;
- 2000 MW – corresponding to some gas turbines with exhaust-heat boilers;
- 900 MW – corresponding to 9 groups with combined cycle with gas turbines of 100 MW;
- 1000 MW – corresponding to 5 gas turbines of 200 MW;
- 73 MW - corresponding to some hydroelectric stations.

The basic power is provided by the nuclear groups and the groups based on bituminous coal from import.

The structure of the new power proposed to be installed is presented in the table V_36. The value of the investment cumulated for such new groups is of 11.5 billion Euro.

The function objective cumulated for this scenario is of 24.4 billion Euro, the resulted costs of exploitation and maintenance cumulated during the period 2015 ÷ 2030 being around 51.3 billion Euro.

Table V_ 36 *Structure of new installed power*

Scenario	**Value of function objective**	**Period**	**New installed power, in MW**							
			TOTAL	**HPP**	**NPP**	**WPP**	**TPP on:**			
	bill.Euro						**TOTAL**	**Lignite**	**Bituminous coal**	**Natural gas**
A.1 Reference	24.4	2013-2015	1553	73	-	-	1480	-	600	880
		2016-2020	1620	-	1320	-	300	-	-	300
		2021-2025	2250	-	-	-	2250	-	1200	1050
		2026-2030	4870	-	2600	-	2270	-	600	1670
		2013-2030	**10293**	**73**	**3920**	**-**	**6300**	**-**	**2400**	**3900**
C.1 Imposed hydro program	24.6	2013-2015	1225	345	-	-	880	-	-	880
		2016-2020	2220	-	1320	-	900	-	-	900
		2021-2025	1550	-	-	-	1550	-	1200	350
		2026-2030	4870	-	2600	-	2270	-	1200	1070
		2013-2030	**9865**	**345**	**3920**	**-**	**5600**	**-**	**2400**	**3200**
C.1.1 Imposed hydro program P_i = 868MW	24.7	2013-2015	1225	345	-	-	880	-	-	880
		2016-2020	2377	157	1320	-	900	-	600	300
		2021-2025	1716	266	-	-	1450	-	600	850
		2026-2030	4770	100	2600	-	2070	-	600	1470
		2013-2030	**10088**	**868**	**3920**	**-**	**5300**	**-**	**1800**	**3500**
C.2 Imposed nuclear program	24.9	2013-2015	1553	73	-	-	1480	-	600	880
		2016-2020	1620	-	1320	-	300	-	-	300
		2021-2025	2250	-	-	-	2250	-	1200	1050
		2026-2030	3470	-	-	-	3470	-	1800	1670

Scenario	**Value of function objective**	**Period**	**New installed power, in MW**							
			TOTAL	**HPP**	**NPP**	**WPP**	**TPP on:**			
	bill.Euro						**TOTAL**	**Lignite**	**Bituminous coal**	**Natural gas**
		2013-2030	**8893**	**73**	**1320**	**-**	**7500**	**-**	**3600**	**3900**
C.3 HPP-PS-1000 MW din 2020	24.65	2013-2015	1553	73	-	-	1480	-	600	880
		2016-2020	2630	1000	1320	-	300	-	-	300
		2021-2025	1650	-	-	-	1650	-	1200	450
		2026-2030	4470	-	2600	-	1870	-	600	1270
		2013-2030	**10303**	**1073**	**3920**	**-**	**5300**	**-**	**2400**	**2900**
C.4 Imposed wind program P_i = 3534 MW	24.7	2013-2015	3414	-	-	2734	680	-	600	80
		2016-2020	2432	12	1320	800	300	-	-	300
		2021-2025	1650	-	-	-	1650	-	1200	450
		2026-2030	4531	61	2600	-	1870	-	600	1270
		2013-2030	**12027**	**73**	**3920**	**3534**	**4500**	**-**	**2400**	**2100**
C.4.1 Imposed wind program Pi= 4534 MW	24.7	2013-2015	3414	-	-	2734	680	-	600	80
		2016-2020	2432	12	1320	800	300	-	-	300
		2021-2025	2150	-	-	500	1650	-	1200	450
		2026-2030	4031	61	2600	500	870	-	600	270
		2013-2030	**12027**	**73**	**3920**	**4534**	**3500**	**-**	**2400**	**1100**
C.5 Imposed thermal program P_i = 3050 MW	25	2013-2015	1553	73	-	-	1480	-	600	880
		2016-2020	4370	-	1320	-	3050	1000	1000	1050
		2021-2025	900	-	-	-	900	-	600	300
		2026-2030	4670	-	2600	-	2070	-	600	1470
		2013-2030	**11493**	**73**	**3920**	**-**	**7500**	**1000**	**2800**	**3700**
C.6 Imposed thermal program P_i = 3050MW Hydro Pi= 868 MW 1000 MW	26.2	2013-2015	1525	345	-	-	1180	-	600	580
		2016-2020	5527	1157	1320	-	3050	1000	1000	1050
		2021-2025	566	266	-	-	300	-	-	300
		2026-2030	3470	100	1300	-	2070	-	600	1470
		2013-2030	**11088**	**1868**	**2620**	**-**	**6600**	**1000**	**2200**	**3400**
D1 Imposed thermal program on lignite	26.1	2013-2015	1432	52	-	-	1380	500	-	880
		2016-2020	2620	-	1320	-	1300	1000	-	300
		2021-2025	1850	-	-	-	1850	1000	-	850
		2026-2030	3970	-	1300	-	2670	1000	-	1670
		2013-2030	**9872**	**52**	**2620**	**-**	**7200**	**3500**	**-**	**3700**
D2 Imposed, thermal, hydro, wind program	26.9	2013-2015	4459	345	-	2734	1380	500	-	880
		2016-2020	4077	1157	1320	800	800	500	-	300
		2021-2025	2616	266	-	500	1850	1000	-	850
		2026-2030	4570	100	1300	500	2670	1000	-	1670
		2013-2030	**15722**	**1868**	**2620**	**4534**	**6700**	**3000**	**-**	**3700**

In accordance with this structure of the generating units, the structure of electricity generation is essentially modified in the 2015 ÷ 2030 period, according to the data presented in the table V_37.

***Table V_ 37** Electricity generation (TWh) per total of years and type of power plants*

Year	**Net electricity generation**	**Out of which :**						
		HPP	**NPP**	**WPP**	**TPP on:**			
					Lignite	**Bituminous coal**	**Hydrocarbon**	**Total**
Scenario A.1 – Reference – economic order, without restrictions								
2015	62.90	17.10	10.50	1.50	18.80	6.30	8.70	33.80
2020	71.60	17.10	20.40	1.50	15.90	6.50	10.20	32.60
2025	79.40	17.10	20.40	1.50	10.20	16.60	13.60	40.40
2030	86.40	17.10	31.20	1.50	2.50	18.80	15.30	36.60
Scenario C.1 – Imposed hydro program (P_i = 345 MW)								
2015	62.90	17.50	10.50	1.50	18.80	6.10	8.50	33.40
2020	71.60	17.80	20.40	1.50	15.90	6.20	9.80	31.90
2025	79.40	17.80	20.40	1.50	10.20	16.30	13.20	39.70
2030	86.40	17.80	31.20	1.50	2.50	18.40	15.00	35.90
Scenario C.1.1 – Imposed hydro program (P_i = 868 MW)								
2015	62.90	17.50	10.50	1.50	18.80	6.10	8.50	33.40
2020	71.60	18.50	20.40	1.50	15.90	6.20	9.10	31.20
2025	79,40	19,00	20,40	1,50	10,20	14,90	12,40	37,50
2030	86,40	19,80	31,20	1,50	2,50	16,60	14,80	33,90
Scenario C.2 – Imposed nuclear program – only 4 units at NPP Cernavodă								
2015	62.90	17.10	10.50	1.50	18.80	6.30	8.70	33.80
2020	71.60	17.10	20.40	1.50	15.90	6.50	10.20	32.60
2025	79.40	17.10	20.40	1.50	10.20	16.30	13.90	40.40
2030	86.40	17.10	20.40	1.50	2.50	28.00	16.90	47.40
Scenario C.3 – Hydro accumulation and pumping power plant of 1000 MW of 2020								
2015	62.90	17.10	10.50	1.50	18.80	6.30	8.70	33.80
2020	71.60	17.10	20.40	1.50	15.90	6.45	10.20	32.55
2025	79.40	17.10	20.40	1.50	10.20	16.55	13.60	40.35
2030	86.40	17.70	31.20	1.50	2.50	18.50	15.00	36.00
Scenario C.4 – Imposed wind program (Pi=3534 MW), in the 2012-2020 period								
2015	62.90	17.10	10.50	6.80	15.90	6.10	6.50	28.50
2020	71.60	17.10	20.40	8.40	10.10	6.50	9.10	25.70
2025	79.40	17.10	20.40	8.40	7.20	13.70	12.60	33.50
2030	86.40	17.10	31.20	8.40	2.50	14.10	13.10	29.70
Scenario C.4.1 – Imposed wind program (Pi = 4534 MW), in the 2013 - 2030 period								
2015	62.90	17.10	10.50	6.80	15.90	6.10	6.50	28.50
2020	71.60	17.10	20.40	8.40	10.10	6.50	9.10	25.70
2025	79.40	17.10	20.40	9.20	7.00	13.40	12.30	32.70
2030	86.40	17.10	31.20	10.10	2.50	13.70	12.00	28.00
Scenario C.5 – Imposed thermal program (Pi=3050 MW), in the 2012-2020 period								
2015	62.90	17.10	10.50	1.50	18.70	6.30	8.70	33.80
2020	71.60	17.10	20.40	1.50	19.40	6.70	6.50	32.60
2025	79.40	17.10	20.40	1.50	18.70	13.00	8.70	40.40

<table>
<tr><th rowspan="3">Year</th><th rowspan="3">Net electricity generation</th><th colspan="7">Out of which :</th></tr>
<tr><th rowspan="2">HPP</th><th rowspan="2">NPP</th><th rowspan="2">WPP</th><th colspan="4">TPP on:</th></tr>
<tr><th>Lignite</th><th>Bituminous coal</th><th>Hydrocarbon</th><th>Total</th></tr>
<tr><td>2030</td><td>86.40</td><td>17.10</td><td>31.20</td><td>1.50</td><td>10.40</td><td>17.10</td><td>9.10</td><td>36.60</td></tr>
<tr><td colspan="9">Scenario C.6. – Imposed thermal energy program (Pi=3050 MW), in the 2013 - 2020 period, Imposed hydro energetic program Pi = 868 MW, within the 2013 - 2030 period, HPP-PS 1000 MW în 2020</td></tr>
<tr><td>2015</td><td>62.90</td><td>17.50</td><td>10.50</td><td>1.50</td><td>18.80</td><td>6.10</td><td>8.50</td><td>33.40</td></tr>
<tr><td>2020</td><td>71.60</td><td>19.60</td><td>20.40</td><td>1.50</td><td>18.50</td><td>6.70</td><td>4.90</td><td>30.10</td></tr>
<tr><td>2025</td><td>79.40</td><td>19.80</td><td>20.40</td><td>1.50</td><td>18.50</td><td>11.70</td><td>7.50</td><td>37.70</td></tr>
<tr><td>2030</td><td>86.40</td><td>20.10</td><td>27.60</td><td>1.50</td><td>10.90</td><td>16.90</td><td>9.40</td><td>37.20</td></tr>
<tr><td colspan="9">Scenario D1. – Imposed thermal energy program for the domestic lignite and bituminous coal consumption</td></tr>
<tr><td>2015</td><td>62.90</td><td>16.90</td><td>10.50</td><td>1.50</td><td>23.80</td><td>1.50</td><td>8.70</td><td>34.00</td></tr>
<tr><td>2020</td><td>71.60</td><td>16.90</td><td>20.40</td><td>1.50</td><td>21.60</td><td>1.00</td><td>10.20</td><td>32.80</td></tr>
<tr><td>2025</td><td>79.40</td><td>16.90</td><td>20.40</td><td>1.50</td><td>26.80</td><td>1.20</td><td>12.60</td><td>40.60</td></tr>
<tr><td>2030</td><td>86.40</td><td>16.90</td><td>27.60</td><td>1.50</td><td>26.80</td><td>0.90</td><td>12.70</td><td>40.40</td></tr>
<tr><td colspan="9">Scenario D2. – Imposed thermal energy program for domestic lignite and bituminous coal consumption, Imposed hydroenergetic program (Pi = 868 MW), within the 2013 - 2030 period, Imposed wind program (Pi= 4534 MW)</td></tr>
<tr><td>2015</td><td>62.90</td><td>17.50</td><td>10.50</td><td>6.80</td><td>17.90</td><td>1.50</td><td>8.70</td><td>28.10</td></tr>
<tr><td>2020</td><td>71.60</td><td>18.50</td><td>20.40</td><td>8.40</td><td>14.80</td><td>1.00</td><td>8.50</td><td>24.30</td></tr>
<tr><td>2025</td><td>79.40</td><td>19.00</td><td>20.40</td><td>9.20</td><td>18.60</td><td>1.00</td><td>11.20</td><td>30.80</td></tr>
<tr><td>2030</td><td>86.40</td><td>19.80</td><td>27.60</td><td>10.10</td><td>16.50</td><td>0.90</td><td>11.50</td><td>28.90</td></tr>
</table>

In accordance with this structure of electricity generation, the structure of the used oils is also changed, according to the data presented in the table V_38.

Table V_ 38 *Quantity of fuel (mil .toe) for generation of electricity in the condensation and cogeneration plants*

<table>
<tr><th rowspan="2">Scenario</th><th rowspan="2">Fuel</th><th colspan="4">Year</th></tr>
<tr><th>2015</th><th>2020</th><th>2025</th><th>2030</th></tr>
<tr><td rowspan="5">A.1
- Economic order reference, without restrictions</td><td>Uranium</td><td>3.06</td><td>5.66</td><td>5.66</td><td>8.72</td></tr>
<tr><td>Lignite</td><td>4.70</td><td>3.70</td><td>1.80</td><td>0.40</td></tr>
<tr><td>Bituminous coal</td><td>2.40</td><td>2.80</td><td>4.40</td><td>4.70</td></tr>
<tr><td>Natural gas</td><td>0.50</td><td>1.00</td><td>1.50</td><td>1.70</td></tr>
<tr><td>TOTAL</td><td>10.66</td><td>13.16</td><td>13.36</td><td>15.52</td></tr>
<tr><td rowspan="5">C.1
- Imposed hydroenergetic program P_i = 345 MW</td><td>Uranium</td><td>3.06</td><td>5.66</td><td>5.66</td><td>8.72</td></tr>
<tr><td>Lignite</td><td>4.65</td><td>3.70</td><td>1.80</td><td>0.40</td></tr>
<tr><td>Bituminous coal</td><td>2.35</td><td>2.75</td><td>4.35</td><td>4.65</td></tr>
<tr><td>Natural gas</td><td>0.50</td><td>0.95</td><td>1.45</td><td>1.60</td></tr>
<tr><td>TOTAL</td><td>10.56</td><td>13.06</td><td>13.26</td><td>15.37</td></tr>
<tr><td rowspan="5">C.1.1
- Imposed hydroenergetic program P_i = 868 MW</td><td>Uranium</td><td>3.06</td><td>5.66</td><td>5.66</td><td>8.72</td></tr>
<tr><td>Lignite</td><td>4.70</td><td>3.70</td><td>1.80</td><td>0.40</td></tr>
<tr><td>Bituminous coal</td><td>2.35</td><td>2.75</td><td>4.00</td><td>4.10</td></tr>
<tr><td>Natural gas</td><td>0.45</td><td>0.75</td><td>0.60</td><td>1.40</td></tr>
<tr><td>TOTAL</td><td>10.56</td><td>12.86</td><td>12.06</td><td>14.62</td></tr>
<tr><td rowspan="5">C.2
- Imposed nuclear program</td><td>Uranium</td><td>3.06</td><td>5.66</td><td>5.66</td><td>5.66</td></tr>
<tr><td>Lignite</td><td>4.70</td><td>3.70</td><td>1.80</td><td>0.40</td></tr>
<tr><td>Bituminous coal</td><td>2.35</td><td>2.40</td><td>4.00</td><td>7.20</td></tr>
<tr><td>Natural gas</td><td>0.50</td><td>0.60</td><td>1.45</td><td>1.90</td></tr>
<tr><td>TOTAL</td><td>10.61</td><td>12.36</td><td>12.91</td><td>15.16</td></tr>
<tr><td>C.3</td><td>Uranium</td><td>3.06</td><td>5.66</td><td>5.66</td><td>8.72</td></tr>
</table>

Scenario	Fuel	Year			
		2015	**2020**	**2025**	**2030**
- HPP-PS - 1000 MW în 2020	Lignite	4.70	3.70	1.80	0.40
	Bituminous coal	2.40	2.75	4.30	4.20
	Natural gas	0.50	1.00	1.45	1.60
	TOTAL	**10.66**	**13.11**	**13.21**	**14.92**
C.4 **- Imposed wind program Pi = 3534 MW**	Uranium	3.06	5.66	5.66	8.72
	Lignite	4.00	3.40	1.70	0.40
	Bituminous coal	2.20	2.60	4.10	4.40
	Natural gas	0.50	0.90	1.20	1.50
	TOTAL	**9.76**	**12.56**	**12.66**	**15.02**
C.4.1 **- Imposed wind program Pi = 4534 MW**	Uranium	3.06	5.66	5.66	8.72
	Lignite	4.00	3.40	1.70	0.40
	Bituminous coal	2.20	2.60	4.00	4.10
	Natural gas	0.50	0.90	1.10	1.40
	TOTAL	**9.76**	**12.56**	**12.46**	**14.62**
C.5 **- Imposed thermal program Pi = 3050 MW**	Uranium	3.06	5.66	5.66	8.72
	Lignite	4.70	4.10	3.70	2.10
	Bituminous coal	2.40	2.50	2.70	2.90
	Natural gas	0.50	0.60	1.20	1.40
	TOTAL	**10.66**	**12.86**	**13.26**	**15.12**
C.6 **- Imposed thermal power program Pi = 3050 MW** **Imposed hydro power program Pi = 868 MW** **HPP-PS 1000 MW in 2020**	Uranium	3.06	5.66	5.66	8.72
	Lignite	4.70	3.90	3.60	1.90
	Bituminous coal	2.40	2.40	2.50	2.70
	Natural gas	0.50	0.60	1.20	1.30
	TOTAL	**10.66**	**12.56**	**12.96**	**14.62**
D1 **- Imposed thermal energy program for the domestic lignite and bituminous coal consumption**	Uranium	3.06	5.66	5.66	7.42
	Lignite	5.70	5.80	5.90	5.90
	Bituminous coal	1.40	1.35	1.40	1.00
	Natural gas	0.50	0.50	0.70	1.30
	TOTAL	**10.66**	**13.31**	**13.66**	**15.62**
D2 **- Imposed thermal power, hydro power and wind power**	Uranium	3.06	5.66	5.66	5.66
	Lignite	4.58	4.56	4.30	4.39
	Bituminous coal	1.37	1.27	1.08	0.98
	Natural gas	3.01	2.94	2.87	3.14
	TOTAL	**12.02**	**14.43**	**13.90**	**14.17**

We notice the frequent use of the fossil fuels as result of the decommissioning of the old technological units and installing of modern units with efficient technologies, which means that the use of domestic lignite and bituminous coal is decreased being replaced by import bituminous coal and natural gases. Thus, the efficiency of electricity generation per fossil fuels is increased from 31.5% in 2013 to 52.3% in 2030.

The modern adopted technologies ensure the meeting of the environmental conditions. The evolution of CO_2 emissions for the 2015 ÷ 2030 period is presented in the table V_39.

Due to the change of the structure of electricity generation in this period, the CO_2 emissions will be reduced, although the generated electricity will be increased from 62.90 TWh in 2015 to 86.4 TWh in 2030.

Table V_ 39 *CO_2 emissions for analysed scenarios*

Scenario	CO_2 emissions in mill. of tons			
	2015	**2020**	**2025**	**2030**
A.1 – Reference, economic order	30.60	29.10	27.90	34.40
C.1 – Imposed hydro power program (P_i = 345 MW)	30.50	29.00	27.80	24.30
C.1.1 – Imposed hydro power program (P_i = 868 MW)	30.40	28.80	27.60	24.10
C.2 – Imposed nuclear program	30.50	29.00	27.90	31.40
C.4 – Imposed wind program (Pi = 3534 MW)	30.50	28.70	27.50	24.10
C.4.1 – Imposed wind program (Pi = 4534 MW)	30.50	28.70	27.30	24.00
C.5 – Imposed thermal program (Pi = 3050 MW)	30.80	32.30	28.50	25.10
C.6 – Imposed thermal energy program (Pi = 3050 MW), Imposed hydro energy program (Pi = 868 MW)	30.50	31.90	28.30	25.00
D1 – Imposed thermal energy program for the domestic lignite and bituminous coal consumption	30.50	31.90	28.50	29.70
D2 – Imposed thermal energy program for the domestic lignite and bituminous coal consumption, Imposed hydro energy program (868 MW), Imposed wind program (4534 MW)	26.70	25.17	24.70	24.50

For the establishment of the future development of the electricity generation sector is achieved an economic analysis of the development options.

The A1 reference scenario presents the development programme with minimum costs of the electric plants resulted in the optimisation process, taking into account the economic order, in absence of several restrictions. This programme is theoretical, because does not take into account, beside the economic criterion other criteria resulted from the energetic strategy and energetic policies of the Romanian Government in line with the European Union demands related to the energetic area.

The scenarios analysed as alternative scenarios considered the key factors affecting the evolution of the electric power sector under the conditions of the unique European power market. These scenarios present advantages and disadvantages relating to the reference scenario according to the assumptions considered. These advantages and disadvantages has to be analysed as objectively as possible, for ranking the scenarios and for establishing an optimal development programme for Romanian power plants during 2013 ÷ 2030.

The variants of power development programmes resulted for the analysed scenarios present advantages and disadvantages relating to the reference variant established only from the economic point of view *("minimum cost"),* according to the evaluation criteria considered.

For scenarios ranking, beside the economic criterion, several criteria were considered, in line with the energetic strategy of the Romanian Government concerning the electric power supply safety, the efficient use of the primary energy resources, the environmental protection. Thus, for the three ranking criteria of the development scenarios, such as:

- Economic criterion;

- Safety criterion in the electric power supply;
- Environmental criterion;

the indicators charactering these criteria are defined.

For the economic criterion, the updated cost of the electric power is considered as indicator, which considers both the investments and the exploitation and maintenance expenditures during 2013 ÷ 2030 period.

For the safety criterion in electric power supply, there are considered three indicators, such as:

- Energetic independence degree;
- Hirschman – Herfindahl indicator (HHI) of import concentration, characterising the diversification of primary power sources;
- Invoice for the primary power import.

For the *environmental criterion*, considering the importance of the obligations imposed by the Kyoto Protocol, the "carbon intensity" (CI) is defined as main indicator.

Considering that only the scenarios for development of power plants are analysed, not the energetic balance of Romania, the above indicators are adapted for scenarios ranking, according to the available data.

Among the indicators defining the safety of electricity supply, the quantity of imported fuels was considered in order to avoid the double assessment.

The total quantity of imported fuels and the expensed with these fuels, within the 2015 ÷ 2030 period, for the analysed scenarios are presented in the table V_40.

Table V_ 40 *Quantity of imported fuels and related expenses, within the 2015 ÷ 2030 period*

No.	Scenario	Quantity of imported fuel [Mil. toe]	Expenses with imported fuels [bill.Euro]
1.	**A.1** – Reference, economic order	169.20	14.20
2.	**C.1** – Imposed hydro power program (P_i = 345 MW)	167.40	14.05
3.	**C.1.1** – Imposed hydro power program (P_i = 868 MW)	157.20	13.35
4.	**C.2** – Imposed nuclear program	160.70	16.50
5.	**C.4** – Imposed wind program (Pi = 3534 MW)	167.90	13.20
6.	**C.4.1** – Imposed wind program (Pi = 4534 MW)	157.20	12.90
7.	**C.5** – Imposed thermal program (Pi = 3050 MW)	139.20	12.40
8.	**C.6** – Imposed thermal energy program (Pi = 3050 MW), Imposed hydro energy program (Pi = 868 MW)	119.10	11.60
9.	**D1** – Imposed thermal energy program for the domestic lignite and bituminous coal consumption	90.50	7.30
10.	**D2** – Imposed thermal energy program for the domestic lignite and bituminous coal consumption, Imposed hydro energy program (868 MW), Imposed wind program (4534 MW)	70.90	7.20

The updated electricity cost resulted for the analysis period of 25 years, in each of the analysed scenarios, for an update rate of 8%, is presented in the table V_41.

Table V_ 41 *Imported fuels quantities, including the costs in the analysed scenarios*

No.	Scenario	Function objective (bill. Euro)	Update cost EE (Euro MWh)
1.	**A.1** – Reference, economic order	24.40	31.20
2.	**C.1** – Imposed hydro power program (P_i = 345 MW)	24.60	31.50
3.	**C.1.1** – Imposed hydro power program (P_i = 868 MW)	24.70	31.70
4.	**C.2** – Imposed nuclear program	24.90	31.80
5.	**C.4** – Imposed wind program (Pi = 3534 MW)	24.70	32.30
6.	**C.4.1** – Imposed wind program (Pi = 4534 MW)	25.20	32.50
7.	**C.5** – Imposed thermal program (Pi = 3050 MW)	25.00	31.80
8.	**C.6** – Imposed thermal energy program (Pi = 3050 MW), Imposed hydro energy program (Pi = 868 MW)	26.20	32.40
9.	**D1** – Imposed thermal energy program for the domestic lignite and bituminous coal consumption	26.10	32.80
10.	**D2** – Imposed thermal energy program for the domestic lignite and bituminous coal consumption, Imposed hydro energy program (868 MW), Imposed wind program (4534 MW)	26.90	33.60

The scenarios ranking, according to the measure of meeting the presented requirements, are presented in the table V_42.

The assessment of scenarios, by economic criterion and safety of electricity supply, was performed considering the grading criteria (1 to 10 for each of the analysed program). The resulted grades obtained for each criterion, within the analysed scenario, has been added to the final grade, used for scenarios ranking. The programs with the higher final grade will be the first in the ranking.

