Energy and environmental strategies in the context of climate change

Strategii energetice și de mediu în contextul schimbărilor climatice

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Abstract. *In the current context of increasing energy consumption, greenhouse gas (GHG) emissions and the serious consequences for the environment, society and the economy, at global, European and national level, the countries of the world are taking measures to fight the effects of climate change by establishing energy and environmental strategies and policies.*
Starting from the commitment established at European level to neutralize net greenhouse gas emissions by 2050, the paper presents the energy and ecological framework of Romania in 2020, the energy and ecological objectives for 2030 and the measures proposed to achieve the targets on reducing GHG emissions, improving energy efficiency and promoting renewable energy sources.

Keywords: greenhouse gas, GHG, emission, neutralization, strategy, energy, ecology, environment, climate change, Romania

Rezumat. *În contextul creșterii consumului energetic, al emisiilor de gaze cu efect de seră (GES) și al consecințelor tot mai grave asupra mediului, societății și economiei, atât la nivel global, cât și european sau național, statele lumii iau măsuri de combatere a efectelor schimbărilor climatice, prin stabilirea unor strategii și politici energetice și ecologice.*
Pornind de la angajamentul stabilit la nivel european de neutralizare a emisiilor nete de gaze cu efect de seră până în anul 2050, lucrarea prezintă contextul energetic și ecologic al României la nivelul anului 2020, obiectivele energetice și ecologice pentru anul 2030 și măsurile propuse pentru atingerea țintelor privind reducerea emisiilor de GES, îmbunătățirea eficienței energetice și promovarea surselor regenerabile de energie.

Cuvinte cheie: gaze, efect de seră, emisie, neutralizare, strategie, energie, ecologie, mediu ambiant, schimbări climatice, România

1. Introduction

In the current context of the disastrous impact of climate change, proved by extreme weather events: floods, drought, forest fires, rising sea and ocean levels, lowering of the ice caps, rising temperatures etc., fighting the increase in greenhouse gas (GHG) emissions, considered the main cause of climate change, is an increasing priority at global, European and national level.

Globally, the year 2020 was the warmest year ever recorded (on par with the record of 2016), with the global average temperature in 2020 being 0.6^0C higher than in 1981-2010 and around 1.25^0C above the pre-industrial period 1850-1900 (Figure 1). At European level, the average temperature in 2020 was 0.4^0C above that of 2019 and 1.6^0C above the 1981-2010 reference period.

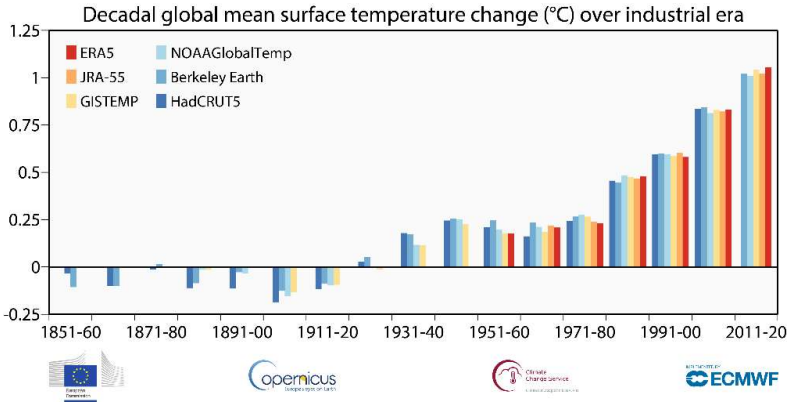


Fig. 1. Global average temperature relative to pre-industrial era [1]

Atmospheric CO_2 emissions continued to growth at a rate of around 2.3 ppm/year in 2020 (lower than in 2019), reaching a peak of 413 ppm in May 2020 (Figure 2).

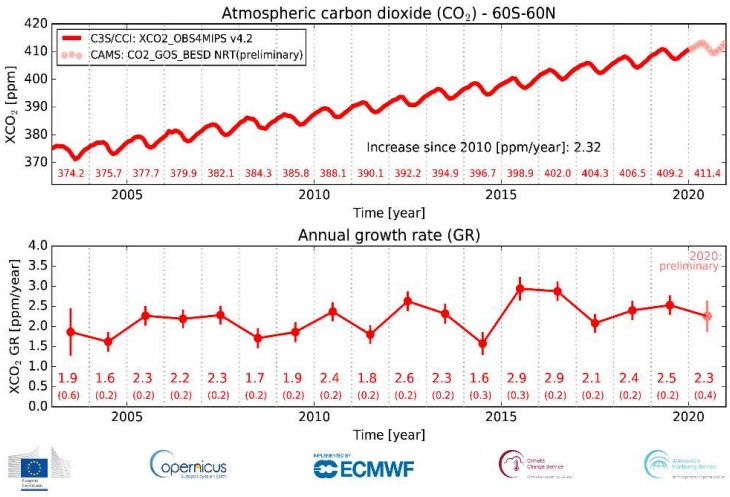


Fig. 2. Global monthly atmospheric CO_2 emissions for the period 2003-2020 and annual growth rate (GR) [1]

