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ROMANIA WITHIN THE CONTEXT OF CLIMATIC CHANGES

BY

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Abstract. Under the circumstances of the menacing climatic changes upon both environment and social-economic framework, the United Nations Framework Convention on Climate Change (UNFCCC) has established its main objective "achieving stabilization of gas concentrations within climatic system".

Due to the fact that the main cause of the climatic changes derives from the exhausted gases resulting in the greenhouse effect, measures, targets and programs of reducing greenhouse effects gases will be established. A first step in this respect is drawing – up the Kyoto Protocol (1997), according to which Romania has embarked upon reducing the greenhouse effect emissions up to 8% as compared with the reference year 1989, in the first period of its engagement, namely 2008...2012.

The present paper submits both an inventory of greenhouse effect emissions in Romania and establishing policies and measures of reducing these emissions within all sectors of human activities.

Key words: greenhouse effect emissions; climatic changes; global heating; policies to reduce such emissions.

1. General Considerations

Climatic changes represent one of the most urgent and threatening issues at global scale, affecting the surrounding medium and the social and economic life, as well. The adverse effects of climatic changes have been already manifested by the ever increasing extreme meteorological phenomena.

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In the case when no measures will be taken, the climatic changes will break down the proper functioning of the environment, negatively affecting both economies and societies of the world.

The impact of climatic changes upon the planet has been lately set into evidence at an ever greater extent by

a) *most severe events* such as: floods, drought, forest fires, heat waves; these are even more frequent in the last decades, the number of natural catastrophes has increased three times as compared with the level of the 60's;

b) *the rise of the sea level* by 12...22 cm in the last century, with even a more frightening increase in prospect;

c) *the smelting of ice caps*: the North Pole glaciers have diminished by 10%, in the last decades, and the ice thickness has decreased by approximately 40%;

d) *withdrawal of glaciers*: it is estimated that about 75% of glaciers from the Swiss Alps will disappear until 2050;

e) *nature under threat*: vanishing of many animals and plants due to not adapting to climatic changes.

In the course of the last 150 years (starting with 1850) the mean temperature has increased by approximately 0.8^{o}C at global scale and by 1^{o}C at European level, meaning a high increase of temperature. The 20th century excelled in the highest temperatures, and the 90's are considered as the hottest 10 years out of the last 1,000 years. Unfortunately, global heating has continued and between 1995...2006 the highest global temperatures within the last twelve years have been recorded.

The Intergovernmental Committee for climatic changes (IPCC) estimates an increase of mean temperature by 1.8^{o}C up to 4^{o}C until 2100, fixing a limiting threshold of global temperature increase at maximum 2^{o}C beyond the level of pre-industrial period. Beyond this level inevitable, irreversible catastrophic climatic changes may occur.

It is possible that the primary cause of climatic changes may be due to greenhouse effect emissions of gases such as: (CO_2 – carbon dioxide, CH_4 – methane, N_2O – nitrogen protoxide, HFC – hydrofluorocarbons, PFC – perfluorocarbons, SF_6 – sulphur hexafluoride), resulting from various human activities namely

a) burning fossil fuels;

b) deforestation;

c) wastes depositing;

d) utilization of industrial fluoride gases.

2. Trends in Greenhouse Effect Gas Emissions in Romania

The threatening issue of climatic changes is globally tackled with by the United Nations Framework Convention on Climate Change (UNFCCC), which

states the general framework of measures to be taken for preventing the disastrous impact of climatic changes.

Accordingly with the provisions of UNFCCC, endorsed by Romania in 1994, the climatic changes are defined as being "the changes which can be directly or indirectly attributed to human activities affecting the composition of the atmosphere at global scale which adds up to natural variabilities of the clime observed along some relevant periods".

The primary goal of UNFCCC consists in "*establishing the stabilization of gas concentration with the climatic system. This level should be achieved in an interval of time, sufficient to allow ecosystems to adapt, naturally, to climatic changes, so that food production would not be endangered, and economic development would be able to carry on in a sustained rate*".