Table V_ 42 *Assessment and hierarchy of the analysed programs*

No.	Scenario	Grading according to criterion		Final grade	Scenarios hierarchy
		Economic	**Safety of provision**		
		Electricity levelized cost	Imported fuels		
1.	**A.1** – Reference, economic order	10	1	5,5	**2**
2.	**C.1.1 –** Imposed hydro power program (Pi = 868 MW)	8	2	5,0	**3**
3.	**C.2** – Imposed nuclear program	8	1	4,5	**4**
4.	**C.4.1** – Imposed wind program (Pi = 4534 MW)	6	2	4,0	**5**
5.	**C.5** – Imposed thermal program (Pi = 3050 MW)	8	4	6,0	**1**
6.	**C.6** – Imposed thermal energy program (Pi = 3050 MW), Imposed hydro energy program (Pi = 868 MW)	6	6	6,0	**1**
7.	**D1** – Imposed thermal energy program for the domestic lignite and bituminous coal consumption	4	8	6,0	**1**
8.	**D2** – Imposed thermal energy program for the domestic lignite and bituminous coal consumption, Imposed hydro energy program (868 MW), Imposed wind program (4534 MW)	2	10	6,0	**1**

The scenarios *C.5, C.6, D.1* and *D.2* are in the first position, with the same final grade, which underline the fact that the program of developing the power plants of NPS, within the 2013 ÷ 2030 period, takes into account the investments included in the National Action Plan for Renewable Resources, new nuclear units with a total installed power of 2600 MW, new hydro power plants amounting 868 MW, thermal power units on lignite amounting 3000 MW and thermal energy unit in gas plants amounting 2050 MW.

In order to ensure the NPS handiness, the realization of accumulation and pumping hydro power plant of 1000 MW was considered, as part of the SC Hidroelectrica SA investment program, during the 2020 ÷ 2030 period.

The scheduling of the group commission has to be made under economic and legal conditions, for allowing the promotion of new units' investments, within the 2013 ÷ 2030 period, with an total installed power of approx. 11.000 MW.

This program is considered for WM scenario.

In the WAM scenario, the installed power in the wind power plants is expected to reach approx. 4600 MW, within the 2013 ÷ 2030 period. The installation of wind units is beneficial, contributing to the increase of renewable energy share, reducing the use of fossil fuels and, consequently the GHG emissions.

V.D.2.2. Evolution of energy consumption in the Industrial sector

Considering the assumptions on the development of various industries, using MAED program, the evolution of energy demand during 2015 ÷ 2030 in industry is projected, for the analysed scenarios - WOM, WEM, WAM (table V_43).

Table V_ 43 *Energy demand 2015 ÷ 2030*

Energy demand	**2010**	**2015**	**2020**	**2025**	**2030**
Scenario WOM					
Total (PJ) Out of which:	293.9	319.8	353.7	365.4	378.6
Electricity	73.5	74.0	81.9	84.6	87.6
Heat	11.8	11.7	13.0	13.4	13.9
Liquid fuel	37.7	46.6	51.5	53.2	55.1
Solid fuel	47.8	50.8	56.1	58.0	60.1
Natural gas	122.9	136.6	151.1	156.1	161.7
RES	0.2	0.1	0.1	0.1	0.2
Scenario WEM					
Total (PJ) Out of which:	293.9	317.8	351.7	363.4	375.6
Electricity	73.5	74.0	81.9	84.6	87.6
Heat	11.8	11.7	13.0	13.4	13.9
Liquid fuel	37.7	45.6	50.5	52.2	53.1
Solid fuel	47.8	49.8	55.1	57.0	59.1
Natural gas	122.9	136.6	151.1	156.1	161.7

Energy demand	2010	2015	2020	2025	2030
RES	0.2	0.1	0.1	0.1	0.2
Scenario WAM					
Total (PJ) Out of which:	293.9	315.8	349.7	360.4	372.6
Electricity	73.5	74.0	81.9	84.6	87.6
Heat	11.8	11.7	13.0	13.4	13.9
Liquid fuel	37.7	44.6	49.5	50.2	51.1
Solid fuel	47.8	48.8	54.1	56.0	58.1
Natural gas	122.9	136.6	151.1	156.1	161.7
RES	0.2	0.1	0.1	0.1	0.2

V.D.2.3. Evolution of energy consumption in the Transport sector

Considering the economic and social development of Romania after the crisis, the Transport sector should ensure in terms of efficiency, both goods and passenger transport at different distances.

The assumptions related to the evolution of the urban and interurban passenger transport, the mobility degree and the reduction of the specific consumption for the main types of vehicles, are presented in table V_44. The assumption related to the cars number in cities, involved an increase from the current contribution of 42% of 2012 to 48% in 2030, considering the need of modernization the urban transport, especially with the electric traction.

Table V_ 44 *Assumptions on passenger transport for the period 2015 ÷ 2030*

	M.U.	2010	2015	2020	2025	2030
Scenario WOM						
Average distance travel						
Interurban	**Km/year**	2550	2350	3250	3600	4000
Urban	**Km/day**	8.4	8.8	9.2	9.6	10
Scenario WEM						
Indices reduction specific consumption						
Cars – interurban (l/100 km)	%	100	97	94	92	90
Cars– urban (l/100 km)	%	100	98.5	96.5	94.5	92.5
Buses – urban (l/100 km)	%	100	97.7	93.8	90	87
Buses – interurban (l/100 km)	%	100	95	90	85	80
Diesel train (l/100 km)	%	100	97	95	92.5	90
Electric train (kWh/100 km)	%	100	95	90	86	82
Electric public transport (kWh/100 km)	%	100	96	93	91	89
Scenario WAM						
Indices reduction specific consumption						
Cars – interurban (l/100 km)	%	100	96	93	91	89
Cars – urban (l/100 km)	%	100	98	96	94	92
Buses – urban (l/100 km)	%	100	97.4	93.2	89.5	86.6
Buses – interurban (l/100 km)	%	100	94	89	84	79
Diesel train (l/100 km)	%	100	96	94	84	79
Electric train (kWh/100 km)	%	100	94	90	85	81
Electric public transport (kWh/100 km)	%	100	95	92	90	88

The assumptions related to the evolution of goods transport and the reduction of specific vehicles consumption, presented in the table V_45, considered an increase of the quantity of transported goods, in line with the economic recovery. Also, the modernization of rail and modal transport is expected to regain the goods market.

Table V_ 45 *Assumptions on goods transport for the period 2015 ÷ 2030*

	M.U	2010	2015	2020	2025	2030
Scenario WOM						
Goods transport	billion.tkm	53.6	59.7	69.4	78.3	87.2
Road transport	%	48.3	48.2	48.0	47.5	47.0
Railway transport	%	23.1	23.2	23.4	23.9	24.4
Naval transport	%	26.7	26.7	26.7	26.7	26.7
Transport via pipelines	%	1.9	1.9	1.9	1.9	1.9
Indices reduction specific consumption						
Transport local vehicles (kWh/100tkm)	%	100	99	98.5	97.5	96.5
Distance transport vehicles (kWh/100tkm)	%	100	93	98.8	97.8	97.0
Diesel trains (kWh/100tkm)	%	100	96	93	90	87.0
Electric trains (kWh/100tkm)	%	100	96.5	94	90	86.0
Naval transport (kWh/100tkm)	%	100	95	90	85	80.0
Transport via pipelines (kWh/100tkm)	%	100	97.5	96.5	95.9	95.3
Scenario WEM						
Goods transport	Mld.tkm	53.6	59.7	69.4	78.3	87.2
Road transport	%	48.3	48.0	47.7	47.2	46.8
Railway transport	%	23.1	23.4	23.7	24.1	24.6
Naval transport	%	26.7	26.7	26.7	26.7	26.7
Transport via pipelines	%	1.9	1.9	1.9	1.9	1.9
Indices reduction specific consumption						
Transport local vehicles (kWh/100tkm)	%	100	98.7	98.1	97.0	96.0
Distance transport vehicles (kWh/100tkm)	%	100	98.5	98.1	97.5	97.0
Diesel trains (kWh/100tkm)	%	100	95	92	89	86
Electric trains (kWh/100tkm)	%	100	96	93	89	85
Naval transport (kWh/100tkm)	%	100	95	90	85	80
Transport via pipelines (kWh/100tkm)	%	100	96.5	95.5	94.9	94.3
Scenario WAM						
Goods transport	Mld.tkm	53.6	97.7	69.4	78.3	87.2
Road transport	%	48.3	47.6	47.3	46.9	46.5
Railway transport	%	23.1	23.8	24.0	24.4	24.9
Naval transport	%	26.7	26.7	26.7	26.7	26.7
Transport via pipelines	%	1.9	1.9	1.9	1.9	1.9
Indices reduction specific consumption						
Transport local vehicles (kWh/100tkm)	%	100	98.0	97.5	97.0	96.0
Distance transport vehicles (kWh/100tkm)	%	100	98.0	97.3	96.9	96.2
Diesel trains (kWh/100tkm)	%	100	95	90	87	84
Electric trains (kWh/100tkm)	%	100	95	92	88	84
Naval transport (kWh/100tkm)	%	100	95	90	85	80
Transport via pipelines (kWh/100tkm)	%	100	96	95	94.4	94

The assumption considered for the analysed scenarios (WOM, WEM, WAM) related to the evolution of energy demand during 2015 ÷ 2030 in the transport sector, determined using MAED program, are presented in table V_46.

Table V_ 46 *The evolution of energy demand for the period 2015 ÷ 2030*

Energy demand	**2010**	**2015**	**2020**	**2025**	**2030**
Scenario WOM					
Total in PJ Out of which:	203.15	239.6	265.0	273.8	293.6
Electricity	4.88	5.6	6.2	6.4	6.9
Heat	0.202	0.6	0.6	0.6	0.7
Liquid fuel	197.89	226.8	250.9	259.2	279.9
Solid fuel	0.0	0.0	0.0	0.0	0.0.
Gas fuel	0.18	1.3	1.4	1.5	1.5
RES	0.0	5.3	5.9	6.1	6.5
Scenario WEM					
Total in PJ Out of which:	203.15	237.6	260.5	268.8	286.6
Electricity	4.88	5.6	6.0	6.1	6.4
Heat	0.202	0.6	0.5	0.5	0.5
Liquid fuel	197.89	224.8	246.8	254.7	269.0
Solid fuel	0.0	0.0	0.0	0.0	0.0
Gas fuel	0.18	1.3	1.3	1.4	1.4
RES	0.0	5.3	5.9	6.1	9.3
Scenario WAM					
Total in PJ Out of which:	203.15	235.6	257.2	265.5	283.6
Electricity	4.88	5.1	5.9	6.0	6.2
Heat	0.202	0.6	0.4	0.4	0.4
Liquid fuel	197.89	223.4	243.8	251.7	266.4
Solid fuel	0.0	0.0	0.0	0.0	0.0
Gas fuel	0.18	1.2	1.2	1.3	1.3
RES	0.0	5.3	5.9	6.1	9.3

The forecast of GHG emissions in the transport sector was obtained for each fuel type, using the emission factors reported in the NIR.

V.D.2.4. Evolution of energy consumption in the Commercial sector

The assumptions regarding the evolution of the service sector in the period 2015 ÷ 2030 are presented in the table V_47.

***Table V_ 47** Assumptions regarding service sector in period 2015 ÷ 2030*

	M.U.	**2010**	**2015**	**2020**	**2025**	**2030**
Scenario WOM						
Weight of population employment in services	%	37.9	40.5	42.5	45.0	50.0
Increase employment area	%	100	106	115	130	160
Weight air conditioning area	%	5	10	20	30	40
Demolition rate	%	0	1	1.3	1.6	2.3
Indices reduction specific consumption						
Heating older buildings (kWh/m^2/year)	%	100	99.0	98.0	97.0	96.0
Heating new buildings (kWh/m^2/year)	%	100	99.5	98.5	97.5	96.5
Electricity in older buildings (kWh/m^2/year)	%	100	99.0	97.8	96.5	94.5
Electricity in new buildings (kWh/m^2/year)	%	100	99.0	97.0	95.0	93.0
Scenario WEM						
Weight of population employment in services	%	37.9	40.5	42.5	45.0	50.0
Increase employment area	%	100	106	115	130	160
Weight air conditioning area	%	5	10	20	30	40
Demolition rate	%	0	1	1.3	1.6	2.3
Indices reduction specific consumption						
Heating older buildings (kWh/m^2/year)	%	100	98	97	96	95
Heating new buildings (kWh/m^2/year)	%	100	98	97	96	95
Electricity in older buildings (kWh/m^2/year)	%	100	98.5	97.5	96	95.5
Electricity in new buildings (kWh/m^2/year)	%	100	98.5	96.5	94.5	92.5
Scenario WAM						
Weight of population employment in services	%	37.9	40.5	42.5	45.0	50.0
Increase employment area	%	100	106	115	130	160
Weight air conditioning area	%	5	10	20	30	40
Demolition rate	%	0	1	1.3	1.6	2.3
Indices reduction specific consumption						
Heating older buildings (kWh/m^2/year)	%	100	97.5	96.5	95.5	94
Heating new buildings (kWh/m^2/year)	%	100	98	97	96	95
Electricity in older buildings (kWh/m^2/year)	%	100	98	97	96	95
Electricity in new buildings (kWh/m^2/year)	%	100	98	96	94	92

Taking into consideration the assumptions presented in table V_47, using MAED program, the evolution of the energy demand for the Services sector during the 2015÷2030 period were predicted, for each analysed scenarios - WOM, WEM, WAM (table V_48).

Table V_ 48 *Energy demand for 2015÷2030 period*

Energy demand	2010	2015	2020	2025	2030
Scenario WOM					
Total (PJ) Out of which:	87.8	91.5	101.2	104.6	108.3
Electricity	27.3	25.4	28.1	29.1	30.1
Heat	9.0	9.3	10.3	10.7	11.0
Liquid fuel	6.5	5.9	6.5	6.8	7.0
Solid fuel	5.2	0.0	0.0	0.0	0.0
Natural gas	39.6	50.8	56.2	58.0	60.1
RES	0.2	0.0	0.0	0.0	0.0
Scenario WEM					
Total (PJ) Out of which:	87.8	91.4	98.2	103.6	105.3
Electricity	27.3	25.4	28.1	29.1	30.1
Heat	9.0	9.3	10.3	10.7	11.0
Liquid fuel	6.5	5.9	5.0	5.8	5.0
Solid fuel	5.2	0.0	0.0	0.0	0.0
Natural gas	39.6	50.8	54.7	58.0	59.1
RES	0.2	0.0	0.0	0.0	0.0
Scenario WAM					
Total (PJ) Out of which:	87.8	90.0	97.2	102.0	104.3
Electricity	27.3	25.4	28.1	29.1.	30.1
Heat	9.0	9.3	10.3	10.7	11.0
Liquid fuel	6.5	5.4	4.5	4.8	4.5
Solid fuel	5.2	0.0	0.0	0.0	0.0
Natural gas	39.6	50.8	54.2	57.4	58.6
RES	0.2	0.0	0.0	0.0	0.0

V.D.2.5. Evolution of energy consumption in the Residential sector

The evolution of the average housing surface during 2010 ÷ 2030 period is presented in Table V_49. Table V_50 presents the main indicators considered in determining energy consumption for households during 2010 ÷ 2030 period.

Table V_ 49 *Average housing surface evolution, in m^2*

Household type	2010	2015	2020	2025	2030
Apartment	56.3	58.5	60.0	62.0	64.0
Urban condominium (multiple families)	69.5	74.0	78.0	82.0	84.0
Urban house	45.0	48.0	50.0	52.0	54.0

***Table V_ 50** Evolution of the main indicators of the population households during 2015 ÷ 2030*

	M.U.	2010	2015	2020	2025	2030
Specific consumption						
* food preparation	kWh/cap/year	523	523	523	523	523
* hot water, per capita	%	44.0	48.0	52.0	56.0	60.0
*Electricity for home appliances	kWh/capita/year	600.0	650.0	700.0	800.0	900.0
Electricity for home appliances	kWh/capita	900.0	925.0	950.0	1065.0	1599.0
Average household surface	capita/household					
Demolition rate	%	0.5	0.7	1.2	1.8	3.0
The evolution of the existing housing						
*type: Total surface heating	%	5	7	9	11	15
*central heating	%	32	33	34	35	37
*partial heating	%	63	60	57	54	48
Specific consumption reduction indices for heating – existing housing*)						
* type: Total surface heating (Wh/m^2/°C/h)	100	99	95	92	89	87
* central heating (Wh/m^2/°C/h)	100	99.8	96	93.2	91	88
* partial heating (Wh/m^2/°C/h)	100	99.8	99	96	93	91
Air conditioning						
*type: Total surface heating	%	5	9	13	17	20
*central heating	%	3	6	10	13	16
*partial heating	%	0	0	0	0	0
Specific consumption reduction indices for heating – new housing*)						
* type: Total surface heating (Wh/m^2/°C/h)	100	98	94	91	88	84
* central heating (Wh/m^2/°C/h)	100	99	94	92	89	86
* partial heating (Wh/m^2/°C/h)	100	99.5	98	94	92	90
Air conditioning						
*type: Total surface heating	%	20	25	35	45	50
*central heating	%	15	20	30	40	45
*partial heating	%	0	0	0	0	9
Electricity use						
Heating	%	0.7	0.8	0.9	0.95	1
Hot water	%	2.4	3.1	4	5	6
Penetration of centralized electricity distribution	%	49.2	49.5	50.0	51.0	52.0

*Note: *) 2010 is considered baseline year for reduction calculation; 2010 = 100.*

Based on the assumptions presented in tables V_49, V_50, the evolution of the energy demand in the residential sector for 2015 ÷ 2030 period was predicted, using MAED software, for all analysed scenarios - WOM, WEM, WAM (table V_51).

Table V_ 51 *Energy demand 2015 ÷ 2030*

Energy demand	**2010**	**2015**	**2020**	**2025**	**2030**
Scenario WOM					
Total (PJ) Out of which:	338.6	355.4	393.2	406.2	420.7
Electricity	40.8	42.2	46.6	48.2	49.9
Heat	47.5	52.9	58.6	60.5	62.6
Liquid fuel	9.9	15.4	17.1	17.6	18.3
Solid fuel	0.4	1.8	2.0	2.0	2.1
Natural gas	92.4	99.5	110.0	113.7	117.7
RES	147.6	143.7	159.0	164.3	170.1
Scenario WEM					
Total (PJ) Out of which:	338.6	352.4	390.1	401.5	415.7
Electricity	40.8	42.2	46.6	48.2	49.9
Heat	47.5	52.9	58.6	60.5	62.6
Liquid fuel	9.9	13.4	12.1	14.6	15.3
Solid fuel	0.4	1.8	1.0	1.0	1.1
Natural gas	92.4	99.5	110.0	113.0	116.7
RES	147.6	143.7	159.0	164.3	170.1
Scenario WAM					
Total (PJ) Out of which:	338.6	350.4	388.1	399.5	412.7
Electricity	40.8	42.2	46.6	48.2	49.9
Heat	47.5	52.9	58.6	60.5	62.6
Liquid fuel	9.9	11.4	10.1	12.6	12.3
Solid fuel	0.4	1.8	1.0	1.0	1.1
Natural gas	92.4	99.5	110.0	113.0	115.7
RES	147.6	143.7	159.0	164.3	170.1

V.D.2.6. Evolution of energy consumption in the Agriculture and Forestry sector

Considering the assumptions related to the development of agriculture and using the MAED program, the evolution of the energy demand for this sector during the period 2015÷2030 were determined, for analysed scenarios (table V_52).

Table V_ 52 *The evolution of energy demand during 2015 ÷ 2030*

Energy demand	**2010**	**2015**	**2020**	**2025**	**2030**
Scenario WOM					
Total in PJ out of which:	16.4	19.5	21.5	22.2	23.0
Electricity	2.4	3.0	3.4	3.5	3.6
Heat	0.8	1.1	1.2.	1.2	1.3
Liquid fuels	9.5	11.3	12.5	13.0	13.4
Solid fuels	0.0	0.0	0.0	0.0	0.0
Gaseous fuels	3.1	3.0	3.4	3.5	3.6
RES	0.6	1.0	1.1	1.1	1.2
Scenario WEM					
Total in PJ out of which:	16.4	19.0	20.5	20.2	21.0
Electricity	2.4	3.0	3.4	3.5	3.6
Heat	0.8	1.1	1.2.	1.2	1.3
Liquid fuels	9.5	10.8	11.5	11.0	11.4
Solid fuels	0.0	0.0	0.0	0.0	0.0
Gaseous fuels	3.1	3.0	3.4	3.5	3.6
RES	0.6	1.0	1.1	1.1	1.2
Scenario WAM					
Total in PJ out of which:	16.4	18.5	19.5	20.2	21.0
Electricity	2.4	3.0	3.4	3.5	3.6
Heat	0.8	1.1	1.2.	1.2	1.3
Liquid fuels	9.5	10.3	10.5	11.0	11.4
Solid fuels	0.0	0.0	0.0	0.0	0.0
Gaseous fuels	3.1	3.0	3.4	3.5	3.6
RES	0.6	1.0	1.1	1.1	1.2

V.D.2.7. Refineries

The liquid fuels demand for industry, transport, agriculture, services, etc. was determined by ENPEP software, based on forecasts the energy balance of Romania during 2015 ÷ 2030, resulting, services, etc. For assuring the internal liquid fuels demand at the country level during 2015 ÷ 2030, the refineries should follow the projected energy balance presented in table V_53, for WOM scenario.

Table V_ 53 *Energy demand evolution during 2015 ÷ 2030*

Energy demand, in PJ	**2015**	**2020**	**2025**	**2030**
Liquid fuels	40.8	45.5	45.6	45.7
Gaseous fuels	18.6	20.8	20.8	20.9
Electricity	4.8	5.4	5.4	5.4
TOTAL, in PJ	64.2	71.8	71.8	72.0

Since no information is available related to the applied measures for increasing the energy efficiency and for reducing the GHG emissions, the trend was considered the same in all scenarios.

V.D.2.8. Handling of fossil fuels

According to Romania's energy balance, for extraction and handling of fossil fuels (coal, oil and natural gas) are required electricity, solid and gaseous fuels. The evolution of energy demand forecast for the period 2015 ÷ 2030, for the WOM scenario, is presented in table V_54. This forecast was made by extrapolating the values obtained in the period 2008 ÷ 2011.

Table V_ 54 *Evolution of energy demand during 2015 ÷ 2030*

Energy demand, in PJ	**2015**	**2020**	**2025**	**2030**
Liquid fuels	12.8	14.1	14.1	14.1
Gaseous fuels	14.5	16.2	16.2	16.3
Electricity	4.8	5.3	5.3	5.3
TOTAL, in PJ	64.2	71.7	71.8	72.0

Fossil fuels presented in table V_54 are used in combustion processes.

From handling coal results fugitive emissions of CH_4. These emissions were approximately 9.88% of the CH_4 emissions due to the energy sector and 3.95% of total CH_4 emissions in Romania, in 2011. Considering the difficulty to make the prognosis of emission sources as a result of coal mining in perspective 2015÷2030, the prognosis was made by extrapolation of the 2011 value for WOM scenario, with an annual average rate of about 3.1% during 2011÷2015, 4.1% in the period 2015÷2025, and 4.21% in the period 2025÷2030.

In the WEM scenario and WAM scenario, the extrapolation value from 2011 assumed an lower annual average growth rates, considering the CH_4 capture and use for heating water at mining exploitations and the closure of unprofitable deep coal mines.

The evolution of CH_4 emissions in the period 2015 ÷ 2030 for the WEM scenario and WAM scenario are presented in Table V_55.

Table V_ 55 *Evolution of CH_4 emissions, in Gg during 2015 ÷ 2030*

Scenario	**2015**	**2020**	**2025**	**2030**
WOM	47.34	57.87	70.73	90.00
WEM	42.08	50.74	63.52	84.03
WAM	41.13	49.69	62.0	82.21

Systems for the oil and gas sector are considering the whole chain from resource extraction (oil or gas) to the final consumer, including the transformation processes for meeting the consumer requirements. From these systems results fugitive emissions (CO_2 and CH_4); these emissions were of 646.24 Gg CO_2 and 334.55 Gg CH_4 representing around 0.73% of total CO_2 emissions and 6.22% of total GHG emissions in Romania.

Considering the difficulty to forecasts the evolution of the oil and gas sector towards 2030, for the prognosis of fugitive emissions, the extrapolation method from 2011 was used. The evolution of CO_2 and CH_4 emissions, in the analysed scenarios – WOM, WEM, WAM -, considering different annual average growth rates are presented in Tables V_56 and V_57.

Table V_ 56 *Evolution of CO_2 emissions, in Gg during 2015 ÷ 2030*

Scenario	2015	2020	2025	2030
WOM	650.0	650.0	650.0	650.0
WEM	577.75	569.89	583.76	606.85
WAM	564.72	558.09	569.74	593.75

Table V_ 57 *Evolution of CH_4 emissions, in Gg during 2015 ÷ 2030*

Scenario	2015	2020	2025	2030
WOM	356.47	396.22	440.42	500.00
WEM	316.85	347.39	395.53	466.81
WAM	309.70	340.20	386.03	456.73

V.D.3. Methodology for GHG emission projections for Industrial Processes sector

Methodology for determining the projected GHG emissions in the Industrial Processes sector is related to non-energy activities in the industry.

For establishing the projected GHG emissions, the methodology specified in NIR 2013 was used, based on the following equation:

GHG Emissions = AD x EF

where AD is the projected activity data;

EF - emission factor forecast.

In determining the amount of expected activity and emission factors, the characteristics of processes were considered, for each specific categories defined in CRF.

Emissions from *Mineral Products sector (category CRF 2.A)* covers emissions from cement manufacturing process (CRF 2.A.1), manufacture of lime (CRF 2.A.2), limestone and dolomite use (CRF 2.A.3), soda ash production and use (CRF 2.A.4) and other processes - manufacture of glass (CRF 2.A.7).

Clinker production in Romania recorded a descendent trend from a peak in 1989 (10,571 kt) to a minimum of 4,971 kt in 1999. With economic recovery in 2000÷2008 followed an increase in production reaching the maximum value of 7,780 kt in 2008, followed by a decrease of about 25% in 2009 (5,801 kt). In 2010, production continued to decline, and in 2011 was an increase of about 10% compared to 2010, but below 2009.