The increase in the frequency and intensity of extreme weather events will generate serious consequences for both people and the economy. To reduce the risk of climate change, efforts to reduce greenhouse gas emissions will need to be continued.

2. EU climate change goals

By adopting the Paris Agreement on climate change (2015), the countries of the world are committed to fight the effects of climate change, limiting the increase in the global average temperature by well below 2^0C (as far as possible to 1.5^0C) compared to 1990 levels, and to presenting national plans to reduce emissions, reviewing their commitments every 5 years.

To highlight the importance of limiting global warming, Figure 3 presents several future scenarios (2020-2100) for GHG emissions: no climate action, if current policies continue, and if all countries have achieved their goals and necessary pathways compatible with limiting global warming to 2^0C (or 1.5^0C). According to the IPCC's Special Report on 1.5°C and the works of Michael Raupach published in *Nature Climate Change*, the presented scenarios underline that urgent and rapid reductions in greenhouse gas emissions will be needed [2], [3], [4], [5].

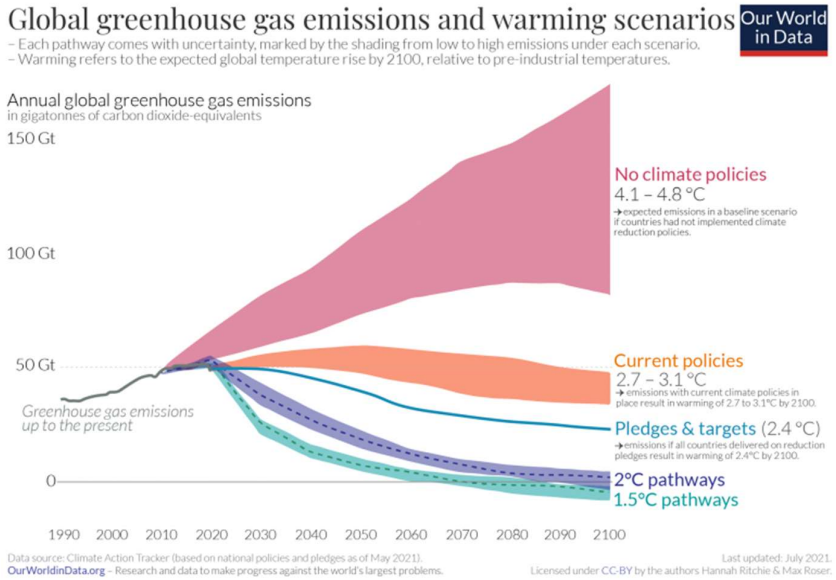


Fig. 3. Climate scenarios and policies on GHG emissions [5]

The current commitment of the European Union (EU) and its Member States is to reduce emissions by at least 55% in 2030 compared to 1990, with the aim of achieving climate neutrality by 2050, pointing for an economy free of greenhouse gas emissions. Romania supports the EU's objective of climate neutrality for 2050 and the implementation of the European Green Deal (EGD).

To overcome the threatening challenges to the environment and society, the European Green Deal aims to transform the EU into a modern, resource-efficient and competitive economy by neutralizing net GHG emissions by 2050 and ensuring economic growth without depleting resources.

3. Romania in the context of climate change. Energy and environmental objectives

Given that 75% of EU greenhouse gas emissions come from energy production and consumption, the focus will be on review the energy sector to ensure climate neutrality [6]. The European Union has thus set the following energy and climate important targets for 2030 [7]:

- The reduction of greenhouse gas emissions by at least 40% by 2030 compared to 1990;
- Renewable energy consumption of 32% in 2030;
- Improving energy efficiency by 32.5% in 2030;
- Interconnection of the electricity market at a level of 15% by 2030.

In order to achieve the proposed targets, EU Member States have submitted National Energy and Climate Plans for the 2021-2030 period, setting out national targets and contributions in terms of energy efficiency, renewable energy and greenhouse gas emission reductions.