In spite of policies and efforts to reduce greenhouse effects emissions, the global mean temperature will continue to increase and strategies and measures will be needed for adaptation to climatic changes impact.

The Kyoto Protocol (1997) of UNFCCC represents the first step to achieve this goal. Within this Protocol measures and targets were fixed with terms/periods of time for reducing greenhouse effect gas emissions (GHG). The major contribution to greenhouse effect emissions on national scale is provided by CO_2 followed by CH_4 and N_2O (Table 1).

Table 1

Share of GHG for the 1989-2007 Period

GHG, [%]	1989	1990	2007
CO_2	70.03	70.82	72.81
CH_4	16.82	16.69	16.89
N_2O	11.94	11.61	9.88
HFC	0	0	0.0105
PFC	1.21	0.87	0.41
SF_6	0	0	0.00209

In conformity with Kyoto Protocol, Romania has pledged to reduce emissions of greenhouse effect gases (GHG) by 8% as compared with reference year level (1989) in the first period its pledge, namely 2008...2012. In Fig. 1 is presented the emissions of GHG in Romania, in the period 1989...2007, as compared with the target value established by Kyoto Protocol.

As can be seen in Fig. 1 the GHG emissions fell in 2007 by 44.83% as compared with reference year 1989. The diminishing of emissions in the period 1989...1996 was primarily due to the economic and energetic decline in transition to market economy. A consistent increase of GHG emissions was recorded in 1996 due to economic recovery and increase of consumption in energetic sector and industrial production. But owing to setting the Cernavodă Nuclear Power Plant in operation in 1996, the emissions fell again in 1997, and

this continued until 1999. After this date another increase of GHG emissions was observed as a result of economic swing between 1999...2004, followed by a new fall beginning with 2005.

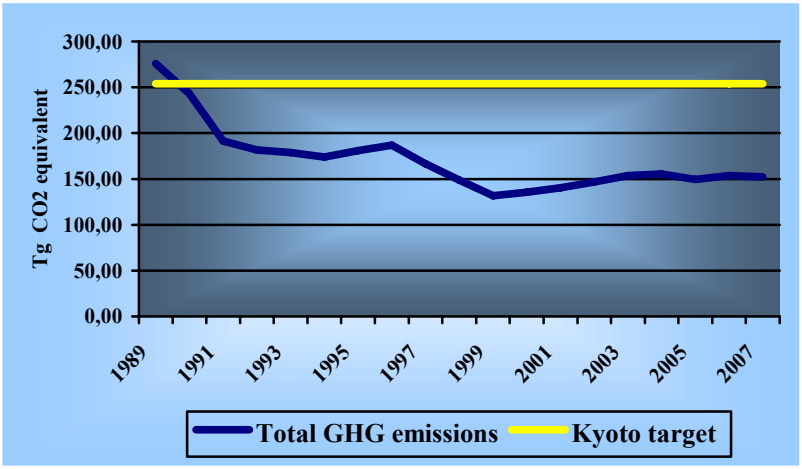

Fig.1 – The total GHG emissions in Romania, in the 1989...2007 period.

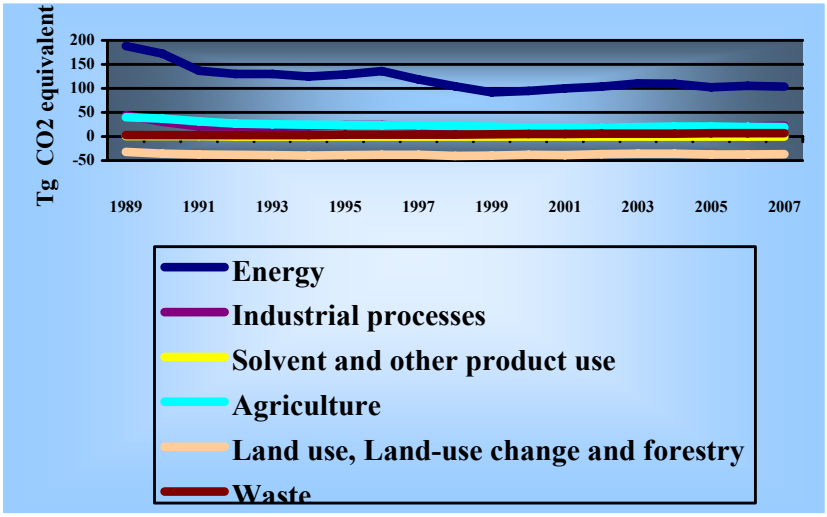

Fig. 2 – Trends by sector, in Romania, in the 1989...2007 period.

