

DECARBONIZATION PROSPECTS IN THE ROMANIAN ENERGY SECTOR

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Abstract: Decarbonization is the reduction of carbon dioxide emissions by reducing the amount of greenhouse gas emissions produced by burning fossil fuels. In general, this implies a decrease in CO₂ production per unit of electricity generated. Reducing the amount of carbon dioxide that occurs as a result of transport and energy generation is essential to meet the global temperature standards set by the Paris Agreement. The study analyzes the need for a change in the energy sector in Romania, through the gradual elimination of coal/lignite power plants, and provides an analysis of the impact of climate change on energy systems, as well as on the national economy.

Keywords: Power plants, pollution, decarbonization, energy sector, climate change.

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1. Introduction

The UNEP Emissions Gap Report 2024 signals a major global concern about the gap between current commitments and the objectives needed to limit global warming to 1.5°C. This gap shows that, although progress has been made, the measures adopted are not sufficient to prevent the catastrophic effects of climate change. In this context, it is essential that each country strengthens its commitments and adopts urgent and coordinated measures.

Romania plays an important role in this global transition, and the National Energy Strategy 2025-2035 is an example of a concrete commitment to the climate challenge. The plan to achieve climate neutrality by 2050 is ambitious and requires a rapid and effective implementation of the proposed measures. Diversifying energy sources, increasing energy efficiency, protecting the environment and ensuring security of supply are key elements that will contribute not only to reducing greenhouse gas emissions, but also to ensuring a balance between economic development and environmental protection.

By increasing the use of renewable energy sources (solar, wind, hydropower), Romania is gradually reducing its dependence on traditional sources, such as coal, which are high carbon emitters. At the same time, energy efficiency measures will help reduce consumption, which directly contributes to reducing emissions. At the same time, strengthening the energy infrastructure and ensuring a just transition will protect energy security and economic competitiveness, essential aspects in a constantly changing international context.

This approach reflects a vision that is not limited to meeting climate goals, but also to strengthening a sustainable and resilient economy. Today's geopolitical and economic challenges, such as energy crises and international instabilities, make this transition all the more important, and Romania has the chance to be a regional leader in the field of energy security and sustainable development.

Implementing these measures will require both strong national commitment and close international collaboration to ensure the success of the energy transition and meet global commitments to climate change.

2. Description of the Problem

Romania aims to make significant progress in reducing greenhouse gas (GHG) emissions in the energy sector, through a series of strategic measures that include the transition to renewable energy sources, improving energy efficiency and developing energy storage technologies.

The target of reducing GHG emissions by 89% by 2035 and by 99% by 2050 compared to 1990 levels reflects a strong commitment to decarbonizing the energy sector. These targets are ambitious, given the need to replace traditional coal-based energy sources with less polluting technologies and renewable energy sources.

Romania will phase out coal-based energy by 2032, which will involve the closure or modernization of coal-fired generation units. This step will be replaced by a significant increase in the share of renewable sources, which will reach 41.1% of final energy consumption by 2035 and 86.1% by 2050. This objective will require the rapid development of infrastructure for wind, solar and hydropower sources.

Romania's Long-Term Strategy for Reducing Greenhouse Gas Emissions – Romania Neutral in 2050 recognizes the transitional role of natural gas, which will contribute to ensuring stable energy production as renewable sources become increasingly important. It also supports the expansion of nuclear energy, which can significantly contribute to reducing carbon emissions and ensuring a stable energy mix.

To cope with the variability of renewable sources, Romania will focus on developing energy storage capacities. Pumped hydropower plants and batteries will become essential for balancing electricity networks, allowing the storage of excess energy from variable sources (such as wind and sun) and its supply when demand exceeds production.

Improving energy efficiency will be another central objective. Among the proposed measures are reducing losses in distribution networks, implementing operational optimization solutions, and promoting efficiency measures in households and industry. These measures will help reduce energy consumption and increase Romania's economic competitiveness.

The strategy promotes the digitalization of the energy sector, including the implementation of smart meters that will allow for real-time monitoring of energy consumption. Smart grids will contribute to more efficient management of energy demand and supply, facilitating more responsible consumption and optimizing costs for consumers.

Through these measures, Romania aims to significantly reduce its carbon footprint, support the transition to a cleaner and more sustainable energy system, and improve the efficiency and competitiveness of the national energy sector.

3. Methodology

The methodology used in the article consists of a descriptive, comparative analysis (Romania compared to other EU countries), interpretation of realities and illustration and argumentation of announcements, enriched with examples, which are based on bibliographical exploration and identification of the main trends in the field.

4. Results

In the context of climate change and international greenhouse gas (GHG) emission reduction targets, Romania, as a member state of the European Union, has the following

climate policies based on relevant European legislation: Regulation on the Governance of the Energy Union, European Climate Law, EU Emissions Trading Scheme, Social Climate Plan, Effort Sharing Regulation (ESR), Land Use Regulation, Land Use Change and Forestry (LULUCF).