Romania's energy and environmental objectives for 2030, included in the National Integrated Plan in the field of Energy and Climate Change 2021-2030 (PNIESC 2021-2030) are highlighted in Table 1.

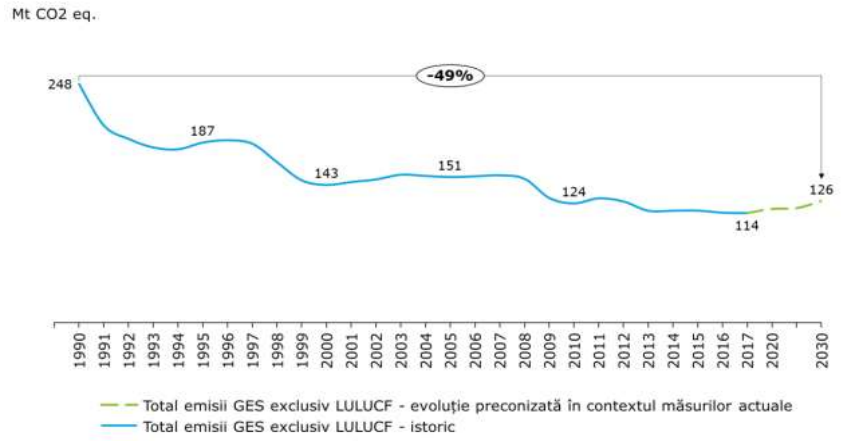
Table 1

The main objectives of the PNIESC 2021-2030 for the year 2030 [7]

ETS emissions (% vs 2005)	-43.9%
Non-ETS emissions (% vs 2005)	-2%
Overall share of energy from renewable sources in gross final consumption of energy	**30.7%**
Share of RES-E	49.4%
Share of RES-T	14.2%
Share of RES-H&C	33%
Energy Efficiency (% compared to PRIMES 2007 projection at 2030 level)	
Primary energy consumption	-45.1%
Final energy consumption	-40.4%
Primary energy consumption (Mtoe)	32.3
Final energy consumption (Mtoe)	25.7

In Romania, GHG emissions experienced a downward trend in the 1990-2017 period, the largest share of emissions being recorded in the energy sector.

In the context of the current measures, Romania is expected to reach a reduction of about 49% of emissions in 2030, compared to 1990 (Figure 4).



Sursă: Ministerul Mediului, Apelor și Pădurilor, Raportarea României în conformitate cu Regulamentul UE 749/2014

Fig. 4. Expected evolution of GHG emissions in Romania [7]

The expected economic growth for 2030 is shown by the increase in final energy consumption in the transport sector, the industrial sector, the tertiary sector and a decrease in energy consumption in the residential sector as a result of improved energy efficiency.

Figure 5 shows the final energy consumption for 2020 and the projections for 2025 and 2030 in two scenarios: the modelling scenario in the context of existing measures (WEM) and the modelling scenario in the context of planned measures (WAM).

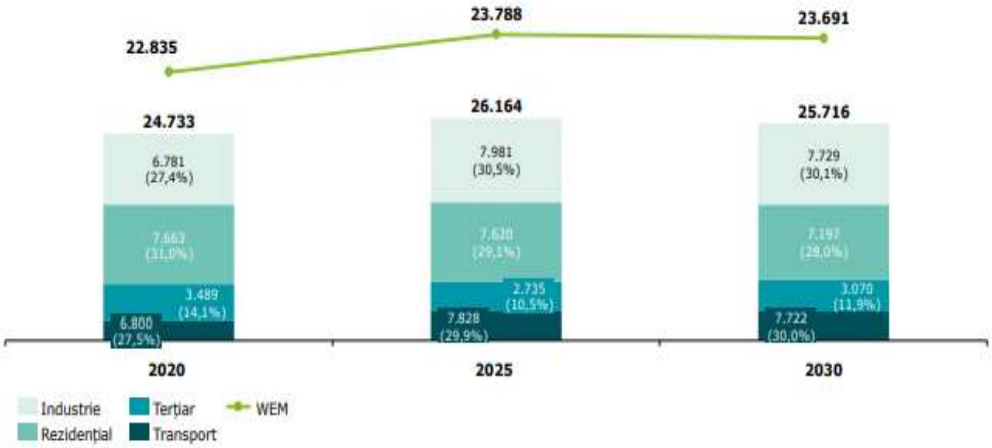


Fig. 5. Final energy consumption in Romania [7]

According to reports over the 1990-2020 period (Figure 6 and Figure 7) it is observed that, both at European and national level, although fossil fuels still dominate

in securing energy supply, there is a growing annual increase in the share of renewable energy.