Considering the evolution of GVA in the construction sector during 2015÷2030 and the average annual growth rate of cement production during 2000÷2008 (5.1%), around the year 2022 the production will reach the maximum of 1989 year. During 2012÷2022 period, the average annual growth rate of cement production was considered to be about 6.2%, as a result of crisis ending and increasing the absorption of EU funds. For the year 2030, the projected cement production will reach 15,000 kt, at an average annual growth rate of about 4.4% in the 2021÷2030 period.

Considering the domestic market requirement, the following trends are expected:

- The lime production is expected to increase up to 2,500 kt in 2020 (meaning an average annual growth rate of about 5.1% in the 2012 ÷ 2020 period) and to 3,500 kt in 2030 (meaning an average annual growth rate of about 4.5% during 2021÷2030 period); the maximum production value registered in 1989 (4,256 kt) will not be reached in 2030;

- The limestone and dolomite use is expected to increase up to 2,000 kt in 2020 (meaning an average annual growth rate of about 8.6% in the 2012 ÷ 2020 period) and up to 2,800 kt in 2030 (meaning an average annual growth rate of around 4% during 2021 ÷ 2030 period); the maximum production value registered in 1989 (3,313 kt) will not be reached in 2030;

- The domestic market requirement, the soda ash production is expected to increase up to 800 kt during 2013 ÷ 2020 period and 1,000 kt during 2021÷2030; the maximum production value registered in 1989 (1,296 kt) will not be reached in 2030;

- The production of glass is expected to increase up to 500 kt during 2013÷2020 period and 800 kt during 2021÷2030 period; the maximum production value registered in 1989 (1,387 kt) will not be reached in 2030.

GHG emissions from *Metal sector (category CRF 2.C)* covers the production of iron and steel (subcategory 2.C.1), of ferroalloys (subcategory 2.C.2) and of aluminium (2.C.3 subcategory).

Considering the requirement of domestic and international market, the following trends are expected

- The production of iron and steel will increase from 3,500 kt to 6,500 kt during 2012 ÷ 2020 period (meaning an average annual growth rate of about 8.1%) and from 6,800 kt to 8,500 kt in the 2021÷ 2030 period (meaning an average annual growth rate of about 3.1%); the maximum production value registered in 1989 (13,277 kt) will not be reached in 2030;

- The production of ferroalloys will increase from 32 kt to 65 kt during 2012 ÷ 2020 period (meaning an average annual growth rate of about 9.6%) and from 70 kt to 140 kt during 2021÷ 2030 period (meaning an average annual growth rate of about 8.4%); the maximum production value registered in 1989 (199 kt) will not be reached in 2030;

- The production of aluminium will be 265 kt during 2013÷2020 period and 300 kt during the 2021 ÷ 2030 period; the maximum production value registered in 1989 (265 kt) will be exceeded by about 13% in 2030.

Considering the uncertainties regarding the forecast of halocarbons and SF6 using on long term and the lack of data which does not allow the use of the methodology used to develop the National Inventory for 2011, for the achieving of HFC, PFC, SF_6 forecasts was used the extrapolation method; the emissions value in 2011 were extrapolated during 2012 ÷ 2030 period with an average annual rate of 5%. For distribution by type of emissions were considered values achieved in 2011. The assumption applied for the forecasts of halocarbons and SF6 emissions are identical for all scenarios – WOM, WEM, WAM.

V.D.4. Methodology for GHG emission projections for the Solvents and Other Product Use

Methodology for determining the projected GHG emissions from the Solvents and Other Products Use is consistent with that used in the NIR 2013.

Considering the NMVOC emissions contribution during 2008 ÷ 2010 period (0.10% of the total GHG emissions in Romania) and the difficulty of long-term forecast for activities which generate these emissions, the data extrapolation method was adopted for the forecast.

Thus, the forecast for WOM scenario was achieved by extrapolation the 2011 emission value with an average annual rate of 1.4% between 2011 ÷ 2015 period and an average annual rates of 2.2%, 3%, 3.8% in the 2016 ÷ 2020, 2021 ÷ 2025 and 2026 ÷ 2030 periods.

In the WEM scenario and WAM scenario, technological improvements and environmental protection investments are envisaged, which will contribute to NMVOC emissions reduction. For WEM scenario and WAM scenario, the NMVOC emissions in 2030 is expected to be 83.6%, respectively, 78% from projected emissions in WOM scenario.

In determining the annual growth rates were considered the NMVOC emission trends during 1989 ÷ 2010 period. Thus, the registered value of 646.80 $GgCO_2$ in 1989 decreased to 225.40 $GgCO_2$ in 1994. During the 1994 – 2002 period, the emissions remained relatively stable around 220 $GgCO_2$. After 2002, the emissions increased to a maximum of 279.90 $GgCO_2$, due to economic activity, and then decreased by 50%, due to economic crisis and changing of activities structures.

V.D.5 Methodology for GHG emission projections for Agriculture sector

For establishment of projected GHG emissions, the methodology specified in NIR 2013 is based on the following equation:

GHG Emissions = AD x EF

where: AD is the projected activity data;

EF - emission factor forecast.

The evolution of Romanian arable land, by usage type, for the period 2005 ÷ 2011, is presented in table V_58. The 2013 ÷ 2030 period has the same assumption as the one used for year 2011.

Related to the consumption of chemical fertilizers in Romania, approx. 46kg/ha of fertilizers were used on 2005 ÷ 2011 period (table V_59). More extended analysis of chemical fertilizers consumption highlights that 160 kg/ha were used in 1989, respectively 52 kg/ha in 1995. This shows that the quantity of elements per surface unit is not compensated by fertilization at the surface level, which permits the compensation of extracted nutrients and production level with other EU countries. In establishing the necessary nutrients, the full manure usage from agriculture was considered. The amount of manure significantly decreased during 1989 ÷ 1995 period, from 41,603 tons to 16,945 tons, in correlation with the livestock number.

Because there isn't long term forecast regarding the evolution of chemical fertilizers quantity used in agriculture, the 2011 reported quantities will be extrapolated with annual average rhythm of 1.36%.

From chemical fertilizers range with GHG emissions, some are based of nitrogen: technical urea, ammonium nitrate, etc. These nitrogen emissions vary by management type and application periods. Therefore, in order to reduce N_2O emissions is required to develop the technologies for fertilizer usage.

Other possible source of GHG is rice cultivation which produces CH_4 emissions from anaerobic fermentation of organic material during flooding or irrigation. Rice crops occupy very small areas. These areas continuously decreased after 1989 (49.3 thousand ha), to 2003 (0.1thousand ha) and increased in 2004 (1.2 thousand ha), 2005 (3.9 thousand ha) and 2010 (12.4 thousand ha). It is considered the assumption which maintains the 12.4 thousand ha surface for next period for rice crops. Taking into account CH_4 emissions of rice crops, on year 2010 the value was 0.89 Gg representing 0.08% of total methane emissions evaluated in the country. No measures are proposed for reducing the GHG emissions from rice crops.

Methane emission from animals' growth has two main source of polluting: emission from ruminants digestion and anaerobic fermentation of animals' organic manure.

The evolution of livestock number for the 2005÷2030 period is presented in Table V_60. Dissolution and privatization of farming cooperatives and public property farms resulted in the emergence of significant structural changes. In 1989, Romanian livestock had 149,071 heads. The steepest decline is noted in cattle class, which in 1989 had 6,291 thousand heads respectively only 1,989 thousand heads in 2011. After a pronounced decrease at the first decade (5,435 thousand sheep head and 11,671 thousand swine heads in 1989), the number has been stabilized to 8,500 thou. sheep heads and 6,500 thou. swine heads although recorded some annual fluctuations. The rising price of feed has also had an impact on these changes. The strengthening of private property in agriculture is expected to increase the number of livestock and livestock products production. It is working to develop feeding practices at farm level and to introduce advanced techniques for livestock improving. In order to reduce methane emissions, it is intended to improve the quality of nutrition and to recover the methane produced in the anaerobic digestion of manure for use as fuel.

In the poultry sector there was a decrease in the number of heads in the 1989 ÷ 1995 period from 113,968 to 80,382 thousand heads and then an increase, especially in the 2000 ÷ 2005 period, based on the economic growth, followed by a decrease to 78,842 thousand heads in 2011, mainly due to the economic crisis.

Evolution of the livestock in the 2013 ÷ 2030 period considered meeting a balanced domestic consumption and creating a surplus for export. Since there is no such information in the National Sustainable Development Strategy of Romania for 2020, 2030 and there are no strategy for the agricultural development in the time horizon, for the livestock evolution during the 2013 ÷ 2030 period, the reported 2011 data were extrapolated with the following average annual rates: 2% for cattle; 1.3% for swine, 1.1% for sheep, 1.36% for goats, 1.57% for horses,1.2% for poultry.

Table V_ 58 *Agricultural area trend, 2005÷2011*

	Agricultural area (thou. ha)						
	Historic						
	2005	2006	2007	2008	2009	2010	2011
Total agricultural area	**14741.2**	**14731.0**	**14709.3**	**14702.3**	**14685.0**	**14634.4**	**14590.9**
of which:							
- arable	9420.2	9434.5	9423.3	9415.1	9422.5	9404.0	9352.3
- pastures	3364.0	3334.4	3330.0	3333.0	3313.8	3288.7	3277.7
- hayfields	1514.6	1524.9	1531.5	1532.3	1528.0	1529.6	1553.5
-vineyards and vine nurseries	224.1	223.7	218.0	214.5	215.4	213.6	211.3
- orchards and tree nurseries	218.2	213.4	206.6	207.3	205.2	198.6	196.1

Table V_ 59 *Chemical and natural fertilizers amounts used in Agriculture trend, 2005 ÷ 2030*

	Fertilizers (thou. tonnes)										
	Used							Forecast			
	2005	2006	2007	2008	2009	2010	2011	2015	2020	2025	2030
Chemical fertilizers,	**461**	**363**	**387**	**398**	**426**	**481**	**487**	**525**	**560**	**595**	**630**
of which:											
- nitrogenous	299	252	265	280	296	306	313	**320**	**340**	360	380
- phosphatic	138	94	103	102	100	123	126	150	160	170	180
- pottasic	24	17	19	16	30	52	48	55	60	65	70
Natural fertilizers	16570	14900	13498	11748	13748	15232	14510	16500	17000	17500	18000

Table V_ 60 *Livestock evolution, 2005 ÷ 2030*

	Livestock (thou. head)										
	Historic							Forecast			
	2005	2006	2007	2008	2009	2010	2011	2015	2020	2025	2030
Livestock	**105168**	**103949**	**101616**	**103829**	**102972**	**98543**	**97560**	**103400**	**109900**	**116350**	**122800**
of which:											
- bovines	2862	2934	2819	2684	2512	2001	1989	2000	2300	2600	2900
- swine	6622	6815	6565	6174	5793	5428	5364	5500	6000	6500	7000
- sheep	7611	7678	8469	8882	9141	8417	8533	9000	9500	10000	10500
- goats	687	727	865	898	917	1241	1236	1300	1400	1500	1600
- horses	834	805	862	820	764	611	596	600	700	750	800
- poultry	86552	84991	82036	84373	83843	80845	79842	85000	90000	95000	100000

For CH_4 forecasts was considered the livestock evolution presented in the table V_60 and the emissions factors reported in 2011, expressed in tonnes CH_4/ animal head/ year.

The CH_4 emissions resulted from rice crops and agricultural waste burning will remain constantly on entire forecast period. This assumption considers the low share of these resources in total methane emissions (0.2% respectively 1.6%).

For reduction of the methane emissions resulted from digestion process, the following measures were considered:

- Improving the quality of nutrition by increasing the percentage of protein which leads to an increased supply by 5%. It is estimated that the improvement of breeding technology leads to methane emissions decreasing by 10% at 2020 and by 25% at 2030 in the scenario steps;
- Increased weight gain per kg of fed animal and milk growth per kg of fed animal that will provide increased performance and will ensure a reduction of methane emissions by 5% in 2020 and 10% in 2030 in scenario with supplementary measures.

In order to reduce methane emissions from livestock manure, the anaerobic fermentation of manure and the methane recovery as fuel will be applied in livestock complexes.

Sludge from livestock will be used as organic fertilizers or will be composted in aerobic method, for avoiding methane emissions.

In the WEM scenario, the recovery rate for methane emissions from anaerobic fermentation of manure was estimated to reach approx. 10% in 2020, approx. 15% in 2025 and approx. 25% in 2030. In the WAM scenario, the methane recovery rate was estimated to reach 40% in 2030.

Considering the inability to forecast the volume of activities that are source of N_2O emissions during 2013 ÷ 2030 period, the emissions evolution in the WOM scenario were estimated by extrapolating these emissions, by type of activity, with an average annual rate of about 3.1%.

In the WEM scenario, due to the large share of emissions from fertilizer application, were included measures for improving the technologies using nitrogen fertilizers, which will increase utilization and reduce nutrient losses by leaching. The technique of fertilization in phases will be used as well as the range of machines for uniform distribution of fertilizers and balancing the ratio of various nutrients (nitrogen, phosphorus, potassium and so on).

Within the WAM scenario, the ferti-irrigation technique will be considered.

In the WEM scenario and WAM scenario, the emissions were estimated to decrease by 25% in 2030, due to modern methods of fertilizer application.

V.D.6 Methodology for creating carbon storage programs by the use of land, changing the destination of land and forestry

The prognosis is created using a number of models of varying complexity, based on the land's type of use, the most complex being forest prognoses. Simulations cover absorbents and major CO_2 sources, except for the carbon stored in forest wood products, which is taken as neutral (entries in these storage equal exits).

To create *carbon storage prognoses* using forestry-specific measures *(for forested lands)*, specialized CBM-CFS3 software is used, which incorporates an empirical model that simulates the dynamics of all carbon stores in forest ecosystem storages according to the Kyoto Protocol (over and underground biomass, litter, deadwood as well as organic carbon deposited in soil). The program was developed in Canada by Dr. Werner Kurz and the Canadian Forestry Service team.

This carbon store dynamic modelling framework conforms to the carbon store estimation and change assessment models of ecosystem stores described in the "Good Practice Guidance For Land Use, Land-Use Change and Forestry" of 2003, of the Inter-governmental Climate Change Committee (GPG for LULUCF, IPCC, 2003).

The software uses the following information: tree species, annual growth and wood production curves for the stands, statistical data on manmade and natural disruptions, harvested wood mass as well as land-use change information (deforestation, forestation). Thus, users are also able to create, simulate and compare various forest management scenarios in order to assess their impact on CO_2 emissions.

To simulate the scenarios, the following data was used:

a) Forested surfaces from the primary results of the first NFI cycle (2008-2012) * namely 6,641,464 hectares, of which:

   (i) Forests and other forest vegetation lands where wood harvesting is regulated (5,925,015 hectares);

   (ii) Forests and other forest vegetation lands where wood harvesting is **not** regulated (716,449 hectares) used to simulate over time the forest vegetation not affected by cutting (protected areas).

   ** the statistical inventorying of the country's entire vegetation is carried out within NFI. Because the definitions of the forest vegetation categories used in our country only partially correspond with international definitions, NFI uses both forest vegetation classification systems. In this case only the international definitions were used (http://roifn.ro).*

b) Forest surfaces were divided into several categories:

   (i) Seven main species groups (spruce, fir, other conifers, beech, oak, miscellaneous hard and miscellaneous soft);

(ii) Eight Romanian development regions (NUTS II) (North-West, Center, North-East, South-East, South, Bucharest and Ilfov, South-West, West);

(iii) Twenty-one stand age classes (stands over one year old were aso taking into account ~4% of the total surface);

(iv) Eight climate units (average annual temperatures and rainfall in forested lands) used in the eight development regions per main species groups (resinous and hardwood), the purpose of this information being to apply the necromass decomposition model (litter, deadwood, soil). The climate units were introduced as per the procedure published by Roberto Pilli (JRC) in *„International Journal of Applied Earth Observation and Geoinformation, Volume 19, p. 59-71"* in the article entitled *„Calibrating CORINE Land Cover 2000 on forest inventories and climatic data: an example for Italy"*.

(v) Current annual growth and productivity curves for the seven main species in *Giurgiu, V., Decei, I., Armasescu, S., 1972. Tree and stand biometry in Romania, Dendrometric Tables. Ed.Ceres 1972, Bucharest, 1154p.*

c) The harvested volume of wood mass used was supplied by the National Institute of Statistics (INS) for the years 1970-2011, per development regions and species groups (age of technical exploitability used was taken from the latest technical norms).

d) A correction was applied both to annual growth as well as the harvesting of wood mass, which consisted in reducing the two parameters with values appropriate to the size of the biomass expansion factors, in order to avoid the model overestimating by automatically applying these factors.

Emissions projection for forest conversions (deforestation) is carried out based on a national average Carbon store in living wood biomass of 66.8 tC/ha, 7.55 tC/ha in litter (dead organic matter, consisting of deadwood and the litter's corresponding decomposition layers) and a decrease of the Carbon store in the soil of 2.65 tC/ha/year, because Romania was only transitioning towards lands which were strongly modified by man (where 30 cm of topsoil are removed). The calculation is carried out using the nation GHG inventory calculation sheets, the report of 15 of January 2013.

The projection regarding conversions to forest includes all conversions to forest, without differentiating whether they are directly or indirectly anthropogenic. The simulations include assessments of fixed CO_2 V2.1 carried out within the JIFOR project and the common implementation project implemented by Romsilva and the World Bank's Carbon Fund. The data is simulated based on Romanian production and validation tables with data measured under real conditions (within the JI project).

Emissions' projections from non-forested lands: arable land (arable and with wood vegetation that is the subject of reforestation and biomass energy wood cultures, orchards, vineyards), as well as pastures (pastures and hayfields), are carried out based on extrapolation on NIR estimations during the interval of 1970-2010. The projections are carried out using the GHG inventory's calculation sheets, linearly regressed for the interval 2015-2030. The time series start with the year 1970 in order to capture the effects of the emissions/sequestration generated especially by changes in the organic matter deposits in soils associated with the land-use changes in the 20 year transition period.

Integrating the emission and absorption by changing the stores in various ecosystem deposits on non-forest lands is carried out using the land-use change matrix in use at the national GHG inventory. Data on land surfaces is supplied by NIS, as per the methodologies described in the NIR 2013. Land representation is considered to be an intrinsic component of the time series supplied by NIS, and for forested lands by NFI as well. NFI forest data is larger than that published by NIS, and the calculation takes them into account by decreasing pastures. The annual surface data supplied by NIS are considered as net values at the end of the year (in kha = 1000ha). These surfaces are included in the land-use matrix covering the interval of 1970 - 2010. The yearly decrease in forested surface from one year to the next is considered deforestation (namely change of the use category to non-forest).

As a consequence, the resulting assessments cannot be used to determine the quantifiable amount in order to fulfil the future emission reduction obligations, because they only concern emissions/sequestration resulting from direct anthropic activities and eligible types of activities.

As a simulation basis, each use category is associated a series of activities that may be carried out based on the land category, presented in table V_61**.**

Table V_ 61 *Hypotheses taken into account when creating scenarios*

IPCC land category (from GHG inventory)	**Activity expected due to the plan/policy/program***
Forest lands	Forests in the national forest funds and forest vegetation outside of the national forest fund; Increasing the yearly wood mass harvest.
Conversions to forest lands	Forestation by plating degraded land and; The natural expansion of forest vegetation (inclusion in forest management plans).
Farmlands	Land replanting and creation of forest curtains (including in any type of agro-forest system); Creation of wood biomass cultures; Implementation of „low till" and „no tillage" technologies.
Conversion to farmlands	Decreasing the conversion of land with high carbon stores (ex. from pastures and wetlands).
Pastures (pastures and hayfields) and wetlands	Integral protection of hayfield surfaces; Encouraging forest management for wood vegetation in agro-forest-type systems.
Conversions to pastures and wetlands	Freeing degraded lands for ecological reconstruction (forested or replanted with plant species of the natural fundamental type); Decreasing the conversion to farmland; Conservation of wetlands.
Anthropogenic lands. Other lands & conversions to them.	Conservation of urban green areas.

Such combinations of activities implemented sartorially by 2030 take into account the country's economic capabilities and presume that the economic sectors implement them simultaneously with no technological, financial and capacity restrictions.

Most detailed data entered into the model is identical regardless of scenario (Table V_62 summarizes the scenarios' input data)

Table V_ 62 *The value range of the Carbon store annual change in various stores used in the simulations*

Carbon store	Value range of carbon store annual change (tC/year/ha)
Forest lands that remained forest lands	
Biomass (national forest fund)	Average annual growth 1.58 - 2.10 and average annual decrease (by harvesting) 0.24 – 0.38
Biomass (outside of the national forest fund)	Average annual growth 1.8 and average annual decrease 0.3
Lands converted into forest lands.	
Biomass (3)	0.16÷2.61
Dead organic matter	0.15÷0.32
Mineral soils	+1.85 from CL; +1.75 from GL,WL; +2.65 from SL; +2.2 from OL
Forest lands converted to other lands.	
Dead organic matter	-7.42 for litter; -0.75 for deadwood
Mineral soils	-1.85 to CL; -1.75 to GL,WL; -2.65 to SL; -2.2 to OL
Forest lands converted to other lands.	
Biomass	-66.88
Dead organic matter	-7.42 for litter; -0.75 for deadwood
Mineral soils	-1.85 to CL; -1.75 to GL,WL; -2.65 to SL; -2.2 to OL
Farmland	
Non-wood annual culture	Neutral
Biomass (forest species' vegetation) (3)	0.16-2.61
Biomass (wooden, non-forest vegetation)	63
Biomass (net annual change) (1)	2.1
Farmland mineral soils (2)	-0.05
Permanent farmland mineral soils (2)	0.01
Mineral soils from conversion lands to any type of farmland	-0.1 from GL,WL; +0.8 from SL; +0.35 from OL
Wood plantings on farmlands	
Willow– Average annual production of aboveground wood biomass (DM, t/ha/year)	7.0
Poplar – Average annual production of aboveground wood biomass (with m/ha/year)	11.6
Pastures	
Biomass (1)	0.85
Biomass (net annual change) (2)	0.01

Carbon store	Value range of carbon store annual change (tC/year/ha)
Mineral soils from permanent pasture lands (net change) (2)	0.01
Mineral soils from lands converted to pastures	+0.1 from CL; 0 from WL; +0.9 from SL; -0.45 from OL
Wetlands	
Biomass	0.85
Biomass (net annual change) in	0.05
Mineral soils from lands converted to wetlands	+0.1 from CL; 0 from GL; +0.9 from SL; -0.45 from OL
Anthropic lands	
Mineral soils from lands converted to anthropic lands	-0.8 from CL; -0.9 from GL,WL; -0.45 from OL
Net urban area sequestration	0.1
Annual wood harvest	

The positive value (+) indicates an increase in the Carbon stored in the ecosystem store and the negative value (-) indicates its reduction (table V_62). The data is available at the national level, except for (1), which is provided by IPCC (2003) and (2) regular average of the implied net growth of Carbon store changes / decrease reported by SM UE-27 in NIR presented to UNFCCC in 2012 (Mandl et al, 2012). For biomass estimations (3), the values reflect the age dependency of stands of the currently used annual growth.

In table V_63, is presented the conditions and prerequisites envisaged to achieve GHG emission projections as a result of land use for the three scenarios without measures (S1), with measures to improve land use (S2), with additional financial incentive measures for specific green economy products and services (S3).

Table V_ 63 *Scenarios and the methodology for the estimation of GHG's projections for the 2015÷2030 period*

	Terms and conditions description	Input data and detailed methodology of quantitative forecast
Scenario 1 – No measures		
Suppose the current administration practices and resource management for all types of land use		Forest land – with the CBM-CFS3 projection. Non-forest land – the average of 30 random projections of current estimates of NIR. The scenario includes afforestation of 2 kha annually. The estimate assumes the projection of the trend during the 1990s plus annual velocity randomization between the maximum and minimum values of the difference between consecutive years. (with presentation of a number of 30 iterations, until the change in the average has been reduced under ± 2% between consecutive years).
Scenario 2 – With measures to improve land use		
(1)	The increase of annual harvest wood as of the pre-1989 period	The projection of removals of the forest vegetation lands with CBM-CFS at the average annual level of 24 million cubic meters. The project involves full conservation of nature protection areas
(2)	Afforestation of degraded lands 5 kha/year (including revegetation and forest belts) for the period 2012-2030	The cumulative annual afforested area for the period 2012-2030 assuming that it derives half from agricultural land (arable land) and half from grassland (including hayfields) according to the simulations of the JIFOR.

Terms and conditions description		Input data and detailed methodology of quantitative forecast
(3)	Implementation of "no-till" practices for 30% of the area of arable land (in rotation) per year from 2015-2030	Transition of such areas is assumed to "no till" management. Emission factors considered are: the conversion of the "normal tillage" to "no till" of +0.3 tC/ha and -0.3tC/ha reverse conversion, with respect to the soil C stock ("+" means absorption from the atmosphere). Emission factors will be applied to the stock currently reported by NIR. The data is from the JIFOR project.
Scenario 3 – With additional financial incentive measures for specific products and services in the green economy		
(1)	The increase of annual harvest wood as of the pre-1989 period through the intensification of forest management.	The projection of removals of the forest vegetation lands with CBM-CFS at the average annual level of 24 million cubic meters This involves simulating the increase in the harvest of wood from secondary works (e.g. thinnings) to a level of 60% of the annual harvest. The project involves full conservation of nature protection areas
(2)	Afforestation of degraded lands 10kha annually (including revegetation and forest belts)	It is added to S1 emissions or removals of (1) The cumulated annual afforestation for the period 2012-2030 assuming it derives half from agricultural lands (arable land) and half from grasslands (including hayfields).
(3)	The creation of woody biomass from rapidly increasing crops at 5kha per year.	The assumption of an annual harvest of biomass 15t SU environments/ha and application of 100 kg nitrate/ha/year.
	Implementation of "no-till" practices for 40% of the area of arable land (in rotation) per year from 2015-2030	Transition of such areas is assumed to "no till" management. Emission factors taken into consideration are: the conversion from "normal" to "no tillage till" + 0.2 t C/ha and reverse conversion of tC-0.3/ha. Emission factors will be applied to the C stock by the NGHGI. The data is from the JIFOR project.
(4)	Increasing the protected area of nature conservation and biodiversity protection.	Keeping meadow area in the natural state and implement measures to prevent the over-exploitation and conversion to other uses.