The *Regulation on the Governance of the Energy Union* (Regulation (EU) 525/2013) aims to ensure the coordination and integration of the energy and climate policies of the Member States of the European Union. It contributes to the creation of an Energy Union that responds to common challenges, in particular with regard to energy security, the energy transition, and the reduction of greenhouse gas emissions.

Romania is required to develop and submit to the European Commission integrated national energy and climate plans (INECPs) for the period 2021-2030, with reviews every 10 years. These plans must detail the measures to achieve the EU decarbonisation, energy efficiency and other priorities related to the energy transition. In addition to the INECPs, long-term (30-year) emission reduction strategies must also be reported to the Commission.

The implementation of national plans is monitored through biennial reports, which allow for the assessment of progress and the identification of corrective measures where necessary.

The impact of the Energy Union Governance Regulation on Romania consists of the integrated national energy and climate plans that have become national strategic instruments, fundamental for the development and implementation of Romania's climate policy, and in the European legislation that influences national policy. Romania, as an EU Member State, is obliged to comply with these regulations and to integrate European objectives into its national strategies and measures.

Thus, the Energy Union Governance Regulation plays a crucial role in achieving the environmental objectives of the European Union and in ensuring a just and efficient transition towards a low-carbon economy.

The European Climate Law is not only a regulatory instrument at European level, but also requires the revision of national legislation of the Member States. Although the targets set by the law are at European level, they guide the revision of relevant European legislation and, implicitly, affect Romania's decarbonization trajectory which must contribute to achieving common European objectives. In Romania's case, this means that it will have to adapt its domestic policies in the fields of energy, transport and agriculture to actively contribute to achieving the established objectives. Thus, Romania will have to implement decarbonization measures and contribute to the transition strategy towards a greener and more sustainable economy.

The EU Emissions Trading System (ETS) is the main policy for reducing greenhouse gas (GHG) emissions in the European Union and the largest carbon market in the world. The European Commission controls the number of allowances issued annually and the pace at which they are reduced, thus setting a decarbonisation timetable.

To meet the decarbonisation timetable, Eastern European countries, including Romania, benefit from the Solidarity Clause and the Modernisation Fund, which consist of additional allowance allocations through special mechanisms. These measures are designed to support the transition to a greener and more sustainable economy, given that these countries have a greater dependence on the coal-based energy sector. Romania will receive approximately €21 billion by 2030 from these mechanisms. It also benefits from the revenues from the auctioning of emission allowances, which are used through the Environment Fund Administration to support investments in cleaner technologies and environmental projects.

The revised ETS has already been approved at European level, but it has not yet been transposed into national legislation. Given the increasing emphasis on the rapid transition to a carbon-free economy, and the policies implemented will significantly influence the development of the industrial and energy sectors in the coming decades, the European Commission has started infringement proceedings against Member States that do not meet the implementation deadline.

Romania does not have a national climate law, it is not mandatory under European legislation, although these could bring significant benefits for climate governance.

In the absence of such a law, Romania has adopted important measures to combat climate change by developing the National Energy - Climate Change Plan (PNIESC), which is important for achieving the objectives of reducing greenhouse gas (GHG) emissions. In the draft version of the 2024 PNIESC, Romania has set more ambitious targets than those presented in the 2023 Long-Term Strategy (LTS) for the Reduction of Greenhouse Gas (GHG) Emissions.

Thus, the PNIESC foresees a reduction of GHG emissions by 85% by 2030 compared to 1990 levels (Figure 1), a 96% reduction by 2040 and, considering net emissions, a 105% reduction by 2050. These objectives are more ambitious than those in the LTS, which aim for a 78% reduction in 2030 (in the most ambitious scenario) and 67% without taking into account emissions absorbed by LULUCF (Land Use, Land Use Change and Forestry) measures. In this context, the PNIESC reflects Romania's clear commitment to comply with the Paris Agreement and the European objectives for climate neutrality by 2050.

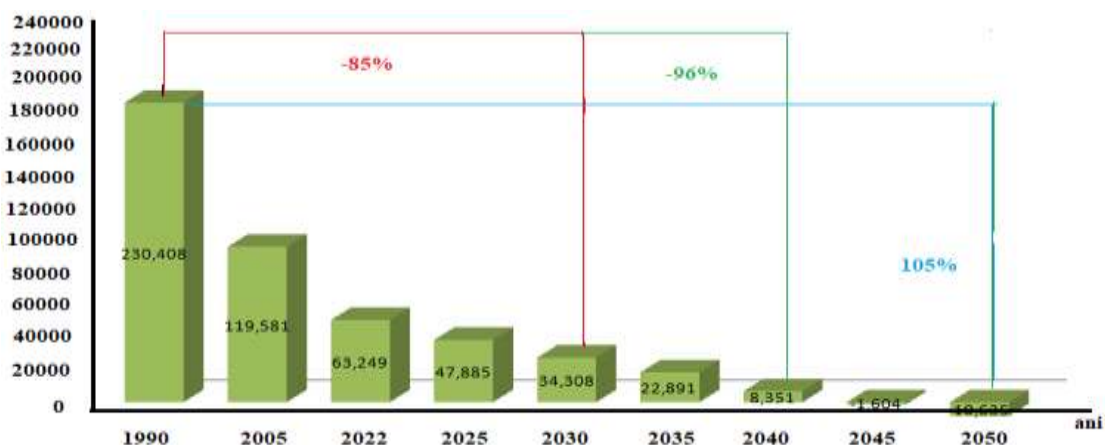


Figure 1. Targets and estimated trajectory regarding the reduction of net GHG emissions in Romania