In order to reduce emissions, improve energy efficiency and increase the share of energy from renewable sources, Romania will aim to reduce primary and final energy consumption, focusing on the use of renewable energy sources (RES) in the relevant sectors, namely: heating &cooling (RES-H&C), electricity (RES-E) and transport (RES-T).

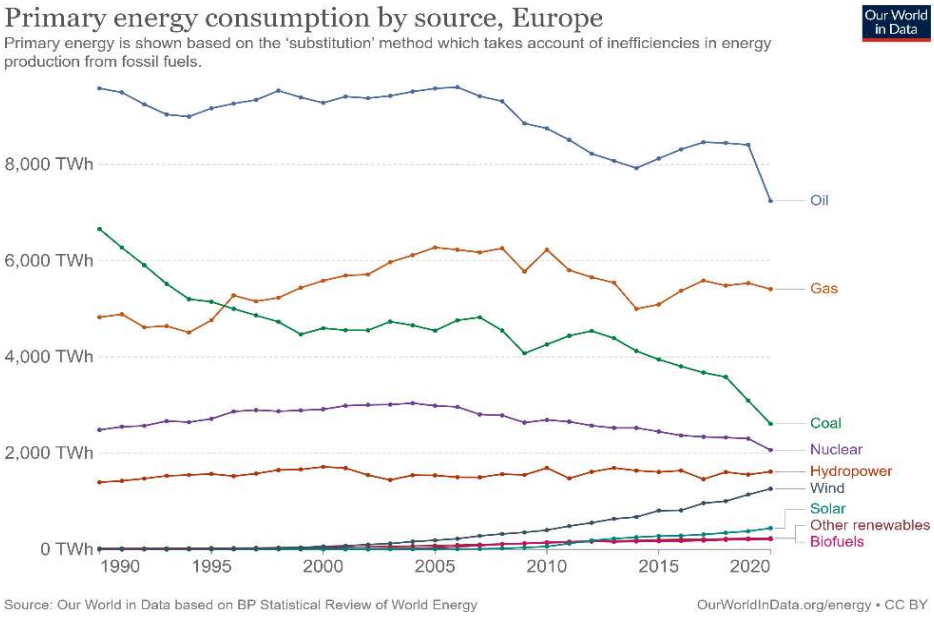


Fig. 6. Primary energy consumption by source in the EU [8]

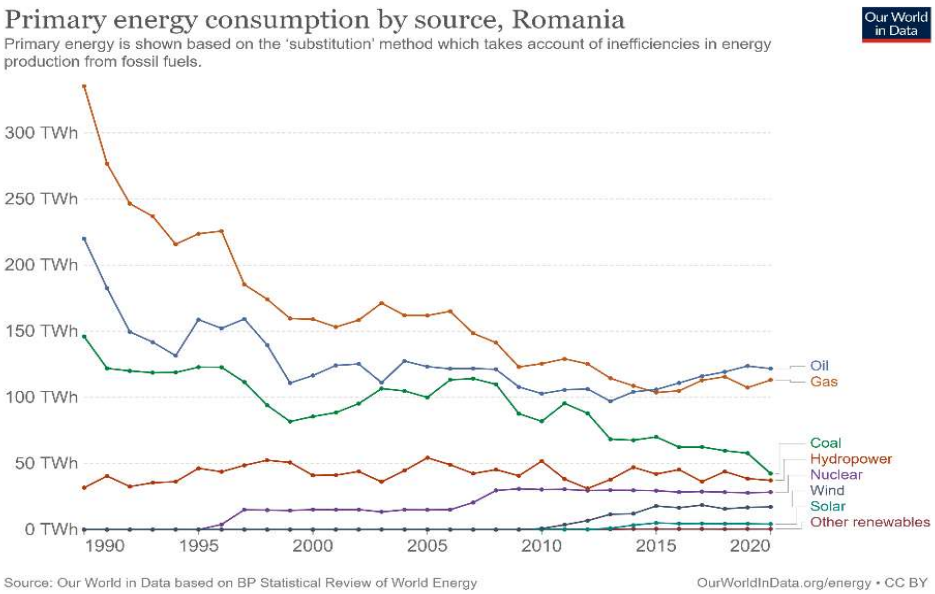


Fig. 7. Primary energy consumption by source in Romania [8]

Tables 2, 3 and 4 show the estimated trajectories of renewable energy, distributed by technology, for the 2021-2030 period.