The evolution of the area occupied by forests, afforestation, deforestation and the harvested wood volume, for the 2010 ÷ 2030 period, for the analysed (WOM, WEM, WAM) is presented in the table V_64.

Table V_ 64 *The evolution of the area occupied by forests (FM), afforestation, deforestation and the harvested wood volume during the 2010 ÷ 2030 period*

	2010	**2015**	**2020**	**2025**	**2030**
Area occupied by forest (thou hectares) of which:	6758.1	6642.1	6642.1	6642.1	6642.1
Forest area	6354.0	6515.7	6515.7	6515.7	6515.7
Other areas	404.1	126.4	126.4	126.4	126.4
Afforested area (thou hectares)	10.1	51.1	101.1	151.1	201.1
Deforested area (thou hectares)	0.11	0.2	0.2	0.2	0.2
Harvested wood volume (S1 - WOM) (thou m^3)	16992	13591	12642	16692	16705
Harvested wood volume (S2 - WEM) (thou m^3)	16992	22651	21070	27819	27841
Harvested wood volume (S3 - WAM) (thou m^3)	16992	22651	21070	27819	27841

V.D.7 Methodology for GHG emissions projection in the Waste sector

Waste elimination by storage has a direct impact on the environment, including by generating GHG emissions.

Waste degradation is a complex process involving chemical and biological reactions, whose results generate biogas with the basic composition: CH_4 and CO_2. The biogas decomposition and elimination process continues for 10 to 30 years, 50 % of degradable organic waste decomposing over 10 years, 12.5 % of the remainder decomposing over 30 years.

In 2011, GHG emissions in the Waste sector accounted for 5,415.21 Gg CO_2 equiv., representing 4.39% of the total national GHG emissions.

In regards to the percentage offset of GHG emissions for the Waste sector, the largest contribution in 2011 was due to the waste water sub-sector (6.B) with a percentage of 53.67%, followed by the stored solid waste sector (6.A) with a percentage of 46.13% and the waste incineration subsector (6.C) with a percentage of 0.20%.

The GHG emissions forecasts were perform according to the IPCC 1996.

V.D.7.1. Forecasting methodology for GHG emissions due to waste storage

The main factors used are:

1. *Methane generation constant, 1/year*
2. *Total amount of generated municipal solid waste, Gg/year*
3. *Municipal waste fraction disposed of in storage*

   Municipal waste consists of the following categories:

   i. Household waste, from individual homes (collected either unsorted or sorted);
   ii. Waste similar to household waste, from business, industry, public and private institution activities;
   iii. Park and garden, market, street waste;
   iv. Sludge waste from municipal wastewater treatment plants;
   v. Construction and demolition waste.
4. *Total amount of municipal waste stored in non-conforming storage facilities*
5. *Total amount of municipal waste stored in conforming storage facilities*
6. *Degradable organic carbon*
7. *Dissimilar DOC fraction*
8. *Methane correction fraction*
9. *Methane fraction in biogas*
10. *The amount of methane recovered to be burned, to be vented and to be used in energy production from waste storage*
11. *Oxidation factor*

The most important factors influencing this gas generation process result from:

- The proportion of organic degradable components in waste, such as fat, proteins, carbohydrates, cellulose, etc.;
- The store's internal temperature;
- Stored waste compaction factor;
- Chemically combined or free water content.

The parameters used for estimating the CH_4 emissions resulted from compliant deposits are presented in table V_65.

Table V_ 65 *Parameters used for estimating the CH_4 emissions resulted from compliant deposits*

Parameter	Symbol	UM/ parameter value	Emissions estimate	Emissions forecast
Activity data				
Total quantity of generated municipal solid wastes	MSWT	t/year	Yes	Yes / variable
Fraction of generated municipal solid wastes laying down	MSWF	t/year	Yes	Yes / variable
Emission factors				
Methane correction factor	MCF	1	Yes	Yes
Degradable carbon organic fraction	DOC	%	Yes	Yes
Correction factor	A	0.975	Yes	Yes
Methane generation constant	k	0.05	Yes	Yes
Degradable carbon organic fraction converted in biogas	DOCF	0.55	No	Yes
Methane fraction in deposit gas	F	0.5	constant	constant
Recovered methane fraction	R	t/year	Yes	Yes
Methane oxidation factor	OX	0	constant	constant

The parameters used for estimating the CH_4 emissions resulted in non-compliant deposits are presented in table V_66.

Table V_ 66 *Parameters used for estimating the CH_4 emissions resulted in non-compliant deposits*

Parameter	Symbol	UM/ parameter value	Emissions estimate	Emissions forecast
Activity data				
Total quantity of generated municipal solid wastes -	MSWT	t/year	Yes	Yes / variable
Fraction of generated municipal solid wastes laying down	MSWF	t/year	Yes	Yes / variable
Emission factors				
Methane correction factor	MCF	0.6	Yes	Yes
Degradable carbon organic fraction	DOC	%	Yes	Yes
Correction factor	A	0.975	Yes	Yes
Methane generation constant	k	0.05	Yes	Yes
Degradable carbon organic fraction converted in biogas	DOCF	0.55	No	Yes
Methane fraction in deposit gas	F	0.5	constant	constant
Recovered methane fraction	R	t/year	Yes	Yes
Methane oxidation factor	OX	0	constant	constant

V.D.7.2. Forecasting methodology for GHG resulted from wastewater treatment

IPCC documentation applied to the Romanian conditions shows the existence of the following possible sources of methane emissions:

- Domestic wastewater collected in the sewerage networks and discharged into the environment without treatment; these water undergoes an aerobic self-cleaning process, with minor methane emission;
- Domestic wastewater collected in the sewerage networks and treated in municipal wastewater treatment plants using aerobic and anaerobic biological processes.

  The large wastewater treatment plants are equipped with active sludge ponds containing aerobic, anoxic and oxic zones. The oxic zones can become anoxic and even anaerobic, if the treatment process is not properly conducted. In this case the methane may occur.

  The sludge from the treatment plants undergoes stabilization processes that can be anaerobic or aerobic. In the case of anaerobic treatment of the sludge is produced biogas high in methane. Usually, the biogas is used for electricity generation or thermal plants. In case of failures the methane can reach the atmosphere.

- Domestic wastewater in the areas without sewage networks is collected in septic tanks or cesspools, where aerobic and anaerobic processes occur that cannot be controlled. The anaerobic processes, source of methane, are more developed in high temperature zone and when the interval between vacuuming is high.

Following the above, domestic wastewaters that can be a significant source of methane emissions come from:

- Population that is not connected to a sewerage network;
- Population that is connected to a sewerage network, with treatment.

N_2O emissions from the human waste are related to the presence of nitrogen discharged from the proteins consumed. To calculate emissions are used an IPCC default method, from "Reference manual", taking into account the total population of Romania.

V.D.8. Sensitivity of underlying Assumption and Uncertainty

The GHG emission projections are based on assumptions related to macroeconomic indicators with high uncertainty on horizon until 2030, because of the economic crisis at nationally and globally level and the lack of updated 2030 strategy on industry, agriculture, transport, etc. Thus, economic development is a dominant factor affecting the results projected.

In order to analyse the sensitivity of projections of GHG emissions in the given assumptions there are developed scenarios on the minimum and maximum economic recovery, compared to baseline scenario for which projections were made. Sensitivity analysis refers to economic development as the effect of other factors is substantially lower.

V.D.8.1 Energy Sector

Considering the share of about 70% of emissions from fuels combustion in total GHG emissions in Romania, sensitivity analysis focuses on GHG emissions due to the energy sector.

The main indicators considered in the sensitivity analysis for alternative scenarios, compared to the baseline scenario, are presented in the table V_67. The evolution of the population is considered to be the same in all scenarios. Macroeconomic indicators determine developments in energy and electricity influence on GHG emissions.

Table V_ 67 *Evolution of the macroeconomic and energy indicators in the 2015 ÷ 2030 period for the analysed scenarios*

Scenario	INDICATOR	M.U.	2015	2020	2025	2030
MINIM	Gross domestic product	10^9Euro$_{2010}$	129.40	142.30	163.60	188.2
	Primary energy consumption	10^6toe	35.40	36.50	38.80	39.50
	Final energy consumption	10^6toe	23.60	25.50	27.00	28.50
	Electricity gross consumption	TWh	60.70	65.70	71.20	77.20
BASELINE	Gross domestic product	10^9Euro$_{2010}$	135.98	159.20	184.50	203.70
	Primary energy consumption	10^6toe	36.20	38.80	39.00	40.20
	Final energy consumption	10^6toe	24.50	27.10	28.00	29.00
	Electricity gross consumption	TWh	63.72	70.50	77.20	82.40
MAXIM	Gross domestic product	10^9Euro$_{2010}$	140.50	169.60	192.80	220.70
	Primary energy consumption	10^6toe	36.90	39.20	40.20	43.70
	Final energy consumption	10^6toe	24.70	27.40	28.15	30.80
	Electricity gross consumption	TWh	66.72	74.30	80.20	85.30

Assumptions on macroeconomic restructuring during 2011 ÷ 2030 period, for the alternative scenarios considered in the sensitivity analyses are presented in the table V_68.

Table V_ 68 *Evolution of Gross Value Added in the 2011÷2030 period*

Scenario	INDICATOR	2011	2015	2020	2025	2030
MINIM	**Gross Value Added**, of which:	100%	100%	100%	100%	100%
	Industry	33.02	32.5	32.0	31.8	31.5
	Agriculture	7.48	7.4	7.0	6.8	6.0
	Construction	9.76	10.0	10.0	10.0	10.0
	Services	49.74	50.0	51.0	51.4	52.6
MAXIM	**Gross Value Added**, of which:	100%	100%	100%	100%	100%
	Industry	33.02	31.0	29.2	28.5	27.5
	Agriculture	7.48	6.5	6.0	5.5	4.5
	Construction	9.76	10.0	10.0	10.0	10.0
	Services	49.74	52.5	54.8	56.0	58.0

The evolution of CO_2 emissions due to energy sector, in the baseline and alternative scenarios (minimum and maximum), is presented in the table V_69.

Table V_ 69 Evolution of CO_2 emissions in analysed scenario

Scenario	INDICATOR	2015	2020	2025	2030
MINIM	A. Fuels combustion	**74300.0**	**7610.7**	**78100.5**	**80244.5**
	1. Energy industry	31390.7	31991.4	32641.4	33901.9
	2. Manufacture and construction industry	15370.0	15770.0	16220.0	16599.6
	3. Transport	16445.8	16945.8	17495.8	17761.5
	4. Other sectors	11093.5	11393.5	11743.3	11981.5
BASELINE	A. Fuels combustion	**75097.25**	**79925.27**	**81070.59**	**83433.74**
	1. Energy industry	31636.7	31834.42	31344.24	31200.9
	2. Manufacture and construction industry	15631.01	17289.81	17864.01	18502.01
	3. Transport	16645.88	18412.39	19023.87	20398.13
	4. Other sectors	11183.66	12388.66	12838.47	13332.70
MAXIM	A. Fuels combustion	**77378.5**	**80973.6**	**83373.6**	**86663.9**
	1. Energy industry	32246.2	32770.8	33098.7	33278.5
	2. Manufacture and construction industry	16031.4	17798.2	18394.5	19100.5
	3. Transport	17345.3	18618.3	19507.8	21809.2
	4. Other sectors	11755.6	11786.3	12372.6	12475.7

The sensitivity analysis for fuels combustion related to the energy sector (energy industry, manufacturing and construction, transport and other sectors) in relation to national economic development allows drawing the following conclusions:

- CO_2 emissions are in line with GDP evolution. However, the increase in the maximum scenario is less than the decrease in the minimum scenario, considering that the higher the GDP is, higher will be funds available for new technologies;
- For manufacturing and construction, the emissions increase with GDP, but the growth is lower than the decrease in the minimum scenario which demonstrates the existence of funds for environmental protection and energy efficiency;
- For the transport sector, in the maximum scenario is an increase of emissions to GDP growth greater than the reduction in the minimum scenario, as a result of the increased standard of living of the population causes a significant increase in its mobility;
- The structure of electricity production park does not differ in the different emission scenarios. Difference in this sector is mainly based on electricity and heat demand to be met.
- The impact on emissions in other sectors such as residential, agriculture and service is not significant.

V.D.8.2 LULUCF Sector

Scenario without measures (S1) is the only option that provides an annual net amount of CO_2 absorbed into the conditions for sustained growth of the annual harvest by 20 percent, increasing the risk to harvest more than annual growth, and thus of having emissions from forests, for the other two already after 2020 scenarios. Major risk generated by scenario with additional measures (S3) is multiple: the annual quantity of strong emissions and increasing trend of emissions over time. The possibility of achieving scenario with measures (S2) (with +20%) and scenario with additional measures (S3) (with +20%) is extremely small, but it would mean an annual harvest of about 35 million cubic meters for the 2015-2030 more realistic is a close variant of scenario without measures(S1) (+20%).

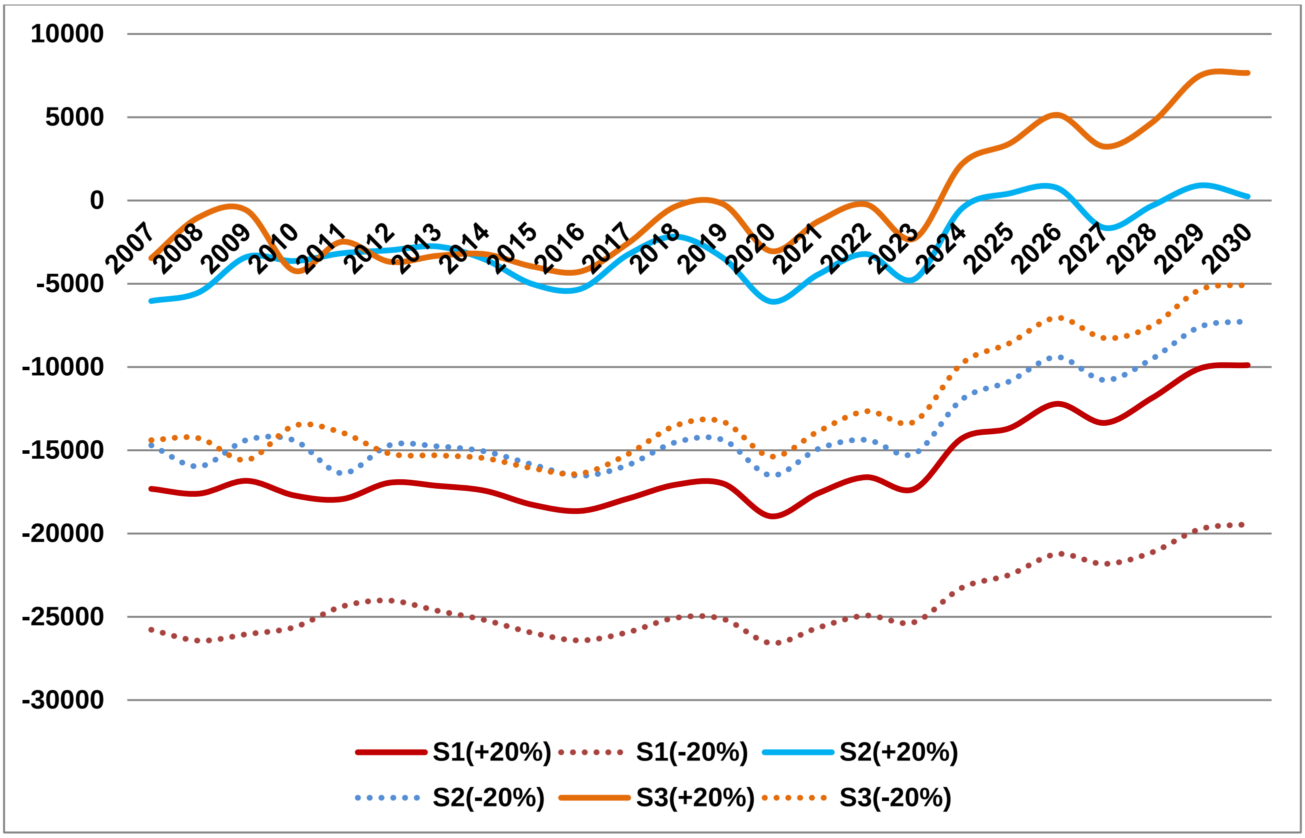


Figure V_D_ 3 *The sensitivity analysis of the three scenarios [Gg CO_2 equivalent]*

VI. VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES

VI. A. Expected impacts of climate change

Over the last years, adaptation to climate change impacts has reached an important position on the Romanian political agenda. The National Strategy for Climate Change in Romania, which has an important adaptation section, was approved in July 2013 by the GO 529/2013. This strategy refers to the effects of climate change on water safety, agriculture, energy, transport, industry, insurance, biodiversity, health, tourism, forestry, infrastructure, and recreational activities. The National Strategy for Climate Change in Romania builds technical knowledge upon the background of the Guide on Adaptation to Climate Change issued in 2008. The strategy adds extra guidance on the approaches and institutional cooperation needed to cope with climate change in Romania in an integrative and multi-sectoral providing more information on implementation/application aspects of adaptation relative to the Guide.

This chapter presents updated observed changes in the climate regime and scenarios on the future climate change as well as climate-related vulnerability and adaptation knowledge produced in Romania from the previously issued report.

VI.A.1 Observed changes in the climate regime in Romania

Air temperature

Analysis performed on data collected from meteorological stations (between 1961 and 2012) highlights significant changes in the temperature regimes in all seasons (see figure VI_A_1) with the following characteristics:

- Upward trends in seasonal temperature are statistically significant (at 90 % level of confidence) over almost all Romanian territory in spring and summer; in winter, temperatures are increasing in parts of Southern, central and North Eastern regions of Romania;
- Upward trends in autumn temperature are statistically significant (at 90 % level of confidence) only in a limited area in the Eastern part of the country.

Precipitation

There were identified the following features in precipitation data, based on statistics using observations made in the interval 1961-2012 at 104 meteorological stations (see figure VI_A_2):

- Downward trends in the seasonal amount of precipitation are present over mountain areas and over Southern and Eastern parts of Romania, in summer, spring and winter (at a confidence level of 90%);

- Significant upward trends (at 90 % level of confidence) in autumn precipitation are present in areas from Northern and central part of Romania; upward significant trends are also present in the South-Eastern part of the country.

Other climate variable trends

Analysis performed on data collected from meteorological stations, in the interval 1961 – 2012, reveals significant changes in other climate indicators, too:

- Sunshine duration is significantly increasing over a large part of Romania in winter, spring and summer; significant downward trends of sunshine duration are found over Southern and Eastern region of the country in autumn (see Figure VI_A_4);
- Snow depth is significantly decreasing over large areas in the central, Western and Northern part of the country; downward trends of snow depth are also present over smaller areas in Southern and Eastern Romanian regions (see Figure VI_A_5);
- Significant decrease of mean wind speed prevails over many areas of the Romanian territory on both annual and seasonal scales (see Figure VI_A_3);
- Warm Spell Duration Index (i.e. annual count of days with at least 6 consecutive days with daily maximum temperature > 90th percentile) is significantly increasing over large areas (except ones in the central part of the country);
- Cold Spell Duration Index (i.e. annual count of days with at least 6 consecutive days with daily minimum temperature < 10th percentile) is significantly decreasing over limited areas in the central part of Romania;
- Number of frost days (i.e. Annual count of days with daily minimum temperature < 0°c) is significantly
- Maximum length of heat waves is increasing in the southern and western region of Romania; the heat wave is defined in Romanian legislation as intervals with at least two consecutive days having maximum temperature greater than 37 °c.

Many of these observed trends are expected to continue in the near future and a part of them to amplify on medium and long terms, as global warming is progressing towards the end of this century.

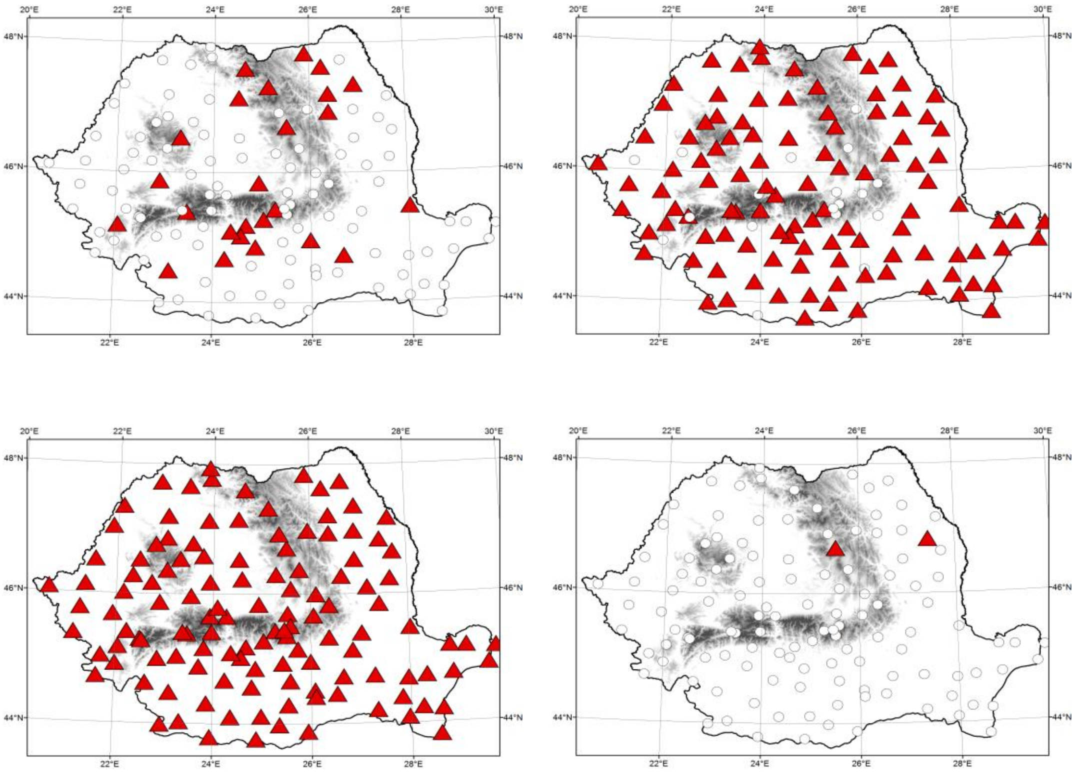


Figure VI_A_ 1 *Seasonal trends of air temperature at 124 meteorological stations for the interval 1961-2012.*[15]

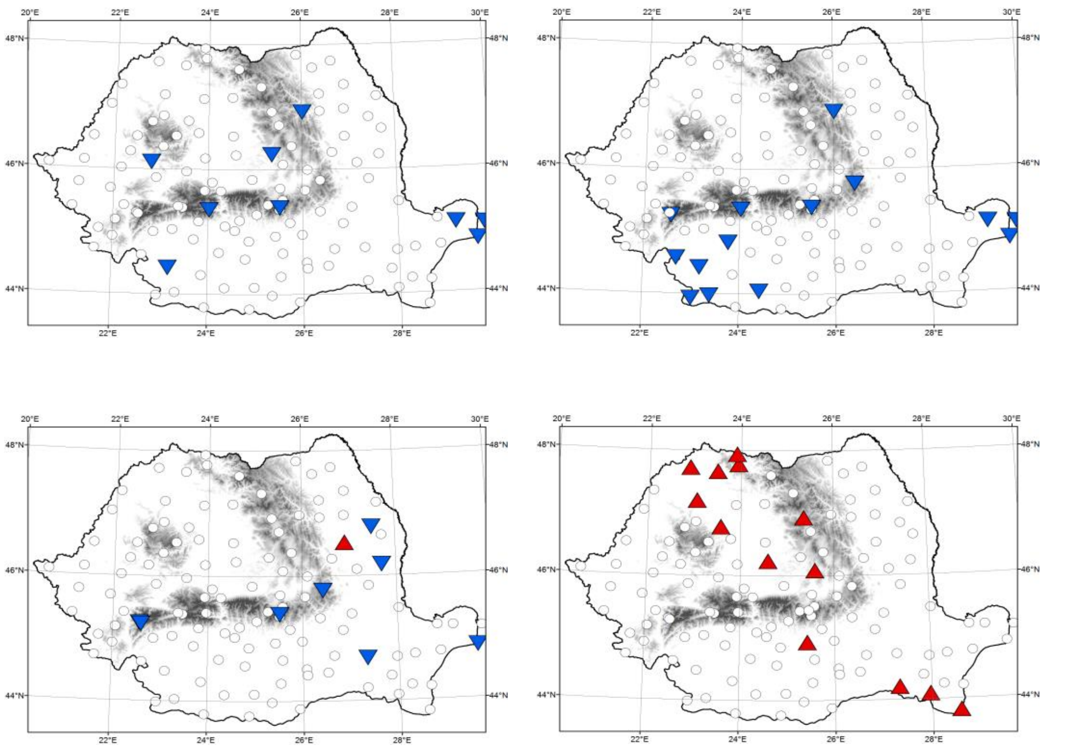


Figure VI_A_ 2 *Seasonal trends of precipitation at 124 meteorological stations for the interval 1961-2012*[16].