From the point of view of GHG emissions, the energetic sector represents the main polluting sector from Romania. Thus, at the level of year 2007, the emissions resulting from this sector represented 68.3% from the total GHG emissions recorded but nevertheless, the GHG emissions from energetic sector fell by approximately 50% as compared with the reference year (s. Fig. 2).

As can be seen in Fig. 2 the other important sectors, responsible for GHG emissions in Romania, are

a) the industrial processes (14.58% of the total GHG emissions in 2007), marking a fall by approximately 50% as compared with 1989;

b) agriculture (12.84% of the total GHG emissions in 2007), also marking a decline of approximately 50% as compared with 1989;

c) waste (4.17% of the total GHG emissions in 2007), marking a rise of 117.5% as compared with 1989.

In Fig. 3 a percentage distribution of the main sectors producing GHG emissions is presented.

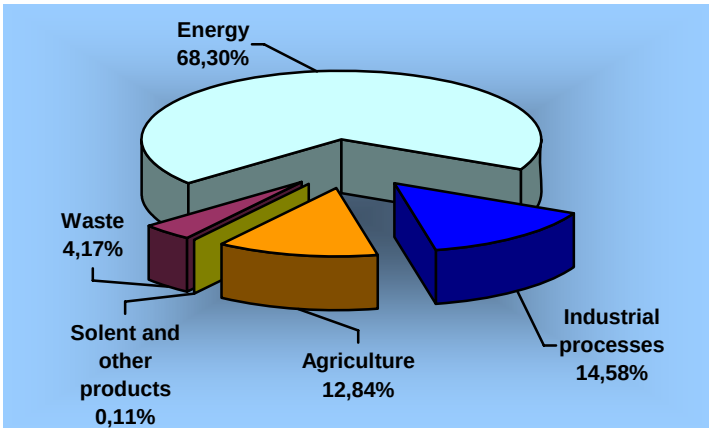

Fig.3 – Sectorial GHG emissions, in Romania, in 2007.

As compared with the other sectors, the energetic sector represents the richest source of GHG emissions. This sector sums up emissions both from combustion activities and fugitive emissions from fuels, the two types of activities can be divided into the following sub-sectors.

a) combustion activities: energy industries; manufacturing industries and construction; transports; other sectors (commercial/institutional, residential, agriculture/forestry/fisheries);

b) fugitive emissions from fuels: solid fuels; oil and natural gas.

Table 2

Contributions to the Energy Sector GHG Emissions

Energy categories GHG emissions contribution	1989	1990
Industries energy, [%]	55.71	41.50
Manufacturing industries and Construction, [%]	19.72	17.95
Transports, [%]	3.04	10.95
Other sectors, [%]	6.76	20.38
Solid fuels, [%]	3.34	2.28
Oil and natural gas, [%]	11.42	6.94

The contribution of each energetic sub-sector in the total GHG emissions, in 1989, respectively in 2007, is illustrated in Table 2.

In most of energetic sectors the GHG emissions fell, but in the transports sector (94.11% land transports, 4.42% railway transports, 0.69% water transports, 0.42% air transports) increases of GHG emissions were recorded, as a result of increasing mobility and number of vehicles.

The second polluting sector in Romania is that from industrial processes, whose GHG emissions represent, in 2007, 14.58% of total GHG emissions. The total GHG emissions from industrial processes, in 2007, are divided as follows:

a) 42.80% metal production ;

b) 35.32% chemical industry;

c) 21.79% mineral products ;

d) 0.09% consumption of HFC and SF_6.