Table 2

Anticipated evolution of renewable energy in gross final consumption of energy in the heating &cooling sector for the 2021-2030 period [7]

ktoe	2020	2025	2030
Final energy demand	3481.2	3892.1	4026.5
Derived heat	76.2	170	263.7
Heat pumps	-	55	119.6
Total gross final consumption of energy from renewable sources in the Heating&Cooling sector	**3557.4**	**4117**	**4409.8**

Table 3

Anticipated evolution of renewable energy in gross final consumption of electricity for the 2021-2030 period [7]

ktoe	2020	2025	2030
Hydro-energy	1415.9	1457.9	1460.3
Eolian	564.6	828.8	1004.9
Solar	170.4	424.6	632.6
Other renewable sources	77.4	77.4	77.4
Total gross final consumption of energy from renewable sources	**2228.4**	**2788.7**	**3175.2**

Table 4

Anticipated evolution of renewable energy in gross final consumption of energy in the transport sector for the 2021-2030 period [7]

ktoe	2020	2025	2030
Renewable electricity in transport road	2.2	10.5	55.7
Renewable electricity in transport rail	46.9	72.2	97.6
Electricity from renewable sources in other types of transport	1.3	5.3	16.2
First generation biofuels	505.7	490.5	474.3
Second generation biofuels	-	40.5	63.6
Total gross final consumption of energy from renewable sources in the transport sector	**635.4**	**728.4**	**989.9**

The gross final consumption of energy from renewable sources in the heating &cooling sector is estimated to increase by 24% in the 2021-2030 period, based on the

availability of biomass sources (firewood, agricultural waste etc.) and the introduction of heat pumps to provide the necessary heating demand (taking into account the estimated reduction in heat pump costs).

It is also planned to install solar panels and integrate other renewable energy sources into the production of thermal energy for district heating systems.

The share of energy from renewable sources in the transport sector will have to reach 14% in the gross final consumption of energy in transport at the level of 2030, through measures such as: accelerating the electrification of transport, the convergence of the costs of light electric vehicles with those of internal combustion cars at the level of 2024 etc.

To achieve the energy and climate objectives, a series of important policies and measures will be needed in the energy sector, including [7]:

- Promoting investments in new electricity production capacities with low carbon emissions, replacing important increased emission source-based capacity with new, efficient and low-emission power plants on gas, nuclear energy and RES, which will lead to a reduction of consumption and GHG emissions. This objective will also be achieved for heating in centralized heating systems of CHSS (Centralized Heat Supply System) type, through the energy transit over the NPS (National Power System) and the use of heat pumps as energy sources, also using the electricity market mechanisms;
- Usage of revenues from the EU ETS (EU Emissions Trading System) and from the Structural Funds under the new Multiannual Financial Framework 2021-2027 for projects in the RES field and energy efficiency at national and international level;
- Encouraging the development of energy storage capacities;
- Development of high-efficiency cogeneration projects;
- Promoting advanced technologies in the energy sector;
- Digitalization of the energy system;
- Liberalization of energy markets.

With regard to the building sector (residential and tertiary), in order to be transformed into an energy-efficient and low-GHG-emitting sector, it is proposed to implement the Long-Term Renovation Strategy (LTRS). This involves, in addition to the renovation of buildings in order to increase energy efficiency, the adoption of RES technologies, such as the installation of solar thermal panels, photovoltaic panels and heat pumps, which will support the fulfilment of the RES-E and RES-H&C targets for 2030 [7]. Reducing the energy consumption in buildings will also help reduce the GHG emissions.

4. Conclusions

In the current context of the disastrous impact of climate change on the environment, man and the economy, highlighted by increasingly extreme weather events

in recent years, the high priority of the world's countries is to limit the increase in the global average temperature (as much as possible to 1.5^0C compared to the level of 1990) by urgently and rapidly reducing the GHG emissions.

In order to achieve climate neutrality at European level by 2050, Romania sets the following energy and environmental targets for 2030:

- Reduction of ETS emissions by 43.9% compared to 2005 levels;
- Increasing the share of energy from RES in the gross final energy consumption to 30.7%;
- Improving energy efficiency by 40.4% (reduction in final energy consumption compared to 2007 levels).

The focus will be mainly on the sector with the most GHG emissions, namely the energy sector.

In order to meet the national energy and climate objectives, it will be pursued:

- Promoting investment in new low-carbon electricity generation capacities;
- Development of high-efficiency cogeneration projects;
- Adoption of advanced technologies;
- Development of energy storage capacities;
- In the buildings sector the renovation strategy, the increase of energy efficiency and the adoption of RES technologies: heat pumps, solar thermal panels and photovoltaic panels will be implemented.

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