[15] *Significant trends (at the 90%confidence level) are represented by red triangle for increasing temperatures and blue triangles for decreasing ones. Grey circles illustrate locations without significant trends.*

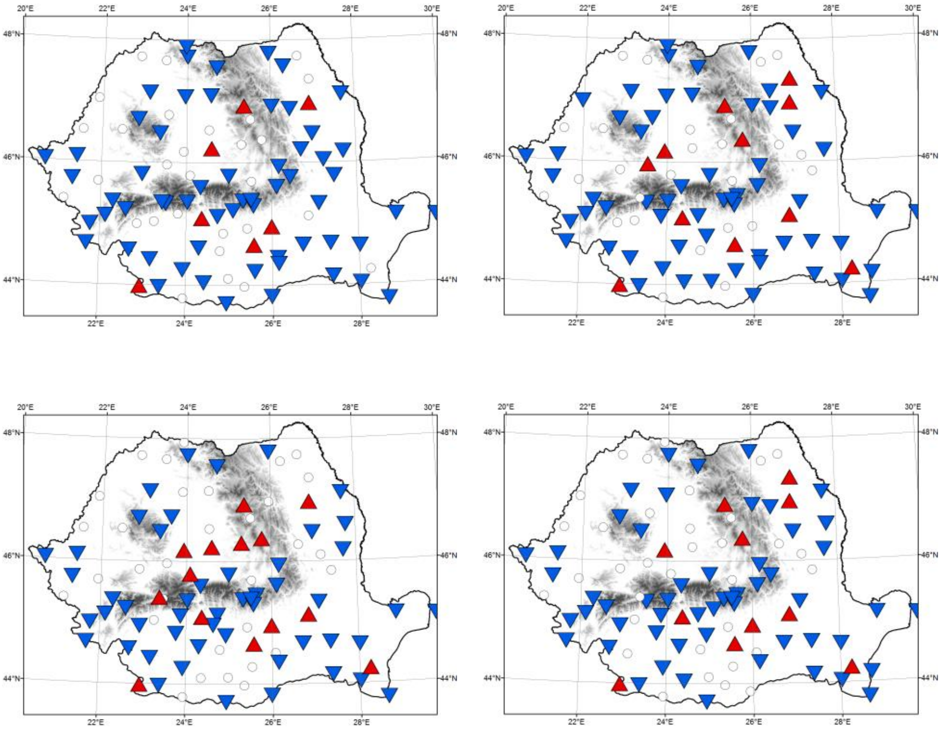


Figure VI_A_ 3 *Seasonal trends of wind speed at 104 meteorological stations for the interval 1961-2012*[17]

[16] *Significant trends (at the 90%confidence level) are represented by red triangle for increasing temperatures and blue triangles for decreasing ones. Grey circles illustrate locations without significant trends.*

[17] *Significant trends (at the 90%confidence level) are represented by red triangle for increasing temperatures and blue triangles for decreasing ones. Grey circles illustrate locations without significant trends*

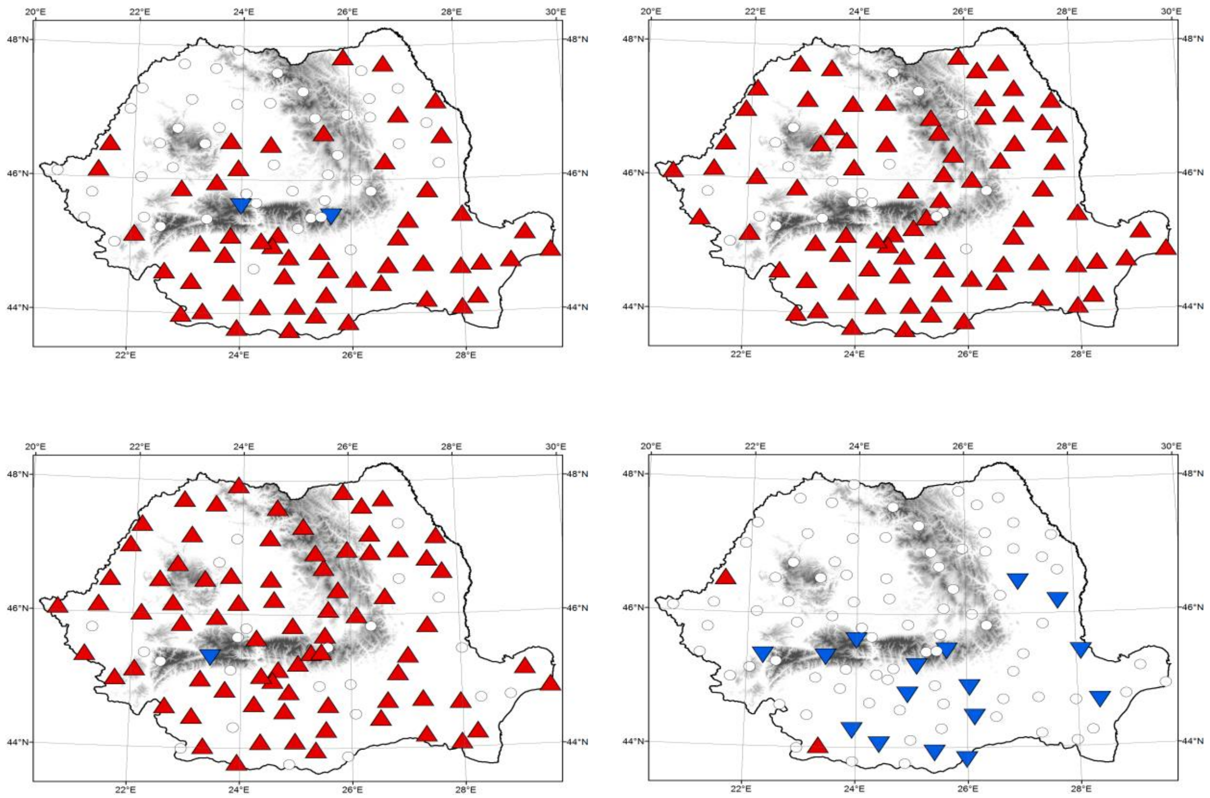


Figure VI_A_ 4 *Seasonal trends of sunshine duration at 101 meteorological stations for the interval 1961-2012[18].*

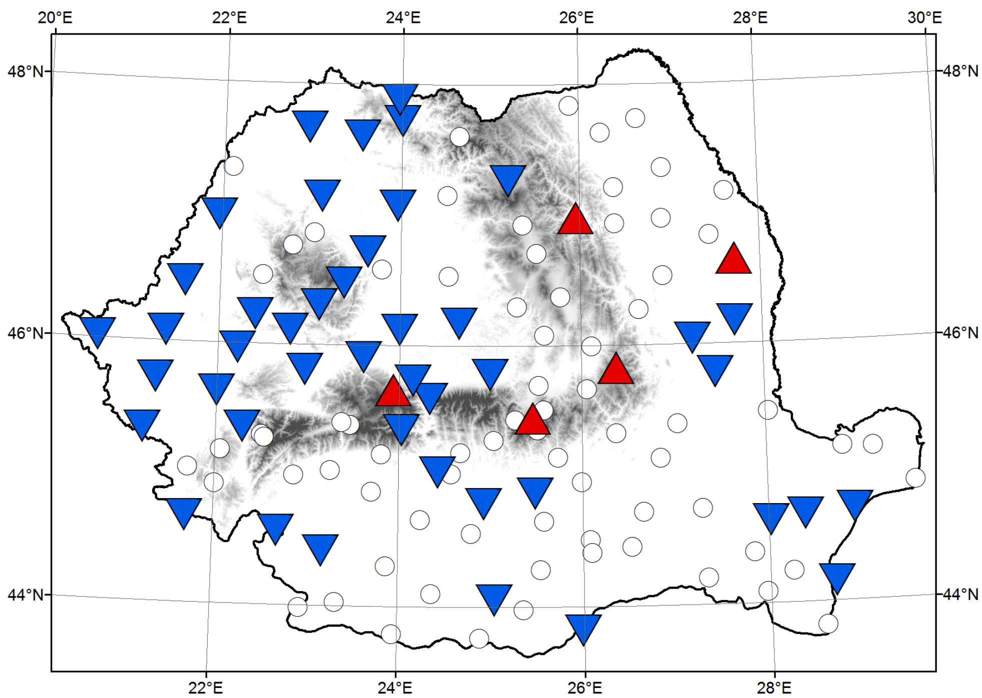


Figure VI_A_ 5 *Trends of snow depth for the cold season (December to February) at 123 meteorological stations for the interval 1961-2012[19]*

[18] *Significant trends (at the 90%confidence level) are represented by red triangle for increasing temperatures and blue triangles for decreasing ones. Grey circles illustrate locations without significant trends*

VI.A.2 Scenarios on the future climate change

One have analysed CMIP3 results based on ensembles of numerical experiments with global climate models. Averaged results over the Romanian territory show a progressive increase in air temperature during the 21st century, for all seasons but more pronounced in summer and winter. The scenario-related differences are relatively small for the first decades of the 21st century. Higher differences in climate are expected towards the end of the 21st century (National Meteorological Administration internal report, 2012). The mean temperature increases are larger for the A2 SRES scenario and smaller for the B1 one. However, even for the moderate emission scenario A1B, the mean temperature increase for Romania is about 3°C to 4 °C for summer months in the interval 2061-2090 compared with the interval 1961-1990.

As for precipitation, climate change signal revealed by CMIP3 data averaged over the Romanian territory indicates, in general, a reduction of mean rainfall in summer months, more pronounced for higher emission scenarios and stronger as we approach the end of the 21st century (e.g. Busuioc et al., 2010). A2 and A1B SRES scenarios show reduction in summer months up to 24%, respectively 20%, for the interval 2061-2090 compared with the reference interval 1961-1990 (National Meteorological Administration internal report, 2012). In the case of B1 SRES scenario, no significant changes in precipitation are identified in the model results for Romania during the 21st century. Changes in winter precipitation are much smaller for all SRES scenarios and associated uncertainties are higher.

[19] *Significant trends (at the 90%confidence level) are represented by red triangle for increasing temperatures and blue triangles for decreasing ones. Grey circles illustrate locations without significant trends*

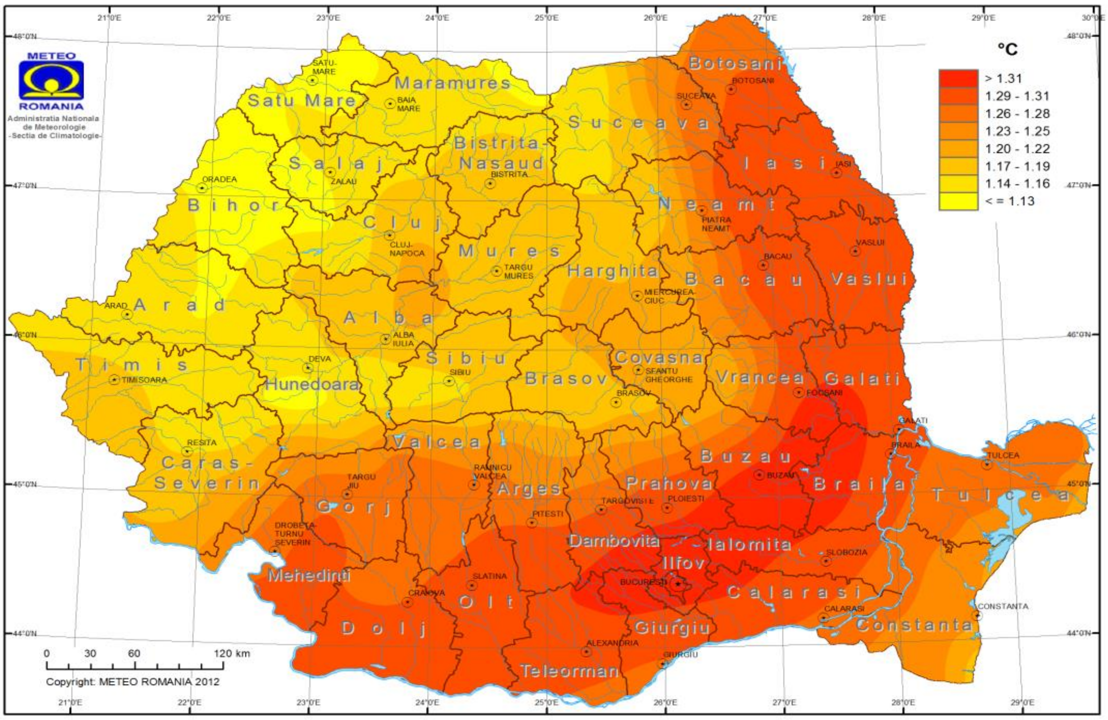


Figure VI_A_ 6 **Multiannual mean changes (2011-2040 vs. 1916-1990) in air temperatrure (in °C)** [20]

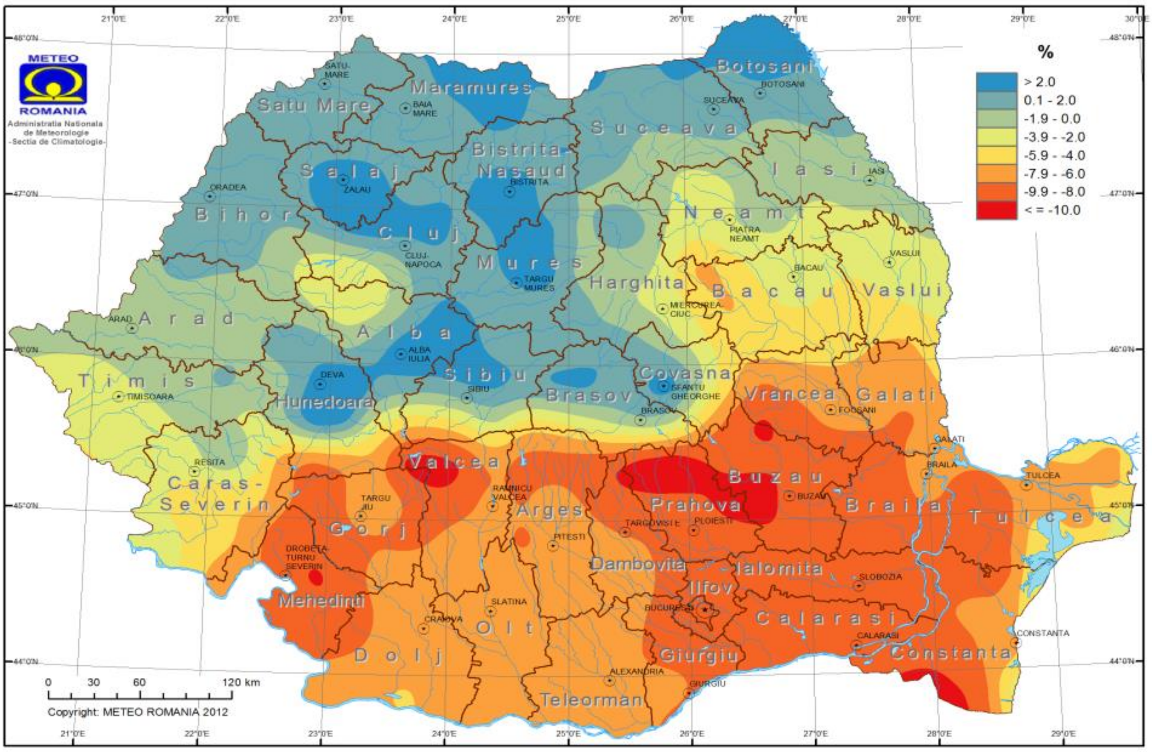


Figure VI_A_ 7 *Multiannual mean changes (2011-2040 vs. 1916-1990) in precipitation (in %)*[21]

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[20] *Mean changes are computed using 9 runs with 9 regional climate models. Climate model results are taken from the FP6 Ensembles project*

CMIP 5 results analysed by now are consistent with the CMIP3 results mentioned above, even though the magnitudes of change are slightly different due to difference between SRES and RCPs scenarios (National Meteorological Administration internal report).

In the context of global warming, changes in the climate regime of Romania are modulated by regional conditions. Regional modelling and dynamical downscaling provide supplementary policy-relevant information on detailed spatial feature of climate change. Figure 8 and 9 show annual mean temperature and precipitation changes for the near term (2011-2040 vs. 1961-1990) obtained from 9 projections with regional climate models under A1B conditions. The signal of change in the near future, in temperature is stronger over the Eastern and Southern regions (up to 1.3 °C) revealing the local influence of Carpathian chain. As for precipitation, the most vulnerable areas from the standpoint of water scarcity are South Eastern and South Western regions of Romania (where the reduction in near future in annual precipitation is estimated to be up to around 10%, under A1B scenario).

Also, projections show that changes in mean temperature and precipitation occur along with changes in extreme phenomena statistics. Extremes related to temperature increase are spatially and temporally prevailing under climate change.

VI.B. Vulnerability assessment

The climate in Romania is expected to undergo significant changes over the coming decades. In near future term (2011-2040), the most pressing consequences are those related to thermal changes (e.g. hotter summers with more frequent and persistent heat waves) over entire country (more pronounced over Southern and Eastern regions) and to reduction in mean precipitation in Southern part of Romania. Estimates based on analysed projections suggest that on the longer terms (2041-2070 and 2071-2100) the temperature increase will continue to grow and the reduction in mean precipitation will extend over majority areas of the country, in warm season. The rainfall reduction seems to be more pronounced in the Southern regions of Romania.

The National Strategy for Climate Change in Romania approved in July 2013 by the GO 529/2013 builds upon the knowledge about priority sectors, vulnerabilities and main actions identified by the Adaptation Guide issued in 2008. Sectors identified to be directly affected by the temperature increase and the modification of the precipitations conditions as well as by the manifestation of the extreme weather include:

1. Biodiversity;
2. Agriculture and Fisheries;

[21] *Mean changes are computed using 9 runs with 9 regional climate models. Climate model results from are taken from the FP6 Ensembles project*

3. Water resources and flood protection;
4. Forests;
5. Construction and Infrastructure;
6. Tourism;
7. Energy;
8. Industry;
9. Transport;
10. Public health;
11. Insurances;
12. Recreational activities;
13. Education.

VI.B.1 Biodiversity

Currently, there were identified in Romania about 3.700 plant species, out of which 23 are declared natural monuments, 74 are extinct species, 39 are endangered species, 171 are vulnerable species and 1253 rare species. Regarding the animals, it was identified a number of 33.792 animal species, out of which 33.085 invertebrates and 707 vertebrates.

Disturbing environmental factors, in a drastic manner, has direct effect on the evolution of the living creatures, initially on their ability to adapt and subsequently on their ability to survive, being likely to act in extreme cases as extinction factors for certain species in the food chains, having drastic consequences on the local biodiversity and having a general impact. In order to prevent this decline of the national biodiversity, as part of the global biologic diversity, it has to be taken into consideration the threats, the opportunities, the recommendations and the adaptation measures in this respect.

The climate change effects may even generate the extinction of certain species which are represented by one single population or by very few populations and which live in ecological niches that are extremely narrow on the one hand, but also extremely vulnerable to these effects.

Identified threats of climate change on the biodiversity are the followings**:**

- Modifications of the species behaviour, as a result of the stress induced on their adaptation capacity (shorter hibernation period, the modification of the behavioural physiology of the animals as a result of the hydric, thermal stress or the stress determined by the solar radiations expressed even as erratic migrations, the impossibility to provide the transpiration conditions at normal physiological levels, negative irreversible influences on the migratory species, disturbance of plants evapotranspiration, essential changes in the plants rhizosphere which may lead to their extinction);

- Modification of the habitats distribution and composition as a result of the change in the species structure;
- Increase of the exotic species at the level of the actual natural habitats and the increase of their potential to become invasive, as a result of either finding the favourable conditions, or of certain "ecological voids" by the extinction of certain indigenous species;
- Modification of the distribution of the ecosystems specific to wet areas, with the possible limitation up to their extinction;
- Changes in the freshwater and marine aquatic ecosystems generated by water warming, and also by the possible rise of the sea level globally;
- Increase of the risk to reduce the biodiversity as a consequence of the extinction of certain flora and fauna species, caused by the decrease of the adaptation and survival abilities, as well as the possibilities of the species to turn into species more enduring to the new climate conditions.

VI.B.2 Agriculture

In near future (2011 - 2040), under climate change conditions, stronger and more spatially extended droughts will likely affect Romanian territory in the growing season, with significant impact on agriculture activities.

Vulnerabilities in adaptation of agriculture activities in Romania to effects of climate change:

- Demographical problems (decline of local population, ageing of local population) ;
- Economic problems (lack of infrastructure for irrigation; low productivity for small farmers);
- Social problems (propriety fragmentation, youth migration from rural areas).

VI.B.3 Water resources

At the national level, concrete actions were started to increase the ability to act, especially concerning the floods problem, but also generally, on the extreme weather phenomena.

As a result of the catastrophic floods recorded at different years, it was elaborated the National Strategy of Flood Risk Management, in which there are set the duties that fall on each structure involved in the flood risk management, structured on prevention actions and measures, of operational intervention as well as those for the rehabilitation and the return to the state of normality. The strategy aims to reduce the impact of the floods on the population and on the goods by an appropriate planning and by a policy that should correspond to the standards and the expectations of the human communities, under the conditions of the environment protection. In order to increase the efficiency on the floods management locally, it was elaborated the Prefect's Handbook for the management of the emergency situations in case of floods as well as the Mayor Handbook for the management of the emergency situations in case of floods. Also, there are set at the national, regional and local level, the procedures necessary for the management of the emergency situations generated by the hydrologic drought.

It is important to underline that the rivers are complex ecosystems, which depend of the watercourses conditions in which the outflows, the sediments transportation, the temperature of the water and other variables have a well-defined role. In case certain modifications occur within these variables in relation to the values existing naturally, the ecologic balance is affected, fact that leads to the restructuring of the biocenoses, respectively the loss of species, the replacement of certain valuable species with less valuable ones.

As a consequence of this fact, the improvement of the rivers by hydro technical works must have as objective the preservation in time and space of the ecologic balance of the aquatic ecosystems, respectively of the watercourses. Instead of embedding the rivers between dams, solution applied usually up to now, the new concept "more space for the rivers" shows the dominant strategy in EU, by which it is sustained the necessity to recover the floodplains, in order for them to sew properly the floods.

The sustainable quantitative and qualitative administration of the water, the management of the natural disasters generated by the excessive presence or the lack of water, the preservation of the aquatic environment biodiversity by means of master plans performed at the level of the hydrographical basins.

Regarding the climate change impact on the water and sanitation supply systems, two major aspects were identified:

- Warmer and shorter winters lead to the decrease of the seasonal snow volume and to the early and fast snow melting;
- During the summers with extreme and dry temperatures generate the quantitative and qualitative decrease of the water resources and the increase of the water demand.

As a consequence to the climate change, the following vulnerabilities were identified:

- Increase of the evapo-transpiration, especially during the summer months due to the increase of the air temperature leading to the average decrease of the flowing conditions of the rivers with 10-20%;
- Decrease of the snow thickness and duration because of the air temperature increase during the winter, leading to a lower flow of the rivers and to a decrease of the capacity of soil moisture recovery;

- Decrease of the soil humidity leads to the decrease to minimum of the leakage (summer and autumn) contributing to the increase of the pollution frequency and of the water supply restrictions;
- Increase stress on water as needs for irrigations in agriculture grow;
- High temperatures may affect water quality in the rivers and storage lakes (the decrease of the dissolved oxygen and algae flourishing, eutrophication may affect the fish populations);
- Decrease of the river outflows may bring problems on the provision of utilities, the self- cleaning capacity of the rivers, the aquatic ecology and recreation;
- During the dry summers problems may occur related to the supply of the salubrious outflow;
- Modifications on the underground water supply and the water-bearing layers;
- Increase of the diseases associated to water;
- Increase of the damages produced by floods and droughts.

VI.B.4 Forests

Climate change will have significant impacts on forests in Romania. In the south and southeast area of country the desertification process will lead to unfavourable conditions for forest vegetation development. Furthermore, climate change will force migration of forests on phyto - climate levels.

In hilly areas, reduced rainfall and increasing of temperatures will cause a decline in forest productivity and forest diversity. In the mountain areas, forests have been severely affected by the winds are stronger and more frequent and snow, a phenomenon most prevalent in areas with spruce outside the natural range. In Romania, the forests are affected by pests that can adapt to higher temperatures and drought. This will lead to a decline in the structure and stability of forest ecosystems (including biodiversity loss) and lower quality wood.

Impact of climate change on forests in Romania was studied by applying several global climate models. One of the main threats, as shown in these studies is the considerable decrease in forest productivity after 2040 because of high temperatures and low rainfall.

Another major threat is the forest fires, causing damage and endangering human lives that can be caused by high temperatures and / or extreme weather events (lightning, storms, etc.). Most forest fires are caused by people, especially in spring and autumn when the crop residues are burning on adjacent to national forest lands. This is a result of conditioning the grant of subsidies to clean their pastures, which in most cases was made by burning unwanted vegetation or pastures dry and affected the forest.

VI.B.5 Infrastructure, construction and urban planning

According to the statistics, the worldwide urban population doubled during the last 50 years and it is estimated that in 2030 two thirds of world population will be living in cities. The increase of the population density, the development, costs dynamic, the way of life, the specific infrastructure, the ethnic and cultural diversity are elements which can be vulnerable to the climate change effects.

The major impact of the climate change on the urban areas, infrastructure and constructions is related, mainly, to the effects of the extreme weather events, such as the heat waves, abundant snowfalls, storms, floods, and the increase of the slopes instability and the modification of certain geophysical features. Therefore, urban planning and the design of an appropriate infrastructure play an important role in reducing the climate change impact and the decrease of the risk on the anthropic environment.

VI.B.6 Tourism

A recent study shows using statistical modelling that extreme temperatures negatively influence the number of foreign tourists at the Black Sea coast; increasing mean monthly temperature favours the larger presence of foreign tourists (Surugiu et. al, 2012).

Tourism in mountain stations is differently affected by monthly mean temperature compared with the stations near the Black Sea coast – increasing temperatures have a negative impact on the occupancy rate in the mountain area (Surugiu et. al, 2012). Precipitation and snow change in the mountain areas are also important factors influencing future winter activities in touristic sites. The potential for artificial snow production will be diminishes in these areas.

The above mentioned study also found the vulnerabilities in adaptation of touristic activities in Romania to adverse effects of climate change::

- Demographical problems (decline of local population, ageing of local population, a large proportion of local population working in tourism sector) ;
- Economic problems (fluctuations in local economic activity; strong dependence of local economy on tourism; low productivity of non-touristic activities);
- Social problems (a high percentage of local population is dependent on touristic activities which is strongly seasonal; a high rate of jobless people from the local population).

VI.B.7 Energy

The decrease of the electricity demand for winter heating as a result of the increase of the global average temperature does not compensate for the increase of electricity necessary for the performance of the air conditioners and of the cooling devices during the hot days.

Climate changes will modify the seasonal demand of electricity which will be lower during the winter and higher during the summer.

Problems may occur in the energy sector especially during the production of hydropower plants, taking into account the fact that the Southern and the South-eastern Europe and, implicitly, Romania is more exposed to the risk of drought. The decrease of the water resources also affects the performance of the cooling systems of the nuclear plants.

The decrease of the hydropower production was already felt in Romania when, due to the significant decrease of the precipitation level, during 2003, 2007, 2009 and 2011 minimum values were historically reached. Particularly during the last three years, electricity production from hydro power plants decreased from about 15,516 TWh in 2009 at 14,710 TWh in 2011 (by comparison the electricity produced in an average hydrological year is about 17,464 TWh).