Then comes agriculture whose contribution to total GHG emissions level, in 2007, is 12.84%. The activities which directly contribute to GHG emissions, in this sector, refer to

a) livestock: enteric fermentation and manure management;

b) agricultural soils.

The main source of emissions of CH_4 in agriculture is provided by domestic animals, both by enteric fermentation and by fertilizers, this later ones being responsible for N_2O emissions. The reduction of GHG emissions in agriculture, in the period 1989...2007, was due to diminution of quantities of fertilizers and decline of animal breeding.

The solvents sector is responsible only for 0.11% of GHG emissions recorded in 2007. These represent chemical compounds used for dissolving various substances. As a result of using solvents, non-methane volatile organic compounds are emitted (NMVOC), indirectly considered GHG. These ones oxidize with time, giving off CO_2 into the surrounding medium, contributing, in this way, to total GHG emissions.

In the interval 1989...2007 the GHG emissions resulting from wastes (represent 4.17% of the total GHG emissions in 2007), increased as compared with other sectors, by 117.5%. This sector contains emissions resulting from solid waste disposal on land, wastewater handling and waste incineration. Solid waste disposal on land represents: the main source of GHG emissions (83.85%), emissions resulting from their incineration cover 15.70% and those coming from wastewater handling, 0.45%. The most significant emissions of GHG from this sector come from CH_4 emissions from solid waste disposal on land.

In forestry the main goal is absorption of CO_2 emissions, in woods. In the time interval 1989...2007 the quantity of emissions absorbed by the Romanian forests, as compared with total GHG emissions, increased from 11.75%, in 1989, to 23.78% in 2007.

Based on the information supplied in the time interval 1989...2007 Romania has all the chances to fulfil its pledge to reduce greenhouse effect gases for the first stage within the Kyoto Protocol, namely 2008...2012.

For the following period, after 2012, a series of actions are needed to achieve the primary objective of UNFCCC. Thus, in 2007, based upon some strategies regarding climatic changes and energetic policies, the European Commission established suggestions and options for a global agreement within the commission "*limitating global climate changes to 2^{o}C, the way ahead for 2020 and beyond"*.

A long term objective has been established for limiting the increase of global mean temperature to under 2°C above the pre-industrial level, meaning a reduction of GHG emissions until 2020 by 20…40% as compared with the level in 1990 and by, at least 50% until 2050, as compared with the level in 1990.

3. Policies and Measures to Mitigate Greenhouse Effect Gas Emissions

In view of achieving the primary objective of UNFCCC, and the pledges of countries to reduce GHG emissions, respectively, the energetic policies impose certain measures and regulations adopted at the level of EU by the European Programme regarding climatic changes. Thus, within the energetic sector one has to pursue

a) reduction of energetic consumption and costs;

b) improving energetic efficiency ;

c) improving the degree of primary energy utilization ;

d) increase in the share of renewable sources of energy;

e) promoting production of electric and thermal energy in high efficiency cogenerating plants;

f) taking measures for reducing GHG emissions in transports sectors by increasing the utilization of biofuels.

One of the ways of implementing the new energetic policy with regard to climatic changes is the increase of utilizing energy from renewable sources. Developing renewable sources of energy (RES) will contribute to

a) reduction of GHG emissions of environmental pollution;

b) increase of safety in supplying energy by efficient administration and rational exploitation of primary energy resources;

c) promoting technological development.

Romania ranked first among the candidates to EU which pledged to assume in its legislation the provisions of the Directive *2001*/*77*/CE regarding the promotion of energy produced from renewable sources on its home market of electric energy, and based on this, the target that „ *the renewable sources of energy would represent 11% of the total consumption of energy in 2010, and from the total consumption of electric energy 30% would be covered from renewable sources*".

In Table 3 the share of renewable sources of energy in electric energy production, in 2010, is presented and in Table 4 is presented the share of renewable sources (RES) in the total consumption of primary resources, in 2000 and 2010, respectively, in Romania.