The energy system infrastructure is affected by extreme weather phenomena; there were many situations in which, thousands of houses remained without electricity. There are the breakdowns of the transportation and distribution electricity lines, the damage of the electric transformers because of the lightning, the long blackout of the consumers because of the extremely fast increase in the energy demand for air conditioning during the summer, for which the electric distribution networks are not prepared to cover.

VI.B.8 Industry

The climate change impact on the global economy in general and of Romanian economy in particular, represents a governing factor for the further industry development because it will have as direct consequences the changes on the global market.

The primary risk to industrial sector to climate change comes from the degradation of infrastructure under the effect of natural phenomena (high temperature, precipitation, wind, etc.) and those associated with extreme events.

Interviews with representatives of the Ministry of Economy (ME) showed that, although not elaborate studies on the effects of climate change in the industrial sectors were still recorded their effects, as follows:

- Torrential rains have caused flooding surface mining, landslides have compromised access to industrial sites;

- Droughts have had an impact in reducing hydropower production which increased the amount of energy from conventional sources, resulting in an increase in emissions of greenhouse gases;
- Structure of raw vegetal and / or animal has changed;
- Operating costs for industrial sites have increased as a result of the need to increase spending on employee health insurance and labor protection;
- Operations of large industrial consumers of electricity have been restricted by the effects of heavy rainfall, heavy snowfall and excessive temperatures on transformers;
- Infrastructure damage due to high temperatures;
- Changing uncertain risk profiles for insurance against natural disasters at national level.

With increased climatic excesses, especially during summer, it is possible that in some sectors / subsectors to register:

- Increased costs for water industry;
- Increased costs for achieving the cooling;
- Lockouts during certain periods of the day due to excessive temperatures.

VI.B.9 Transport

A transport mode resilient to climate change requires, first of all, a sustainable transport infrastructure. This means that, for example, roads covered with a material resistant to temperature fluctuations and flooding, as well as bridges which take into account the water flow record.

The infrastructures of road, railway, marine and air transport are vulnerable especially to the manifestations of the extreme weather events. The direct impact of the climate change on the marine transport will be manifested, as a result of the fluctuations on the flowing conditions of the rivers and streams. Indirectly, the climate change impact will be felt at the level of the road and railway transport by the damage of the infrastructure and the lack of thermal comfort produced to the passengers.

VI.B.10 Health

A pressing problem today and in the near future is the impact of heat waves in urban areas. Under climate change conditions, many part of the Romanian territory will be affected by frequent and persistent heat waves, but urban areas are more likely to feel negative effects than others (Bojariu et al, 2013).

Heat waves effects are more severe in high populated urban areas. Young people and older one are most vulnerable but people affected by certain diseases are also highly vulnerable.

Much more vulnerability assessments have to be coupled with the information about physical basis of climate change to obtain updated and improved knowledge for adaptation in all sectors identified in the strategy for climate change in Romania.

VI.B.11. Insurances

The sector of insurances is affected by effect of climate change. Currently, there are new financial products on the market, such as derivative financial instruments or bonds for cover the climate disasters, being necessary to develop more in the future this type of products.

VI.B.12. Recreational activities

The reduction of the period with frost and of rainfalls in comparison with the raising of the temperature determines the favorable condition in the development of the activities in open air.

Impact on climate change for recreational activities is negative only due to effects generated by the extreme events.

VI.C. Adaption measures

The National Strategy for Climate Change in Romania approved in July 2013 by the GO 529/2013 builds upon the knowledge about priority sectors, vulnerabilities and main actions identified by the Adaptation Guide issued in 2008. In addition, the Strategy adds extra guidance on the approaches and institutional cooperation needed to cope with climate change in Romania in an integrative and multi-sectoral manner. On national level, the Strategy recommends the following actions: (1) periodically updating climate change projections; (2) supporting climate research and building a national data base on climate change; (3) assessing costs related to climate change for prioritary sectors; (4) elaboration of the National Agenda on Climate Change and implementing it in relevant policies; (5) monitoring and analysis of adaptation to climate change; (6) raising climate-related awareness of general public. As for the sectoral recommendations, a sound base for assessing costs related to climate change for different sectors is the evaluation of the state of the art in the knowledge of adaptation to climate change in Romania. Defining specific objectives on different time horizons and the tools to monitor the way to reach these are also important for sectoral approach of adaptation.

VI.C.1 Biodiversity

The measures for the conservation of the biodiversity ensure indirect support for the reduction of the general effects on climate change. The ecosystems play an essential role in the adjustment of the climate through theirs role in the absorption of CO_2 and in the storage of carbon.

Recommendations and adaptation measures are:

- Setting up of a national monitoring system of the endangered species, performed with public and private support, through national programs and through the participation of the Civil Society, as a result of the research activities;
- Evaluation of the monitoring system in order to determine its efficiency in accordance with the evolution of the climate change effects and the identification of its modification opportunities;
- Elaboration of the special management plans of the natural habitats in order to prevent and limit the degradation process of these habitats as a result of the climate change impact;
- Reduction of the supplementary pressures which affected the vulnerability species;
- Decrease of the agricultural activities in the areas directly affected and the implementation of appropriate measures to protect the natural and semi-natural habitats existing close to the agricultural surfaces, including the identification of compensatory measures necessary for the survival of the affected population;
- Increase of the forest areas by the rehabilitation of the waste areas and by the creation of other favourable areas;
- Performance of surveys on the assessment of different ecosystems/species vulnerability to the climate change effects;
- Management oriented towards nature;
- Improvement of the ecological conditions aquatic and at the seaside.

VI.C.2 Agriculture

The HadCM3/SRES A2 scenario's projections for 2010-2039 (2020s) and 2040-2069 (2050s) have predicted an increase in minimum and maximum air temperatures by around 1°C to 3.4°C for the 2020s and around 1°C to 6.2°C for the 2050s. The forecasts have given precipitation totals ranging within +/-18 mm in the 2020s and from -35 mm to +15 mm in the 2050s. Precipitation totals are generally higher during the winter and lower in summer.

Table VI_1 and Figure VI_C_1 show the modifications undergone by monthly average high and low air temperatures and precipitation totals over 2010-2039 and 2040-2069 as compared to the current climate ones (1961-1990) provided by the Agro-Meteorological Station Călăraşi.

Table VI_ 1 *Modifications of the monthly average high and low air temperatures (oC) and precipitation totals (mm/month) provided by the HadCM3/SRES A2 scenario over 2010-2039 (the 2020s) and 2040-2069 (the 2050s), respectively, as compared to the current climate parameters recorded by the Agro-Meteorological Station Călăraşi*

Scenario	Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
	High (°C)	0.7	1.5	1.5	0.8	1.2	1.8	3.3	3.4	2.5	1.1	1.6	0.5	**1.7**
2020	Low (°C)	0.8	1.5	1.1	0.8	0.9	1.3	2.0	2.5	1.7	0.8	1.2	0.6	**1.3**
	Precipit (mm)	2.6	-1	-1	2	-7	-12	-21	-17	-18	-10	18	8	**-**
	High (°C)													
2050	Low (°C)	1.3	2.7	2.7	2.3	1.9	3.8	6.2	5.4	4.2	2.6	3.7	4.0	**3.4**
	Precipit (mm)	2.7	3.4	2.4	2.6	1.7	2.5	4.3	4.7	3.0	2.2	2.7	4.6	**3.1**
		11	-3	14	15	-7	-34	-35	-21	-19	-14	12	14	-

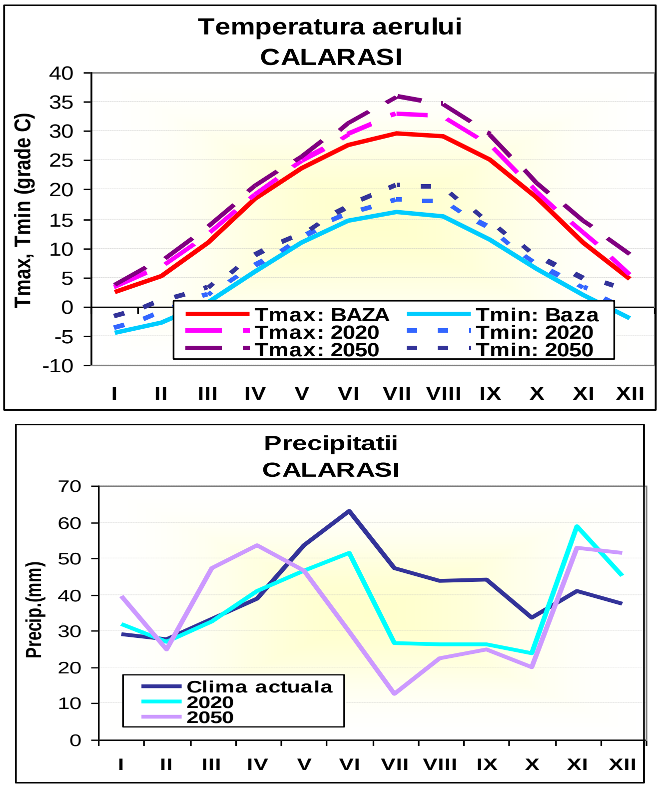


Figure VI_C_ 1 *Modifications of the monthly average high and low air temperatures (oC) and precipitation totals (mm/month)*[22]

[22] Provided by the HadCM3/SRES A2 scenario over 2010-2039 (the 2020s) and 2040-2069 (the 2050s), respectively, as compared to the current climate parameters recorded by the Agro-Meteorological Station Călăraşi

The vegetation period in winter wheat lasts 250-270 days in current climate conditions, while in the RegCM/ICTP/2080-2099/SRES A1B scenario's conditions it has been estimated a faster development by 8-9 days on an average. Although daily evapotranspiration has been growing higher on the background of a probable air temperature rise, the cumulative water loss caused by evapotranspiration during the vegetation season has been diminished by 14-22% due to the interaction between two opposed processes, a shorter vegetation period associated with high temperatures and the physiological effects of rising concentrations of carbon dioxide on crops. The precipitation totals recorded over the wheat growing season in current climate conditions reached generally 360-450 mm, but due to climate change they can possibly get lower by 26-31% as a consequence of forced vegetative processes and shorter vegetation seasons.

Tables VI_2 a, b and Figure VI_C_2 show the results simulated in current and future climate conditions by the RegCM/IPCC/SRES A1B scenario over 2080-2099 at two representative agro-meteorological stations from south Romania.

Table VI_ 2 *Results of the CERES-Wheat model in climatic conditions provided by the regional scenario RegCM /IPCC /SRES A1B over 2080-2099 (with / without CO_2) at two representative stations from south Romania*
Modifications of the current climate conditions are given in percentages (%).

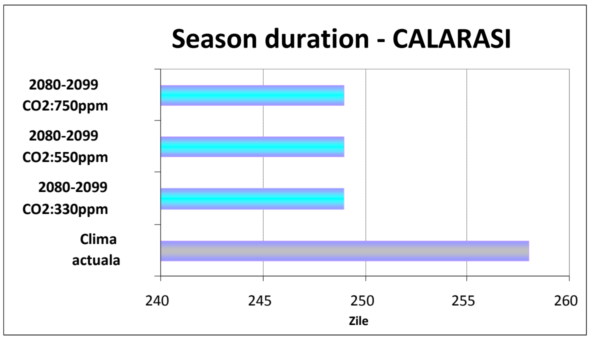
a)

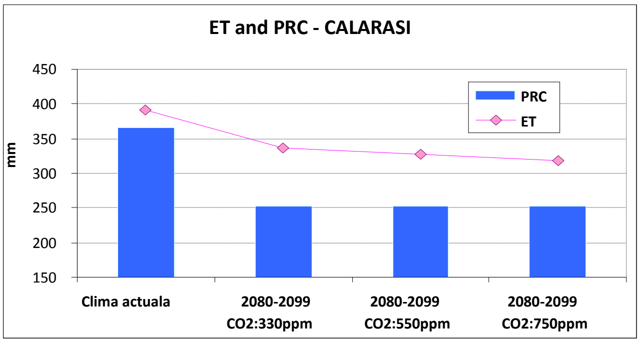
Station	**Climatic Scenario**	**DS (days)**	**PB (kg/ha)**	**ET (mm)**	**PRC (mm)**	**EUA (kg/m^3)**
CĂLĂRAŞI	**Current Climate**	**258**	**4945**	**391**	**365**	**1.26**
	2080-2099/no CO2	-9	-9.6%	-14.1%	-30.7%	+5.5%
	2080-2099/ 550ppm	-9	+14.6%	-16.4%	-30.7%	+37.3%
	2080-2099/ 750ppm	-9	+35.3%	-18.4%	-30.7%	+65.5%
BUZĂU	**Current Climate**	**260**	**4393**	**416**	**362**	**1.06**
	2080-2099/no CO2	-8	-7.0%	-15.6%	-29.6%	+9.8%
	2080-2099/ 550ppm	-8	+14.6%	-18.0%	-29.6%	+39.1%
	2080-2099/ 750ppm	-8	+32.0%	-20.4%	-29.6%	+65.2%

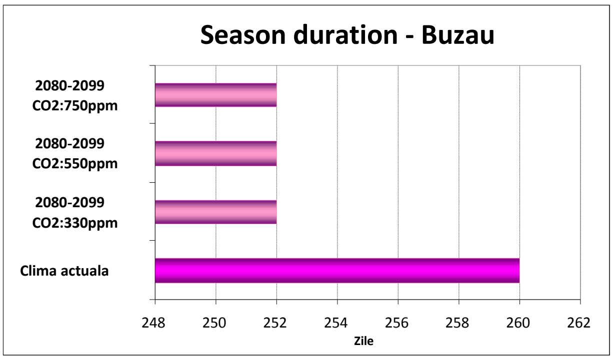
b)

Station	Climatic Scenario	DS (days)	PB ($kg.ha^{-1}$)	ET (mm)	PRC (mm)	EUA ($kg.m^{-3}$)
CĂLĂRAŞI	**Current Climate**	**258**	**4945**	**391**	**365**	**1.26**
	2080-2099/no CO2	249	4470	336	253	1.33
	2080-2099/550ppm	249	5667	327	253	1.73
	2080-2099/750ppm	249	6693	319	253	2.10
BUZĂU	**Current Climate**	**260**	**4393**	**416**	**362**	1.06
	2080-2099/no CO2	252	4086	351	255	1.16
	2080-2099/550ppm	252	5034	341	255	1.48
	2080-2099/750ppm	252	5800	331	255	1.75

Note: DS: length of vegetation period, PB: grain yield, ET: cumulative evapotranspiration, PRC: total precipitation, EUA: water use efficiency.







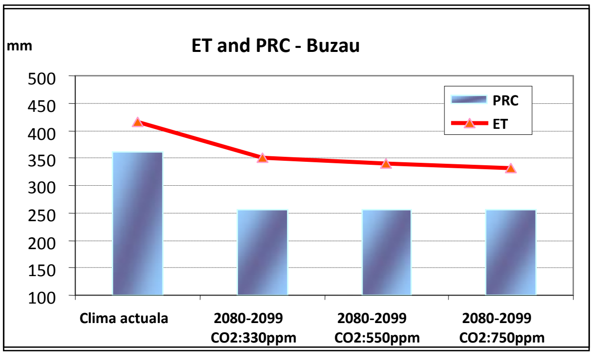
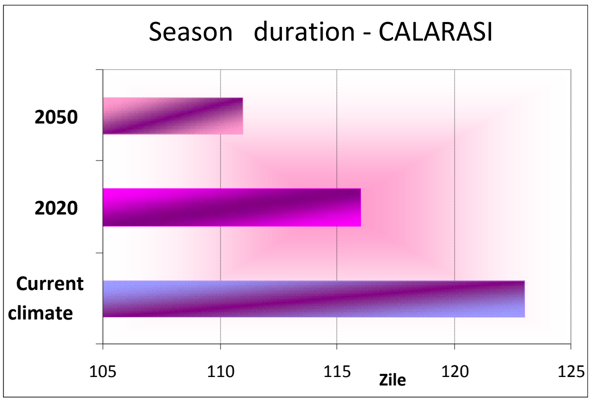


Figure VI_C_ 2 *RegCM/IPCC/SRES A1B scenario over 2080-2099, results*

According to climate predictions, a shortening by seven days of the vegetation period in maize is possible by 2020 and a twelve-day one by 2050 due to increasing air temperatures and, consequently, 14% lower yields by 2020 and 21% lower yields by 2050, respectively, as a result of higher in-soil water deficits mainly during the grain fill period (July-August) – Figure VI_C_3.



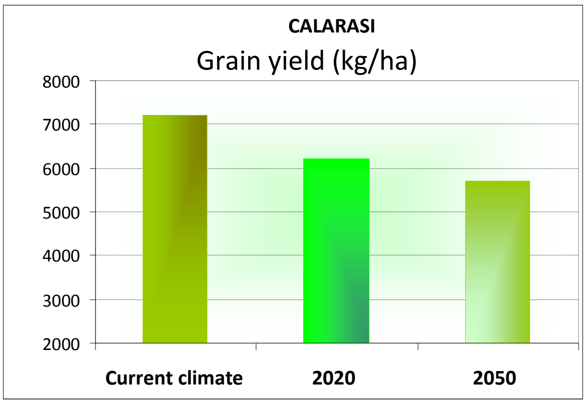


Figure VI_C_ 3 *Effects of climate change upon maize crops*[23]

Today's interest in extreme weather phenomena and their impact upon human and economic activity is stronger than ever. Agriculture, in every branch of it, is directly affected by such phenomena, whose effects, be them positive or negative, cannot be minimized or ignored. For this reason, the importance of agro-meteorological information for economy and particularly for one of its domains – agriculture, is connected with a complex approach of the genotype-environment correlation. Every information on the current and future condition of agro-climatic resources and the development of models to simulate and forecast the global/regional change of the environment are particularly useful to decision takers in their efforts to elaborate realistic and sustainable environmental policies. Assessing the climate change influences upon crop yields makes it possible to elaborate several methodologies that lay the agricultural planning and sustained development process on a scientific basis.

The climate data recorded over the last decades have therefore shown a progressive warming of the atmosphere as well as a higher frequency of extreme events, rapid alternations of severe heat/drought and heavy precipitation being more and more apparent. As it can be seen, the climate change effects in Romania have been clearly mirrored by modifications in the temperature and precipitation regimes, mainly since 1961 until now, with significant influences upon plant growth and development. In this context, water scarcity and pedological droughts in south and south-east Romania can cause drastic yields decreases, particularly during the excessively droughty agricultural years (such as 2006-2007 and 2011-2012), and the higher/lower than optimum temperatures are reflected by metabolically reactions in plants, causing thermal stress especially in summer and winter, while every modification

[23] ***According to the CERES-Maize model and the climate scenario HadCM3/2020-2050/SRES A2***

in the trend of their lows can easily aggravate frost injury in sensitive plants. For this reason the adaptation of crop species to climate change can be mainly based on the experience obtained from their reactions to extreme climate events by implementing climate change risk adaptation and management plans as well as on the new researches approaching the regional and local effects related to the behavior of genotypes in current and predictable climate change conditions. Basically, every solution and recommendation aimed to support the actions and procedures for climate risk prevention and mitigation in agriculture should include the complete range of known measures (agro-technical, cultural, irrigation etc.) as well as actual interventions to locate and confine every extreme weather phenomenon in order to avoid aggravated consequences

VI.C.3 Water resources

Taking into consideration the present and the future climate change must to undertake the following measures:

Adaptation measures for ensuring of the available water at the source:

- Performance of new infrastructures to turn the hydrological resources into socio-economic resources (new storage lakes, new inter-basin derivations, etc.);
- Modification of the existing infrastructures in order to be able to regularize the liquid outflows whose distribution in time is being modified as a result of the climate change (increased heights of certain dams, re-equipment with new works, etc.);
- Design and the implementation of certain solutions for the collection and the use of the rain water;
- Extension of the water recharge solutions of the phreatic layers;
- Special construction for the attenuation of the high flood.

Adaptation measures for the use of water:

- More efficient water use and conservation by the rehabilitation of the transportation and distribution installations and also through technological modifications (the promotion of the technologies with low water consumption, etc.);
- Modifications in people's life style (the decrease of the water demand, the use of the recycled water for certain activities, etc.);
- Increase of the recycling degree of the water for industrial needs;
- Modification of the types of the agriculture cultures through the utilization some cultures with low requirement of water.
- The se by certain utilities of the inferior quality water.

Measures which must be undertake at hydrographical level:

- Update the guiding schemes of arrangement and management, for to take into consideration the effects of climate change (the decrease of the availability of the source, the increase of the demand of water);
- Application of the integrated management for water (for quantity and quality);
- Inclusion since the design phase into the storage lakes that will be performed of certain reserve volumes that should be used only in exceptional cases or the construction of certain storage lakes with special operation conditions in order to supplement the available water resources in critical situations;
- Transferring inter-basins of water for the compensation of the deficits in some basins;
- Improvement of the treatment of the residual and domestic water;
- Identification of the area with high potential risks of flood and deficit of water.

Measures which must be undertake in the field of floods risk management:

- Performance of protection works with local aspect (protection of human establishments, of economic and social objectives) to the detriment of certain protections of great length;
- Use of certain solutions of expansion and temporary deflation of the flood waves into the specially improved areas, in the place of increased height of the existing dams or the performance of new dams;
- Utilization of the new best methods and technologies for the rehabilitation/construction of dams and the performance the works for protection in correlation with territorial plan of arrangement;
- Elaboration of new design standards of the protection works against the floods (by the inclusion of the accepted risk);
- Correlation of the territorial development and improvement plans with the strategy and the risk management plans in case of floods.

Measures which must be undertake for to control the drought/the deficit of water:

- Monitoring and the advertising about the decreasing of debits/drought at national level;
- Deceasing of the losses in the distribution system of the water;
- Measures of the saving and the efficient utilization of water(irrigation, industry)
- Increasing of the capacity for the water deposit;
- Plan for the supplying with water for population and animals/hierarchy of restriction for water use in the period of deficit.

VI.C.4 Forests

For forests sector, as in the case of agriculture (food security), public health (disease etc.) adaptation to climate change is a matter of national security. Actions such as deforestation and overgrazing can lead to the exacerbation of climate change.

The most appropriate measure of adaptation to climate change would be the intensification of reforestation. This would not only help balance local ecosystems but would also decrease the soil erosion, would prevent landslides and prevent flooding. It should be continued and intensified the afforestation of new areas with tree species appropriate to local conditions. It is also necessary that the land be included in the national forest and managed forest regime.

Adaptation measures to climate change in the forestry sector should be based on scientific and technological research which supports sustainable forest management, taking into account the context of environmental and socio - economic context.

In this context, it is necessary to continue the monitoring the health of forests. Finally, the importance of forests, especially in the context of climate change should be well explained to all stakeholders and the public, to encourage forest protection and defense. The key indicators of adaptation to climate change are:

- Percentage of afforestation;
- National wood production;
- The amount of wood used;
- The forest health expresses as a percentage of trees degradation: loss of foliage, fallen trees, broken trees);
- Distribution of tree species in appropriate areas.

To implement the adaptation measures to climate change should be achieved an assessment of the damage caused by climate change in the forestry sector. According to experts in forestry, there are currently no such estimates, being necessary to develop appropriate monitoring in this way and the correlation of measures in this regard from climate change strategy and strategy on forests, in preparation for this moment.

VI.C.5 Infrastructure, construction and urban planning

Adaptation of housing (construction) is one of the most urgent actions in the context of climate change. Given the increased number of people living in cities affected by climate change and taking into account the socio - economic concentration in urban planning and development should be a priority.

The main measure of adaptation to climate change for the built environment is the correction of existing building standards and rules in order to meet future climate conditions and extreme weather events. Houses, buildings, offices and other built structures will face the impact of higher summer temperatures, lower temperatures of winter, the winds stronger, the more abundant snow and other hazardous environmental changes. Currently, in Romania apply Eurocodes for construction, with national standards, based on weather maps, seismic etc. specialized. Energy efficiency of buildings has also become a focus of policy element in the construction sector in Romania (important for comfort of residents). However, none of these rules and standards do not make direct reference to climate change, and many of them are based on outdated estimates of climate (eg technical standards for heating are based on climate data from the period 1965 - 1985).

Construction specialists recommended as first adaptation to climate change the update and revision of the parameters on which technical standards (temperature, humidity, etc.) to ensure that the buildings reflect the reality of climate of Romania. Other measures to adapt to climate change refers to the cooling of each city as a whole, providing more green space for residents and / or shaded areas, introducing heating and cooling systems more efficient and also the information campaigns of population regarding the climate change risks.

An important measure which has already been introduced and is now supported by legislation, is the promotion of mandatory insurance for housing against natural disasters (floods, landslides and so on). All homes must be insured, as the probability of damage due to natural disasters is higher today than in the past.

VI.C.6 Tourism

Analyses show that in order to increase the adaptation capability, touristic areas have to change their traditional way of making money from touristic activities (Surugiu et. al, 2012):

- On medium and long term, in mountain locations, alternative activities to traditional winter sports have to be taken into account;
- On short and medium term, at seaside locations, the touristic season have to be extended beyond the traditional interval from May to September.

VI.C.7 Energy

As adaptation measures to climate change the followings issues can be mentioned:

- Urgently elaboration of studies on the risk assessment concerning the climate change effects for the energy sector generally, and especially, in the risk assessment for the hydroelectric sector, but also taking into consideration these risks concerning the investment projects scheduled to be built;
- Taking actions to determine the critical infrastructure in the energy system (hydroelectric dams, the transportation and distribution system, natural gas transportation system, oil and its derivatives) in order to determine the measures required in case of extreme weather phenomena (storms, tornadoes, floods, droughts, very low temperatures);
- Researches and studies are necessary concerning the possible modifications in the increase of energy consumption because of the higher temperatures and of the extreme phenomena;
- Promotion of the energy production from renewable sources;

- Elaboration of strategies by the local public administration authorities in order to use energy sources which should comply with the European environment and efficiency norms, in order to produce electric and thermic energy, in centralized systems.

VI.C.8 Industry

In order to adapt to the climate change effects, all the industry sectors, as a matter of fact the whole economy, has to get oriented towards sustainable development, towards the use of energy efficient products, processes and technologies, the decrease of the greenhouse gas effects, the decrease of the carbon dioxide level and towards the use of the renewable energies.

The adaptation has to be reactive and proactive. It has to be identified the appropriate approach in order to transform all the challenges generated by the climate change into opportunities to encourage the research and the innovation, to identify new techniques, technologies and products.

Given the major contribution of the industrial sector emissions of greenhouse gases, the main tasks of ME on climate change are mostly related to measures to reduce GHG concentrations in the atmosphere and are limited in terms of the adaptation to climate change. ME should have an important contribution to the training and awareness of adaptation to climate change, as the industrial sector will be responsible for promoting technologies resilient to climate change.

VI.C.9 Transport

Alternative modes of transport such as walking or cycling movement and meshed transport systems can contribute to a significant decrease of air pollution in urban areas in general and in particular and to the rational use of energy resources. In addition to protecting existing infrastructure (possibly as part of the rehabilitation required) it is essential that all future infrastructure be designed taking into account adaptation to climate change. Additionally, the means of transport must also be adapted and / or designed so as to be resilient to climate change.

It requires that planning policies to be improve for mobility and supporting cycling as an alternative and environmentally friendly urban transport especially by creating adequate infrastructure integrated transport systems and meshed network.

The promotion of cycling as a multipurpose vehicle for urban transport and environmentally adaptable to existing infrastructure can be achieved by reorganizing urban space. It is necessary that spatial planning process of urban transport systems to be known as many local stakeholders.

It is very important to support and promote public policies and actions to change the attitudes and behavior towards of the younger generation regarding the transport problems and forming a healthy lifestyle based on sustainable mobility.

To achieve these goals are further researches are needed in the transport sector. Studies on the influence of climatic factors on various modes of transport as well as those of new technologies resilient to climate change is essential to ensure that the transport system in Romania will not be affected by projected climate changes or unforeseen. Must also be created risk maps to help prioritize adaptation measures to climate change.

Floods, landslides and torrents were defined by experts as the main threats to transport and particularly for transport infrastructure. For this reason, adaptation projects to climate change must begin with the construction / rehabilitation of dams and riverbanks protection systems. Other negative effects of climate change to be controlled are clogging waterways and ports courses due to increased erosion and infrastructure damage due to high temperatures.

Warning systems are needed for real-time water levels and landslides, and extreme weather events as potentially harmful. It is recommended constant monitoring at regional and local level to record the effects of weather events and risk time for transport activities.

Best Practices for adaptation to climate change in the transport sector can be identified in the waterway transport sector, as authorities in this area have already taken steps to protect maritime and inland waterways against extreme events.

VI.C.10 Health

On short term, risk maps for heat wave in urban areas of Romania could help, to map the present vulnerabilities and to prevent the future ones. In the case of health issues, risk maps could help disaster management planning, too (Bojariu et al., 2013).

However, more efforts have to be dedicated to improve and update the inventory of recommendation and adaptation measures for all sectors identified in the strategy for climate change in Romania. Also, mitigation and adaptation measures have to be coherently integrated.

VII. FINANCIAL RESOURCES AND TRANSFER OF TECHNOLOGY

Romania is not included in Annex II to the Convention, therefore the provisions of Decision 2/CP 17, Annex I "UNFCCC biennial reporting guidelines for developed country Parties", section VI (A, B, C) are not applicable.

However, Romania decides to report related data on public financial support for 2011 and 2012 years, pursuant to the provisions in Article 16 of the Regulation (EU) no. 525/2013 of the European Parliament and of the Council on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision no. 280/2004/EC.

Since the Fifth National Communication Romania's public financial support for climate change programs in developing countries was distributed through multilateral organisations, namely:

- 2011: Global Environment Facility - 202,599.46 USD
- 2012: UNFCCC Trust Fund for Supplementary Activities – 243,119.35 USD.

The technology support and transfer and capacity-building were not provisioned for the above mentioned period.

VIII. RESEARCH AND SYSTEMATIC OBSERVATIONS

According to the requirements of the UNFCCC, research and systematic observations are performed for a better understanding of the effects of the climate change in Romania in such a way that they can be used to propose GHG mitigation and adaptation measures to be adopted. In this context, Romania is synchronized with the international efforts (e.g. contributing to GCOS activities).

This chapter reports on general policy and funding related to research and systematic observation (section VIII.A), research made on national, European and international levels (section VIII.B) and systematic observation (section VIII.C).

VIII.A. General policy on research and systematic observation

Research activities in Romania consist of themes related to climate system, impact and adaptation for policy support. However, up to now, the number of studies dedicated to climate change impact and adaptation is significantly smaller than those dedicated to physical basis of climate system.

National research activities are carried out along with participations in international and European programmes. The main coordinator of Romanian research is the Ministry of Education and Research which financially supports research projects selected from national competitions which are organized by its Executive Unit for Scientific Research (UEFISCU). Also, The Ministry for Education and Research financially supports a part of the contributions to the European and international research area.

The Ministry of Environment and Climate Change coordinates and financially supports applicative research on water management, climate related environmental risks and sustainable adaptation planning. The Ministry of Regional Developing and Tourism is the focal point on the SEE Transnational programme which partially supports projects on adaptation to climate change and climate-related risk assessment in relation to disaster management.

In Romania, research activities related to climate change are synchronized with the international programmes such as the European Framework programmes (FPs) and GEOSS (on global level). Also, Romanian scientists have participated at international cooperation on specific projects (e.g.). Results from the international, European and national research programmes are made available to the international community through reports, publications and usually the information related to them are available on the Internet.

As for the systematic observation, Romania has actively participated in various fields of climate-related monitoring, both nationally and within European and global programmes (such as GCOS). Romania has internationally exchanged data and contributed to European and global databases.

VIII.B. Research

Cooperation in international research

The Romanian research on climate change is synchronized with three large international scientific programmes in the field of global change research: the International Geosphere Biosphere Programme (IGBP), the World Climate Research Programme (WCRP) and the International Human Dimensions Project (IHDP). The National Meteorological Administration is scientifically involved mainly in activities related to WCRP. The Institute of Geography of the Romanian Academy has activities related to IGBP and IHDP.

Romania is also contributing to the work of the Intergovernmental Panel on Climate Change (IPCC). National Meteorological Administration coordinates the Romanian contributions to the IPCC. Research for Working Groups II and III is mainly carried out by. Three Romanian scientists contributed as (lead) authors to the 5th IPCC assessment report, while various Romanian experts also contributed to the reviewing process of the IPCC reports.

Cooperation in European research

Many of the Romanian institutions have had research projects under the EU 7th Framework Programmes (FP) and have participated at COST actions and in other European programmes related to climate (e.g. the South Eastern European Transnational Cooperation). The synergy and cooperation between European and the national research programmes are enhance by participation in Joint programme Initiative (JPI). Romania is member in JPI Climate, JPI Ocean. The most relevant research projects and networks with Romanian participants and financed by the 7th Framework Programmes and other programmes are listed in Annex 3.3.

National research programs

The national activities concerning climate change in Romania consist of research projects financially supported by:

- Ministry of Education and Research (e.g. the environment section of National Research Program for Research, Development and Innovation II);
- Ministry of Environment and Climate Change;
- Ministry of Agriculture and Rural Development.

The physical basis of climate change has been the main area of climate research in Romania in the recent years. Romanian scientists have analysed climate variability and change at regional level in observed data and in results from global and regional climate models to identify the policy relevant risks related to climate change.

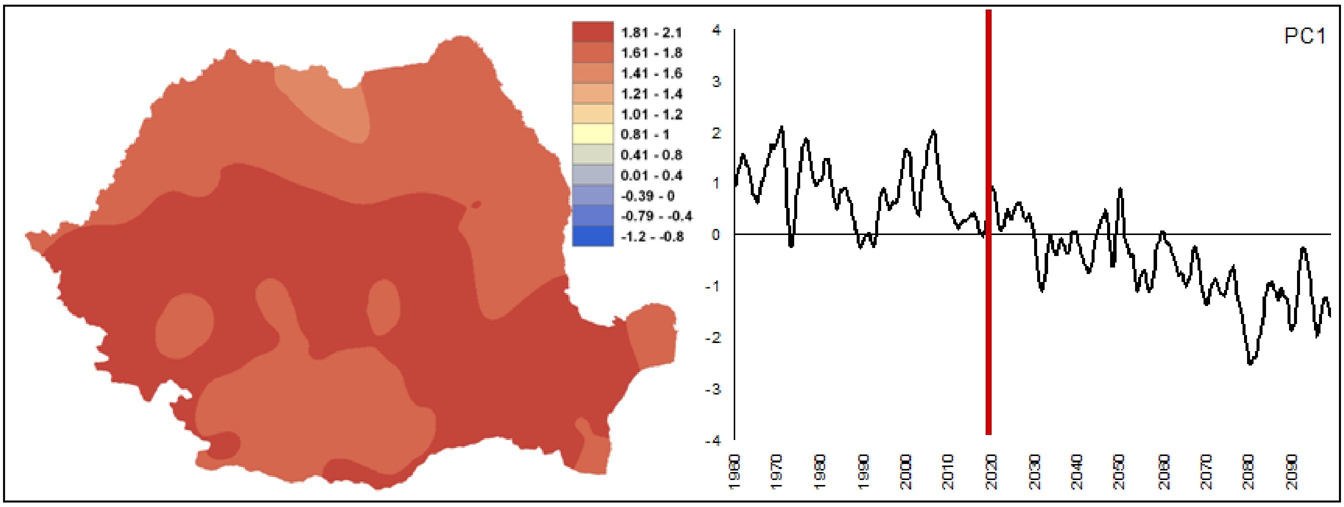


Figure VIII_B_ 1 *Simulated spatial and temporal evolution*[24]

[24] *Represented by EOF analysis of the auto calibrated Palmer Drought Severity Index in the interval 1961-2100. The analysis uses the mean of 9 runs with 9 regional climate models. Results from regional climate models are taken from the FP6 Ensembles project (National Meteorological Administration internal report, 2013)*

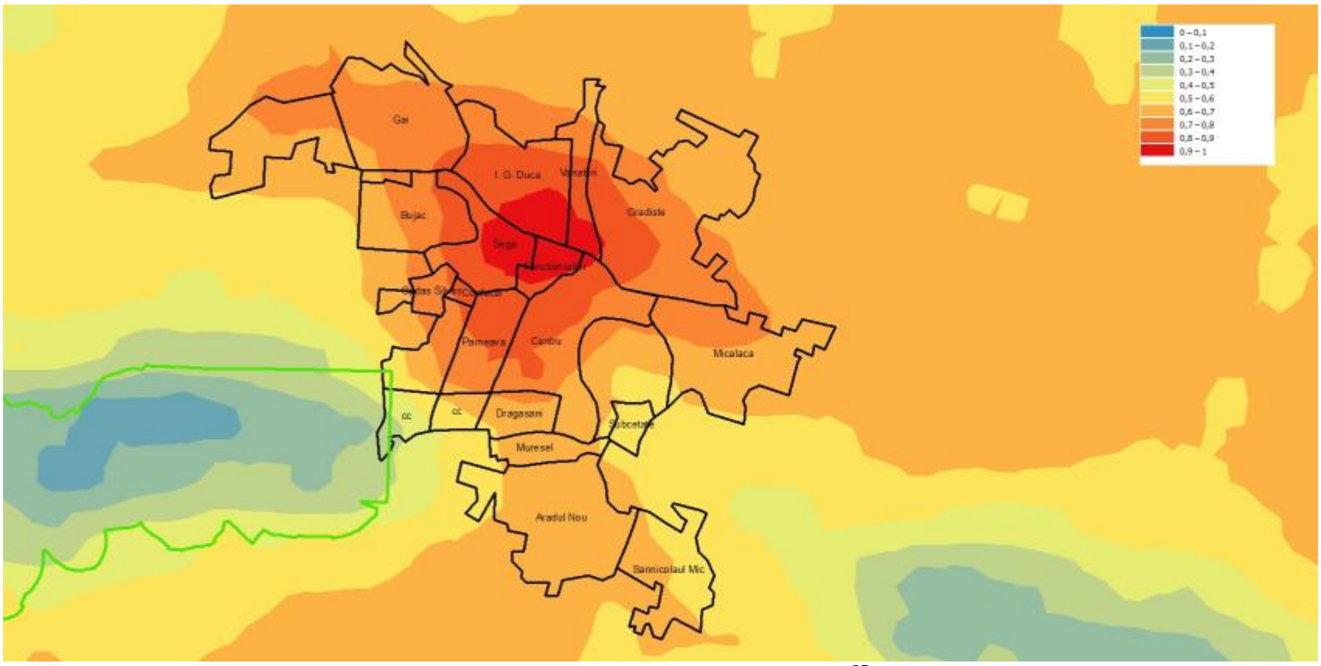


Figure VIII_B_ 2 *Urban heat island*[25]

The National Meteorological Administration of Romania participates as coordinator or partner in the Sectoral Plan of the Ministry of Agriculture and Rural Development – ADER 2020 (2011-2014):

- ADER 1.1.1: Geo-referential indicators system at different spatial and temporal scales to assess the vulnerability and adaptation of agro-ecosystems to global changes;
- ADER 3.3.1: Monitoring and assessment system of the indicators regarding the agreement with the EU Agro-environmental Directives specific to semi-subsistence farms;
- ADER 5.1.1: creating of geo-referential data bases regarding the regional climate risks for the main agricultural and horticultural crops;
- ADER 8.1.1: Evaluating the risk of contamination with micotoxines at winter wheat crops in Romania.

At European level, the researches related to climate change adaptation refer to the assessing vulnerabilities and risks and translating them to implementation actions at the regional and local levels**:**

- INTERREG IVC / WATERCoRe - Water scarcity and drought - Co-ordinated activities in European Regions (2010-2013);
- PROJECT CE DGE / MIDMURES - Mitigation Drought in Vulnerable Area of the Mures Basin (2011-2012);
- SEE Transnational Cooperation Program / ORIENTGATE: a structured network for integration of climate knowledge into policy and territorial planning (2012-2014);
- SEE Transnational Cooperation Program /CC-WARE: Mitigating Vulnerability of Water Resources under climate Change (2012-2014).

[25] *Defined using satellite data of land surface temperature (Aqua MODIS) in the interval 2002-2010 (from the internal report of SEERISK project, 2013*

The WATERCoRe Project provides an exchange platform for water scarcity and drought issues on regional and local level for all European regions. The project partners (14) were committed to identify their specific skills on water resources management, exchange good practices and adapt lesson learnt to their local or regional context. The practices were identified and collected through the establishment of 5 working groups:

A1 : demand- side water management – technical issues;

A2: demand-side water management – economic aspects;

B: handling drought periods and mitigate drought effects;

C: climate change effects on water management;

D: public awareness and public participation.

Best practices are collected in the "Good Practices Handbook", the knowledge core of the project (http://www.watercore.eu/new.asp?notid=920). Also, "Good Practices Guide"" focuses on practical solutions for dealing with on water scarcity and drought. (http://www.watercore.eu/new.asp?notid=1058). The project finalized the result in a digital exchange E-learning Platform (http://www.watercore.eu/e-learning/index.html) with thematic modules as well as policy recommendations in the field of water scarcity and drought regions, respectively in the Central and Eastern Europe. 24 Study visits have been carried out by the experts of PP 10 (Ministry of Environment and Forest), PP11 (National Meteorological Administration) and PP12 (Environmental Protection Agency of Covasna) and several bilateral contacts have been established for a better understanding of the selected good practices applied in other partner regions.

The Orientgate project aims to gather and communicate up-to-date climate knowledge relevant to key economic sectors; and to implement adaptation across South Eastern Europe (SEE) in a coordinated way. To enable this, Orientgate has three thematic centers (TC). The first thematic center studies forestry and agriculture sectors. The two other thematic centers study drought, water and coasts; and urban adaptation and health. As part of the work of the first thematic center, Orientgate is carrying out a pilot study on the *Climate change adaptation measures in Romanian agriculture*. The study will both address specific concerns for a key vulnerability sector in Romania, and also provide a framework for studying climate change impacts and adaptation options that can be applied in other sectors and counties. The study is carried out by the two Romanian Orientgate partners – the Environmental Protection Agency of Covasna and the National Meteorological Administration of Romania. The study focuses on two agricultural areas: Covasna in central Romania and Caracal in the south of the country both vulnerable to water scarcity and drought. The 2 sites were selected based on historical climatic data how show that these areas where frequently affected especially by drought and periodically by other extreme events (heat waves, heavy rainfall). Also, the need to identify critical issues related to climate adaptation was crucial. Another important argument was the structure of crops and the need to find different adaptation options for farmers in the context of future climate changes. In these 2 regions the agriculture it is traditionally developed by farmers in order to get sustainable production in every year and to provide a better crop management systems. The linkage between scientific community and practitioners must be correlated with the need to put in practice the scientific climate knowledge according with the necessity to improve the technology and resource management in terms of relation of the crops-water-soil.

The Orientgate project can be considered as scientific support for Romania's climate adaptation regional policy, given the National Climate Change Strategy for 2013-2020 recently adopted by the Romanian Government (HG 529/July 2013). Basically, the project results aimed to support the actions and procedures for climate risk prevention and mitigation in agriculture should include the complete range of known measures (agro-technical, cultural, irrigation etc.) as well as actual interventions to locate and confine every extreme weather phenomenon in order to avoid severe consequences.

The study will be finalized in May 2014 and will be published on the project website in English version (http://www.orientgateproject.org/) together with all case studies developed by Orientgate partners (in total 6 case studies).

The MIDMURES project was a pilot project financed by the EC/DG Program "Development of prevention activities to halt desertification in Europe". The objective of the project was to test specially designed technologies, methods and practices, with the aim to mitigate the drought effect in the Mures river basin of Romania. Within this project a multi-discipline team has built up made up of researchers from four partner institutions in Romania: the National Meteorological Administration- Bucharest, the National Research-Development Institute for Soil Science, Agrochemistry and Environment - Bucharest, the National Institute of Hydrology and Water Management-Bucharest and the National Institute for Aerospace Research "Elie Carafoli"- Bucharest. This project aims to render the population sensible to the possible consequences of the depletion of the water resources and the degradation of their quality. The beneficiaries of the project and the groups it aims are local decision-makers, people working in the scientific field and the farmers.

The Guide to Good Practice is the result of a team effort made by the participants within the MIDMURES project, aiming to elaborate specific measures for mitigating to hazard towards the lack of water and drought in the area of concern for the project, i.e. the Mures river hydrographic basin. Thus, there are shaped technological measures for the mitigation of effects generated by water scarcity and drought, with an annexed list of good practices that users may adopt for a rational use of the water resources within the area of the Mures river hydrographic basin. Overall, the Guide can contribute to formulating relevant answers to the effects generated by the lack of water and drought in the agricultural activity, at the level of one agricultural area and implicitly the management of available water resources in limiting conditions.

The practical aim of the Guide is, therefore, to identify the necessary measures for limiting the negative effects of water lacking and drought in the area of the Mures river hydrographic basin. The identified measures may further be implemented through cooperation with the local authorities and through ensuring proper technical assistance. The effects of the decisions and actions recommended at present may materialize in the mean and long range, function of the volume of economic and technological investments. In other words, the Guide ensures better understanding of both the drought phenomenon impact and of the risk enhanced by disregarding and non-implementation in practice of the specific measures.

Beneficiaries of the guide are the local and regional authorities in the fields of environment, agriculture and the water resources management, the scientific community, farmers and agricultural associations.

However, Romania needs more research on mitigation, adaptation and „climate-proofing". Research institutes and socio-economic players have to join efforts in bridging the gaps between physical basis of climate change and impact, adaptation and mitigation research areas.

The most relevant research projects and networks nationally financed are listed in Annex 3.3.

VIII.C. Systematic observation

Meteorological observations are coordinated, and partly integrated, both on a European and on a global level. Romania participates in various fields of climate-related monitoring, on national level and in European and global programmes. Romania exploits observing systems for the monitoring of Essential Climate Variables (ECVs) covering:

- Atmospheric climate (including measurements for some atmospheric constituents such as ozone);
- Black sea climate;
- Terrestrial climate.

Romania complies with the GCOS requirements. The GCOS monitoring principles and best practices are taken into account in the systematic observation activities. In Romania, these activities have been synchronized with the European research area and World Meteorological Organization (WMO) programmes (especially that in Region VI) and with GCOS on global level. Also, Romania has internationally exchanged data and has contributed to European and global databases.

The National Meteorological Administration (NMA) is the main organization which performs systematic observations on atmospheric climate and, to a lesser extent, on parts of sea and terrestrial climate. These observations are recorded in the framework of the National Meteorological Network (NMN) designed for making observations, primary validations and data transfer.

The NMN is organized in 7 Regional Meteorological Centers which consists of 159 operational weather stations, 126 of them being automatic weather stations (MAWS). Observations at 64 rain gauging stations are made on a voluntary basis. From the 159 weather stations, 133 are full-time operational and 26 are part-time operational. 55 weather stations perform an agrometeorological measurement program. Radiometric measurements are performed at 35 stations.

The programme of meteorological upper-air measurements is carried out at the Aerologic Observatory of Bucharest, including two daily radio soundings (at 0000 and 1200 UTC). Daily wind soundings with PILOT balloon are also carried out at the station at 0600 UTC.

In 2003, the operational National Meteorological Integrated System (SIMIN) was established. Within SIMIN the national radar network was upgraded. Now, the national meteorological radar network consists of 8 Doppler weather radar systems. The national radar network is one of the most advanced in Europe and it integrates three types of equipment produced by several radar system manufactures (Enterprise Electronic Corporation - EEC, Gematronik and Metstar). The radar information from all equipment is combined into a unique product – the national radar mosaic (available in 3 versions every 10 minutes). The radar information from Romanian network is useful for the neighbouring countries, too.

Observations from meteorological satellites refer to receiving and primarily processing in real time digital images and data from geostationary satellites METEOSAT-7 and MASG-1 in 3, and 12 spectral channels, respectively. The operative running of EUMETSAT/SAFNWC model started in February 2005, obtaining 8 of the 12 now-casting products, every 15 minutes, which are transmitted to the National Forecasting Centre.

In addition to the monitoring activities of the NMA, systematic observations are also recorded by National Institute of Hydrology and Water Management for hydrological-related climate indicators and Black Sea climate. GeoEcoMar performs climate relevant measurements of oceanographic variables and marine ecosystem and geological indicators in the Black Sea. Institute for Marine Research (Constanta) perform other measurements of climate related indicators of Black Sea climate ecosystems. GeoEcoMar and Institute for Marine Research contribute to EuroGoos and Black Sea GOOS. National and local agencies for environmental protection gather data mainly on atmospheric constituents and pollutants.

Romania contributes to free data exchange within the limits of national (e.g. Romanian Law of Meteorology) and international regulations (e.g. ECOMET rules). NMA participates in the international meteorological data exchange with a number of 23 stations in RBSN (Regional Basic Synoptic Network) and 14 stations in RBCN (Regional Basic Climatological Network). Also, NMA has submitted data to ECA&D dataset.

IX. EDUCATION, TRAINING AND PUBLIC AWARENESS

Education and training play a crucial role in the process on the long run of reaching sustainable development in Romania. Public outreach, through public engagement and awareness, is also very important for a successful implementation of the national strategies and policies in the field of sustainable development.

In the National Sustainable Development Strategy Romania 2013-2020-2030 it is recognized that the Romanian educational and training system is a priority objective of strategic importance and basic preconditions for an effective implementation of the principles of sustainable development in the medium and long run.

In the Romanian society there is a wide recognition that the education represents the strategic prerequisite for future national development, that its contribution is essential for the multidimensional shaping of the human capital for the future. Education is perceived as the way to achieve sustainable development, which is, after all, a process of societal learning in search of innovative solutions.

Romania is committed to reduce regional disparities in terms of income, wealth and opportunities by promoting R&D activities via information, best practices and know-how transfer practices through innovation, knowledge economy and environmental protection.

Our national objective, for the 2013-2020 horizon, is to develop human capital and increase competitiveness by linking education and lifelong learning to the labour market and ensuring better opportunities to participate in a modern, inclusive and flexible labour market.

European Council conclusion of 19 November 2010 on education for sustainable development recognized that European Union faces a considerable number of interlinked challenges in the early 21st century, including the economic and social consequences of the global financial crisis, climate change, declining water and energy resources, shrinking biodiversity threats to food security and health risks.

To this aim development of education and awareness raising contribute to the eradication of poverty and to the promotion of sustainable development through public awareness raising and education approaches.

In a continuously changing world all European citizens should be equipped with the knowledge, skills and attitudes needed to understand and deal with challenges and complexities of modern life, whilst taking into account the environmental, social, culture and economic implications.

For these reasons the Europe 2020 strategy for jobs and growth seeks to turn the EU into a smart, sustainable and inclusive economy capable of delivering high level of employment, productivity and social cohesion taking into consideration that education, training and public awareness have a major contribution.

IX.A. Education

In Romania the responsible authorities for the initial and continuing vocational education and training systems (IVET and CVET) are both Ministry of National Education and Ministry for Labour, Family, Social Protection and Elderly, together with the National Authority for Qualifications (NAQ). IVET is the professional education and training set out within the national education system.

By Labour Code, in Romania there are covered the procedures regarding the CVET, respectively getting new competences and skills, including the assessment of knowledge level and certification according to occupational standards.

One of the fundaments of the Romanian education is to familiarize the children with the natural environment in order to set up the positive attitude towards the protection of the environment. So the children have the contact with nature even in primary school, thus remarking different natural phenomena.

In order to enhance the knowledge level and interest on the natural environment, a special attention is given at organized field trips in various regions (mountains, rivers, delta etc.) and at different didactic games related to the cognition of the nature.

Climate change issues are present into the curricular activities in the college and the high school. So Geography books for the V-VIII class contain elements like: impacts of the human activities on the environment, the planet in transformation, solutions for the protection of geographical environment etc.

The Geography book for IX class contains elements like: weather and climate, evolution of climate indicators, the global trends of climate evolution. Other subjects treated are:

- Present changes of the terrestrial environment;
- Natural and anthropic hazardous;
- Afforestation, desertification and pollution;
- Scenarios of the environmental evolution ;
- The environmental management.

The Ministry of National Education approved a schedule of the education activities like seminars, symposiums, conferences related with the climate change (further information on the web site www.edu.ro). For example:

- National symposium "The Forest and People" organized at Râmnicu Sărat in May 2011 by National College "Alexandru Vlahuta"
- National symposium with international participation: "Geography of local horizon" organized at Bistrita in October 2011 by National College "Liviu Rebreanu"

There are also many optional areas provided by the educational curricula that are targeting climate change subjects. So at the Technical College "Traian Vuia" from Galati is presented the subject" Ecological Impact of energy consumption".