Table 3
The Share of RES in the Production of Electric Energy

RES	2010, [MWh]
Solar energy	1.860
Wind energy	314
Total hydro energy hydro <10 MW	18,200 1,100
Biomass	1,134
Geothermal energy	–

Table 4
The Share of RES in the Total Consumption of Primary Resources

RES	2000 1000 toe	2010 1000 toe
Solar energy thermal electric	– – –	7.50 7.34 0.16
Wind energy	–	27
Total hydro energy hydro >10 MW hydro <10 MW	1.272 1.185 87	1,565.2 1,470.6 94.6
Biomass thermal electric	2,772 2,772 –	3,347.3 3,249.8 97.5
Geothermal energy	–	17.5

The renewable sources will essentially contribute to the country'senergetic balance by limiting the imports of primary energy resource, contributing, at the same time, to reduce the negative impact of energetic sector upon environment.

In the industrial sector, considered as one of the sectors having the greatest potential of saving and conserving energy, the reduction of GHG emissions will be achieved by taking some measures, such as

a) industrial reorganization;
b) technological modernization;
c) improving energy management and environment;
d) increasing competitivity.

Considering that the major GHG emissions, in agriculture, derive from CH_4 emissions, resulting from enteric fermentation of animals and N_2O emissions, resulting from the use of fertilizers in arable lands, in view of reducing GHG emissions measures are taken for

a) managing farm and domestic wastes;

b) control and improvement of utilization degree of fertilizers.

Since, in the wastes sector the GHG emissions (especially CH_4 emissions) increased in 1989...2007, urgent measures are needed to reduce emissons such as

a) the control of wastes quantities deposited;

b) recycling;

c) energetic revaluation of wastes by recovering energy from fermentation gases;

d) promoting utilization of compost in agriculture;

e) irrigations.

Forests represent 28% of Romania's territory but each year 40% of wooded land is chopped down. In the conditions of increasing temperatures and decreasing of rainfall quantity, a long term, a drop in forest productivity is foreseen. Being the main source of emissions absorption, within the manacing conditions of climatic changes, some measures are needed to reduce GHG emissions, such as

a) deforestation control and use of pesticides;

b) preventing fires;

c) protecting woods;

d) managing woods by consevation, stocking and substitution of carbon;

e) diversification of species and forms of trees;

f) extending aforestation.

4. Conclusions

Under the circumstances of the negative impact of climatic changes on environment and on social-economic medium, as well some measures are needed to reduce greenhouse effect gases, a first step being to fix a target to reduce these emissions by 8% until 2012, as compared with the reference year 1989, in conformity with Kyoto Protocol.

In view of satisfaction of the obligation of reducing emissions, Romania as well as the other member states, will establish energetic policies and measures to reduce GHG emissions both in energetic domain and other sectors. One will observe: diminution of consumptions, replacing classic fuels with renewable sources of energy, improving energetic efficiency, reorganizing industry, technologic modernization, control in fertilizer utilization and solid waste disposal on land and extending forested zones.

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ROMÂNIA ÎN CONTEXTUL SCHIMBĂRILOR CLIMATICE

(Rezumat)

În situația amenințătoare a schimbărilor climatice atât asupra mediului înconjurător cât şi a cadrului social-economic, Convenția-cadru a Organizației Națiunilor Unite privind schimbările climatice (UNFCCC) a stabilit drept obiectiv principal *"realizarea stabilizării concentrațiilor de gaze cu sistemului climatic"*.

Dat fiind faptul că principala cauză a schimbărilor climatice se datorează emisiilor de gaze cu efect de seră se vor stabili măsuri, ținte şi perioade de reducere a gazelor cu efect de seră. Un prim pas în acest sens îl constituie încheierea Protocolului de la Kyoto (1997), în urma căruia România s-a angajat să reducă emisiile de gaze cu efect de seră cu 8% față de nivelul anului de bază 1989, în prima perioadă de angajament şi anume 2008…2012.

Lucrarea prezintă atât o inventariere a emisiilor de gaze cu efect de seră, în România, cât şi stabilirea unor politici şi măsuri de reducere a acestora, la nivelul tuturor sectoarelor.