The state and private Universities prepare the future specialists in the fields of environmental protection and climate change.

University "Politehnica" of Bucharest (www.upb.ro) has four faculties which ensure the preparation of the specialists in these fields. These faculties are:

- The Faculty of Power Engineering, which is one of the elite schools of the Romanian higher education, has one undergraduate programme "Industrial Environmental Protection and Engineering" and two in-depth master programmes "Environmental Engineering in Energetics" and "Environmental management and Sustainable Development";
- The Faculty of Biotechnical Systems has various specialties. Those, who are interested in the issues regarding ecology and environmental protection can choose one of the following specialties: "Biotechnical and Ecological System Engineering" and "Sustainable Rural Development Engineering";

- The Faculty of Applied Chemistry and Materials Science has various major fields of study. One of these fields is Environmental protection Engineering in the Chemical and petrochemical Industry;

- The Faculty of Material Science and Engineering offers the programmes of study in Environmental Engineering and Protection in Industry.

At the University of Bucharest the Faculty of Geography has four departments. Two of them are related with climate change. These departments are:

- Department of Regional Geography and Environment which prepares the specialists for the integrated assessment of the environment, for the assessment of the impact of various factor on the environment and the protection of environment;

- Department of Meteorology and Hydrology which prepares the specialists for optimal administration of meteorological, climatological and hydrological risks.

Additional information about the activities of the university can be obtained on the web site: www.unibuc.ro.

The Bucharest Academy of Economic Studies has the Faculty of Agrofood and Environmental Economics which includes in its curricula ecological subjects related to the climate change.

The faculty offers guidelines for the diploma on the following topics: assessment of economic and environmental performance at the microeconomic level, climate change affects natural capital, hazardous waste management, environmental policies etc.

The didactical activity is also dedicated to master or doctoral studies on ecology, such as:

- Carbon capture processes analysis – a new M.Sc. course within the existing Energy Efficiency Master Programme at UPB – Faculty of Power Engineering;

- *University "Politehnica" of Timisoara* with two Masters' degrees: "Research regarding the capture of CO_2 released from fossil or unconventional fuels combustion processes" (accomplished) and "Analysis of the flue gas CO_2 absorption processes" (on-going).

Both universities, being involved in the "National Programme for CO_2 Capture and Storage – 2020 horizon", are now interested in future development of a Bachelor's Degree on CCUS, closely related to a Master Programme on "Carbon capture, transport and storage processes analysis".

We should not underestimate the increasing role of the civil society representatives in the public information, engagement and awareness process developed through different NGOs projects / public out-reach roll-out with the support of EEA Financial Mechanism 2004-2009 and the new call 2009-2014. Thus, there are already 159 winning projects within the first round of calls for proposals under the NGO Fund Program in Romania 2013 – Sustainable Development component aim to support sustainable development and to improve the environment in Romania through the NGOs' contribution and public participation.

The National Administration of the Environmental Fund had a major role in promoting and supporting education and public awareness activities strongly related to climate change mitigation and GHG emissions reduction, such as:

- Supporting program for promoting non-pollutant and energy efficient vehicles / 2013;

- Supporting program for public education and awareness in environmental protection and GHG emissions reduction / 2010;

- Supporting program for installing heating systems based on renewable energy, including replacement of traditional heating systems for public and private buildings / 2010-2011;
- Supporting program for renewing the National park of old and pollutant tractors and agricultural machines / 2011;
- Supporting program for stimulating the renewal/change of the old and pollutant vehicles at national level / 2009-2013;
- Supporting program for environmental quality improvement, degraded areas forestation, ecological restoration and sustainable forest management / 2011.

IX.B. Training

The subject of climate change was also debated in numerous knowledge sharing and best practices events, workshops, conferences and dedicated projects. For example some actions organized by different institutions were selected.

Romanian National Committee of World Energy Council (WEC-RNC) organized:

- Regional Forum of Energy – FOREN 2010 (13-17 June 2010) with theme " Energy and major regional issues-Dialogue and co-operation" which gave the opportunity to debate the major issues of the countries from Central and South -East Europe, such as :
  - ✓ Renewable energy and sustainable development in Central and South-East Europe;
  - ✓ Carbon capture and storage-the necessity the opportunity ,the world trend;
  - ✓ Oil and natural gas and the their role in sustainable development;
  - ✓ Clean coal technologies;
  - ✓ Energy efficiency.
- FOREN 2012 - WEC Central & Eastern European Energy Forum (16-21 June) with the topic "National and Regional Energy Policies and Strategies. The Security of Supply" which gave the opportunity to debate main issues such as:
  - ✓ Sustainable development of renewables as energy sources for electric and thermal;
  - ✓ Promoting simple technologies for hot water and household use;
  - ✓ Improving the thermal performances of the buildings;
  - ✓ Energy efficiency of power plants;
  - ✓ Promotion of renewable resources in centralized heating systems. Biomass;
  - ✓ The role of high efficiency cogeneration in reducing greenhouse gases;
  - ✓ Solutions to reduce emissions at power plants;
  - ✓ The future of fossil energy sources at national and regional level for sustainable development;

- ✓ Competition or complementarity with renewable energy sources.

At the *University "Politehnica" of Bucharest* (UPB) the Faculty of Power Engineering organized the following international conferences related with sustainable development, energy and climate change:

- The fifth International Conference Energy and Environment - CIEM 2011 (3-4 November) with the theme "Energy for Sustainable Development" debating main issues related with renewable energy, clean coal technologies, impact on environment, capture carbon and storage, risks of the implementation of CCS technology etc.;
- The sixth International Conference Energy and Environment – CIEM 2013 (7-8 November) with the theme "Green and Smart Energy" debating main issues related impact of new technologies on environment ,biomass cogeneration system and negative balance of CO_2, passive house, smart grid etc.

The Institute for Studies and Power Engineering (ISPE) gained a broad experience in implementing and developing knowledge sharing, public awareness and institutional capacity building programs within different projects, developed in the energy and climate change fields, financed by European, bilateral, international or national funds:

- PROMITHEAS-4 Project (FP7) - National Workshop "Development and Assessment of Mitigation/Adaptation (M/A) Climate Change Portfolios for Romania", 28 May 2013, ISPE headquarters; Bucharest;
- International Workshop "Integrated Carbon Management Solutions - towards a de-carbonised Romanian economy",15 March 2013, Bucharest;
- Round Table "Optimum integration of CCS technology" 22 November 2012, ISPE headquarter; Bucharest
- CO2TRACCS Project (Black Sea ERA.NET) - International workshop „CO2 Transportation Risk Assessment for Carbon Capture and Storage", 02 November 2012, Bucharest;
- high level meeting "The need for political support in implementing CCS technologies across the EU" and press conference – 06 September 2012, Bucharest;
- International Round Table "Clean fossil fuels, carbon capture, use and storage in countries of Central and Eastern Europe", event included in the „Sustainable Energy Week" - 21 June 2012, Regional Energy Forum - FOREN 2012; Neptun-Olimp, Constanţa county;
- The 3rd Edition of the International Workshop "Promoting CCS in Romania" - 22-23 March 2012, Hotelul Jiul from Craiova;
- International Round Table „Strategic objectives and action plans to achieve targets for reducing CO2 emissions - Obligations and opportunities" - 2 March 2012, ROMEXPO-ROMENVIROTEC, Bucharest;
- Training sessions – Phare Project "Support for implementing UE requirements regarding the monitoring and reporting of the carbon dioxide emissions (CO2) and of other greenhouse gases", 21-25 November 2011, Bucharest
- International Workshop "National Program Carbon, Capture and Storage – 2020" hosted by the International Conference for Energy and Environment - CIEM 2011 - 3 November 2011, University Politehnica from Bucharest;
- International Workshop „CCS Regulatory Test Toolkit in Romania" - 21-22 July 2011, Sport Hotel, Poiana Braşov;

- CCS – meeting with students enrolled in master and doctoral studies – 20 June 2011, Politehnica University from Bucharest;
- International Conference "CO2 Transport and Storage "- 9 June 2011, Documentation and Information Centre, Mediaş
- Round Table with international participation „CCS - horizon 2020" - 12 May 2011, Hilton Hotel, Bucharest;
- Meetings of the CCS Working Group „CCS Regulatory Test Toolkit in Romania" - 20 April – 20 October 2011, Bucharest;
- "Turceni Open Door Event", event included in the European project „Sustainable Energy Week" - 14 April 2011, Turceni Energy Complex;
- International Workshop „Getica CCS Demo Project representatives in dialog with the Diplomatic environment in Bucharest" - 29 March 2011, InterContinental Hotel, Bucharest;
- Getica CCS Demo Project – First Educational Program - 14 March 2011, Industrial College from Turceni;
- National Symposium on Information regarding "The National Program for CO2 capture and storage with horizon 2020" - 23 November 2010, Brâncuşi Hotel,Târgu-Jiu;
- FOREN – Keynote Address 1 (KA1) "Carbon capture and storage – necessity, opportunity and global trends" - 14 June 2010, Neptun Conferences Centre, Constanţa county;
- International Conference "Promoting carbon capture and storage in Romania" the 2nd edition - 25 March 2011, Palatul Parlamentului, Bucharest.

A number of interesting projects aiming at capacity building, policy influencing, increasing the education level and the public awareness (specific target groups and/or general) have been developed during the last years:

1. Educational and Training System for Clean Coal Technology (CleanCOALtech)

General objective: to create and develop an educational and training system for promoting, developing and implementing clean coal technologies, through knowledge and best practices shared from advanced EU country – UK to South-East European region – Romania and Greece in order to provide high performance and innovation in the vocational education and training systems and to raise stakeholders level of knowledge, skills and competencies.

Activities

- WP 1 – Project Management and Coordination
- WP 2 – State of Play of each national environment in Romania, Greece and UK in the field of coal power industry
- WP 3 – Assessment of the level of performance and knowledge in Romania and Greece
- WP 4 – Technological and know how transfer from UK to Romania and Greece

- WP 5 – Long life learning support materials – Educational package for the targeted group (specialists and non-specialists) from the coal power sector in Romania and Greece
- WP 6 – Organising the training sessions for the coal power sector employees (specialists and non-specialists)
- WP 7 – "CleanCOALtech" Project results dissemination and promotion

Expected Results

- Reports of findings of the current technological situation in coal fired PPs for each Romania, Greece and UK and one Joint report
- Curricula elaboration for specialists and for non-specialists; didactic methods / tools and techniques for CVET system
- New skills and abilities to be learned by the target groups in the coal power sector
- Training session 1 x developed by UK for 7 trainees (5xRO, 2xGR)
- Training sessions developed by the trainees for the target groups in the coal power sector - specialists and for non-specialists (4 x RO x 25 employees; 2 x GR x 25 employees; 200 x training handbooks)
- Dissemination and promotion activities addressed to the projects' results, CVET system and LLL Programme via mass media and knowledge sharing events (3 x conferences, project website, 400 x project flyers, press releases, articles published, 5 x participations to other events in the field)

Targeted Public

- Educational & training programs providers - companies specialised in providing IVET and CVET system development for the power industry
- Coal power industry mainly involved in the clean heat and power generation process within coal fired PPs
- Governmental agencies, regulatory authorities
- R&D Institutes
- Academic environment – universities and related R&D centers
- Consulting and engineering companies in the field
- NGOs

Project coordinator: University Politehnica of Bucharest - Faculty of Power Engineering

Project co-funded by: EC - LIFELONG LEARNING PROGRAMME / LEONARDO DA VINCI / Transfer of Innovation TOI/2012

*Duration***:** 2012-2014

Partners: Institute for Studies and Power Engineering (ISPE), Romania; Romanian Association for Technology Transfer and Innovation (ARoTT); The University of Edinburgh (UEDIN), UK; Centre for Renewable Energy Sources and Saving (CRES), Greece

2. Knowledge transfer and research needs for preparing mitigation/adaptation policy portfolios (PROMITHEAS-4)

The general objective of the project was the development and evaluation of mitigation/adaptation (M/A) policy portfolios and the prioritization of research needs and gaps for twelve countries (Albania, Armenia, Azerbaijan, Bulgaria, Estonia, Kazakhstan, Moldova, Romania, Russian Federation, Serbia, Turkey and Ukraine) characterized as emerging economies.

Activities:

The achievement of the project aims was ensured through seven work packages (WPs):

- WP1 - Evaluation of available data and information;
- WP2 - Choice and implementation of models;
- WP3 - Scenarios and policy portfolios;
- WP4 - Evaluation of policy portfolios;
- WP5 - Prioritization of research gaps and needs;
- WP6 - Training – Dissemination;
- WP7 – Coordination.

Results:

- Overview of international procedures and standards in collecting and reporting data and information for the development of M/A policy portfolios
- Overview of national procedures sources and available data for M/A policy portfolios in the twelve targeted countries;
- Database with users' manual consisted of twelve national databases;
- Overview of models in use for M/A policy issues;
- Evaluation and selection of model(s) for M/A policy portfolios;
- Overview of the requirements for a post-2012 climate change agreement;
- Overview of the M/A policies in use in the participating targeted countries;
- Development of scenarios for the targeted countries;
- Development of effective M/A policy portfolios for the targeted countries;
- Evaluation of the M/A policy portfolios;

- Overview of EU and international research funding programs;
- Overview of research needs and gaps in the targeted countries;
- One training seminar for participants from the twelve targeted countries;
- Elaboration of dissemination material (newsletter; special editions, etc) and website;
- Twelve national workshops, one in each targeted country (more than 60 participants in the Romanian workshop);
- Final Conference

One important activity of the project was the training session that consisted in two stages:

i) Tele-teaching (1st March – 6th July 2012). This task was based on theoretical training on an e-class platform. The main activities of the tele-teaching were:

   - ✓ Training in collecting the available data and information and preparing a database;
   - ✓ Training in using models for developing M/A policy portfolios;
   - ✓ Training in developing scenarios and M/A policy portfolios;
   - ✓ Training in using evaluation for climate change policy issues;

   Four environmental engineers from ISPE Romania attended this part. The trainees successfully passed the exams of the tele-teaching part and have qualified for the second stage of the training procedure, the case study seminar.

ii) Case Study Seminar on developing national climate change policy mixtures (3-7 December 2012). The seminar was held in Athens, Greece and gave to the participants the chance to implement their theoretical knowledge gained during the e-class by creating national climate change policy mixtures.

Another important activity was the national workshop „Development and Assessment of Mitigation/Adaptation (M/A) Climate Change Portfolios for Romania" held in Bucharest (28th of May 2013). The event was organized as part of the dissemination activities. The main objective of the workshop was to disseminate the results of the PROMITHEAS-4 project, mainly the results of the work done for the preparation of the report "Development and Assessment of Mitigation / Adaptation Climate Change Policy Portfolios for Romania".

The event gathered more than 60 participants representing the Romanian Government, the Black Sea Economic Cooperation organization, the business environment and industry, as well as representatives from WEC-Romanian Member Committee. The following information and knowledge sharing materials were distributed: printed copies of the "Development and Assessment of Mitigation / Adaptation Climate Change Policy Portfolios for Romania" report translated in Romanian language and CDs containing the databases for all 12 targeted countries participating in the project and both Romanian and English versions of the report.

Implementation period: January 2011 - December 2013

Project coordinator: Energy Policy and Development Centre of the National and Kapodistrian University of Athens (Greece)

Partners: National Observatory of Athens (Greece); Institute for Advanced Studies (Austria); TUBITAK – Marmara Research Center (Turkey); Energy Strategy Centre of the Scientific Research Institute of Energy (Armenia); University of Belgrade-Faculty of Mining and Geology (Serbia); Institute of Power Engineering (Moldavia); Aristotle University of Thessaloniki (Greece); Finance University (Russia); Institute for Studies and Power Engineering (Romania); Polytechnic University of Tirana (Albania); Geotechnological Problems of Oil, Gas and Chemistry (Azerbaijan); Black Sea Regional Energy Center (Bulgaria); Energy Saving and Energy Management Institute of "Kiev Polytechnic Institute" (Ukraine); SRC KAZHIMINVEST (Kazakhstan); Tallinn University of Technology (Estonia).

Project supported by: FP7 programme

3. Support to the implementation of EU requirements for monitoring and reporting carbon dioxide emissions (CO2) and other greenhouse gases

The overall objective of the project is to fulfill the Romania's obligations regarding the implementation of EU policy on climate change. The project goal was to improve the national system for estimating anthropogenic emissions of greenhouse gases by sources and removals by sinks of carbon dioxide, regulated by the Kyoto Protocol (SNEEGES) and improve of the national inventory of greenhouse gas greenhouse (NIR) for submitting the NIR under optimum quality in accordance with the provisions set out in the Decisions 280/2004/EC and 166/2005/EC respectively, as mentioned in the UNFCCC Protocol Kyoto Protocol and related international law.

The project included the following *activities*:

- WP1. Improving the National System for estimating anthropogenic GHG emissions (SNEEGES) covered by the Kyoto Protocol, including the National Emissions Inventory of Greenhouse Gases (NIR) with the key objective of improving institutional coherence and capacity for reporting the emissions under the Kyoto Protocol to ensure the eligibility of Romania in the mechanisms established by the Protocol and to avoid the adjustments of estimations by UNFCCC emissions during the commitment period.

- WP2. Development of the institutional capacity for reporting GHG emissions with the key objective of improving institutional coherence and ability to meet all the requirements of Decision 280/2004/EC and subsequent relevant decisions.

- WP3. The establishment of programs and measures for the determination of emission factors and parameters relevant national and aimed at highlighting the financial effort to be made by Romania to determine these factors and national parameters.

In WP 1, one of the conducted activities was "Improving the training of staff working in the climate change in the central and subordinated institutions (Ministry of Environmental and Forests – (MMP) Ministry of Economy and Business Environment – (MECMA), Ministry of Transport and Infrastructure – (MTI), Ministry of Internal affairs – (MAI), Ministry of Agriculture and Rural Development – (MADR), National Environmental Protection Agency – (ANPM), National Institute of Statistics – (INS), Regional Environmental Protection Agencies and County Agencies for Environmental Protection)".

The Ministry of Environment and Forests, as Implementing Authority, organized a training session during 21 to 25 November 2011 at the ISPE headquarters having the technical support of the consultant who carried out the project in order to increase awareness and develop professional level of institutions responsible in achieving NIR.

The 5-days training session was attended by 89 experts from the central and subordinated institutions (MMP, MECMA, MTI, MAI, MADR, ANPM, INS, Regional Environmental Protection Agencies and County Agencies Environmental Protection).

The 5 days of the training program were split between:

- Legislation and regulations;
- Energy Sector;
- Land use, land-use change and Forestry Sector (LULUCF);
- Industrial Processes, Solvents and other products Sector;
- Agriculture and Waste sectors.

The training covered explanations on the use of: the 1996 IPCC Guidelines for National Greenhouse Gas Inventories, the IPCC Good Practice Guidance and Uncertainty Management in preparing NIR (IPCC GPG 2000) and IPCC Guidelines good practice on land use, land - use change and Forestry (IPCC GPG 2003). The training was conducted separately on the topics included in the above mentioned guides by analyzing general issues as well as specific issues for each sector.

In WP 2, the activity "Improvement of ANPM's staff training with responsibilities of administration and, respectively, NIR" was conducted.

In order to improve the training of personnel within ANPM having responsibilities in the elaboration of NIR and in SNEEGES administration, a training session specific to each sector of NIR was organized:

Session	Training periods	Participants
1– Energy	15 – 18 nov.2011	5 ANPM specialists
2 – Industrial processes, solvents and other products	15 – 18 nov.2011	4 ANPM specialists
3 – Land use, land-use change and forestry	15 – 18 nov.2011	3 ANPM specialists
4 – Agriculture	28 – 30 nov.2011	3 ANPM specialists
5 – Waste	28 – 30 nov.2011	2 ANPM specialists

The first three sessions had duration of four days each, while the last two sessions lasted three days each. All were carried out simultaneously at ISPE headquarters.

The interactive sessions aimed at:

- Presenting how to prepare the national inventory report by sectors using the IPCC guidelines (IPCC 1996, the IPCC GPG 2000 and IPCC GPG 2003) as basis;
- Discussing and clarifying the differences that appear in the user guides IPCC 2006 from IPCC 1996, IPCC GPG 2000 and IPCC GPG 2003;
- Discussing and clarifying the data by sector related to the addressed technologies;
- Completion of data needed to be entered in the common reporting format (CRF);
- Explanations on how to fill-in the fields of the CRF;
- Statistical analysis to determine the uncertainties of the used data;

- Clarifications regarding the trend of GHG emissions for the period 1989 - 2009.

Project coordinator: Institute for Studies and Power Engineering Bucharest (ISPE)

Partners:

- University of Agronomic Sciences and Veterinary Medicine Bucharest (USAMV) - Agricultural Sector;
- University Politehnica of Bucharest - Research and Expertise Centre for Eco - Metallurgical (UPB - ECOMET) - Industrial processes Sector;
- Forest Research and Management Institute (ICAS) - Land Use, Land-Use Change and Forestry (LULUCF) Sector;
- 2 freelancers: Badita Petroaica – Chemical Industry and Marilena Pătraşcu - laws and regulations.

Implementation period: 27.09.2011 - 30.11.2011.

Project supported by: PHARE funds

4. Capacity building of local governments to advance Local Climate and Energy Action – from planning to action to monitoring" (Covenant capaCITY)

General Objective: Covenant capacity takes up the urgent challenge to develop more sustainable energy communities (SEC) across Europe.

Activities: During the project a comprehensive European capacity building programme is offered for local governments to support all the phases of implementing a Sustainable Energy Action Plan (SEAP) – from motivation, planning, implementation, to monitoring and evaluating. It empowers and supports municipalities to sign up to the Covenant of Mayors – helping to bring together committed cities and towns, and their supporters.

Expected Results:

- The training programme, system and award for completion.

  The programme deals with developing a new SEAP ("1st generation" SEAP) and provides ideas when reviewing existing SEAPs ("2nd generation" SEAP). It gives basic guidance, offers ideas, hints, tips and tools - dealing with people, structures, processes.

- The structure is comprised of: 8 inter-connected topics (dealt with as modules): greenhouse gas inventories, SEAP development, stakeholder involvement, procurement, plus 4 sectors: buildings, transport, waste, water.
- Per topic there are two thematic modules – one for start-up level and another for more advanced communities

Targeted public:

- Trainees: local governments in Europe; local decision-makers (mayors, vice mayors, councilors, opposition leaders); municipal staff (senior, mid-level and junior staff dealing with energy, including departments: transport, water, waste, urban planning, communication, Local Agenda 21, etc.)
- Potential trainers: local government associations & networks; energy agencies working with municipalities

Implementation period: 2011-2014

Project coordinator: ICLEI Europe

Partners: Centre for Social Innovation (ZSI), Austria; Municipal Energy Efficiency Network EcoEnergy, Bulgaria; City of Burgas, Bulgaria; WWF Danube-Carpathian Program, Bulgaria; City of Koprivnica, Croatia; Estonian Regional and Local Development Agency (ERKAS), Estonia; FCG Finnish Consulting Group (FCG), Finland; Climate Action Network – France (CAN-F); Regional Energy Agency of Crete (REAC), Greece; City of Padova, Italy; Sogesca, Italy; WWF Poland; Agency for Energy Efficiency and Environment Protection (AEEPM), Romania; Association of Municipalities and Towns of Slovenia (SOS), Slovenia; City of Malmö, Sweden; The Climate Municipalities (CM), Sweden; Institute for Housing and Urban Development Studies (IHS), The Nederlands; Act on Energy,

Project co-funded by: Intelligent Energy Europe (IEE) programme.

5. Capacity building and lessons to be learned for the institutionalization of sustainable energy policies in the municipalities' operations (Green Twinning)

General Objective: strengthening the capacity of EU-12 public authorities in institutionalizing sustainable energy policies into their operations and in committing and fulfilling their Covenant of Mayors obligations

Activities:

- assessment of training needs of the "learning" municipalities regarding sustainable energy planning and implementation;
- development of detailed capacity building strategy and related action plan addressing the specific training gaps of the "learning" municipalities;
- organization of capacity building activities on SEAP development and implementation such as training events, helpdesk with the assistance of the Consultants team;
- conclusion of twinning agreements and organization of twinning approaches (study visits, staff exchanges, mentoring etc.) between 10 "learning" municipalities from EU-12 including Greece and 10 "experienced" municipalities from Spain

Expected Results:

- Direct exchange of experience, peer-to-peer and twinning approaches between local authorities from the EU-15 that are experienced in the sector and learning ones from the EU-12. "Learning from each other – working together and avoiding repetition of past errors" is the project concept
- Performance Indicators
- Report on Twinning work plans

Target public: municipalities, associations/networks of local authorities, agencies and consulting firms

Implementation period: 24 months, April 2012-March 2014

Project Coordinator: Regional Union of Municipalities of Attica (PEDA).

Partners: 10 partners (municipalities, associations/networks of local authorities, agencies and consulting firms) from Greece, Bulgaria, Poland, Romania, Slovenia and Spain

Project co-funded by: Intelligent Energy Europe (IEE) programme.

Related to training and education projects developed by Romania in European consortiums it must be underlined the important role of the National Agency for EU Programs in the field of Education and Vocational Training responsible for managing several UE dedicated programs. Thus during 2011-2013 several projects were developed in the field of sustainable development, GHG emission reduction and climate change impact mitigation, by Romanian consortium's leaders or partners, as follows:

- 10 Bilateral schools' projects and 140 Multilateral schools' projects in *Comenius Program*, focusing on all levels of school education, from pre-school and primary to secondary schools;
- 2 Universities' projects in *ERASMUS Program* – the student exchange program;
- 10 projects developed within *Grundtvig Program* – aiming to help develop the adult education sector
- 17 practical projects in the field of vocational education and training co-funded by The *Leonardo da Vinci Program* out of which 2 Multilateral projects - transfers' of innovation , 5 Partnerships and 10 Mobility

Further climate change mitigation dedicated actions are envisaged considering the future launch of Horizon 2020 in December 2013, LIFE 2014-2020, RDI National Programs, and the current EEA and Norwegian Financial Mechanism implementation (2009-2014).

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