Source: PNIESC (2024)

The national climate legislative package includes:

- Long-Term Strategy (LTS),
- National Energy-Climate Change Plan (PNIESC),
- National Circular Economy Strategy,
- National Sustainable Development Strategy,
- National Long-Term Renovation Strategy,
- Law on Decarbonization of the Energy Sector,
- Law on Energy Efficiency,
- Law on the Promotion of Energy Production from Renewable Sources and
- Law on Energy Performance of Buildings.

These policies are coordinated for their implementation by the Interministerial Committee on Climate Change (CISC), created in 2022. The Climate Change Adaptation Strategy for the period 2022-2030 provides for important steps in coordinating and setting priorities for managing the impact of climate change, in adapting various economic sectors (such as agriculture, transport and construction) to new climate conditions, which represents significant progress in implementing an integrated climate change policy. For example, in agriculture, emphasis is placed on diversifying and adapting plant varieties, and in transport infrastructure, on the use of materials more resistant to extreme temperatures. In the residential building sector, emphasis is placed on improving thermal comfort through insulation and ventilation measures. However, there are also multiple shortcomings in the implementation process, especially in decarbonization policies that are still reactive and there is neither a clear strategic vision nor sufficient resources to monitor their progress. Also, in many important economic sectors, such as transport, industry, agriculture or waste management, there are no specific plans and clear measures to reduce greenhouse gas emissions, despite the requirements imposed by European legislation. Public authorities also lack the necessary resources to develop and implement these policies effectively.

Thus, although progress has been made in some areas, a significant gap remains between strategic intentions and their effective implementation.

In 2022, the energy sector continued to be one of the main sources of greenhouse gas (GHG) emissions globally, from the energy sector in Romania were estimated at approximately 40-45 million tons of CO₂ equivalent.

The share of fossil fuels (especially coal and natural gas) in Romania's energy mix remains significant (Figure 2), and the transition to renewable sources has not yet been fast enough to drastically reduce emissions.

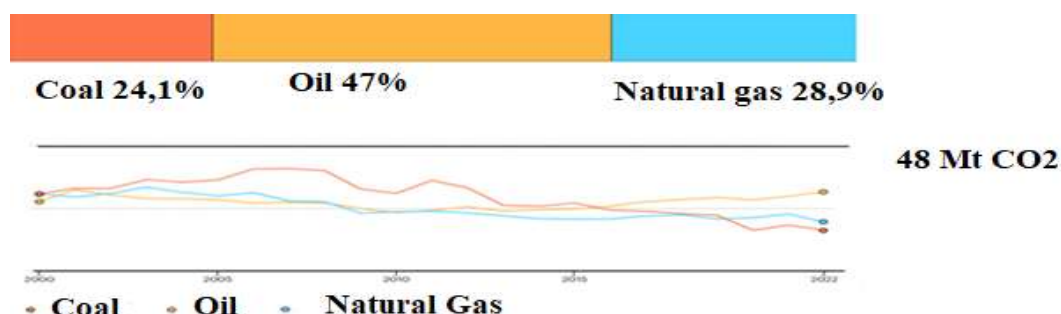


Figure 2. Share of fossil fuels in Romania's energy mix

Source: Eurostat data (2024)

The electricity generation sector has made significant progress, also thanks to the implementation of strict carbon pricing policies, but also through increasing investments in renewable sources. Increasing renewable energy capacities, in parallel with gradual reductions in the use of lignite, is essential to reduce CO₂ emissions and achieve decarbonisation objectives.

Under the influence of a European carbon price, the electricity generation sector has seen an increase in renewable energy capacities simultaneously with the adoption of a lignite phase-down schedule. This will lead to a progressive decarbonisation of the sector, with the exception of energy-intensive industry, which has not started the profound transformation necessary to put it on a trajectory towards climate neutrality.

Romania aims to significantly increase its production capacity, reaching 32.3 GW by 2030, which represents an increase of 68.2% compared to the 2022 level. Almost 75% of this capacity will come from renewable energy sources (RES), a clear objective to reduce greenhouse gas (GHG) emissions.

In addition to renewable sources, there is also a strong focus on nuclear energy, through the development of new plants based on Small Modular Reactor (SMR) technology and the expansion of the Cernavoda nuclear power plant with 2 additional units (Unit 3 and Unit 4), planned to be completed between 2031 and 2032. The construction of natural gas-fired power plants, including cogeneration units and combined cycle power plants (CCGT), is also planned to support the energy transition.

Romania also aims to eliminate fossil fuel imports for electricity and heat production by 2030, by closing coal-fired power plants and developing new production capacities based on natural gas and renewable sources.

A medium-term objective is for Romania to become a net energy exporter, with almost zero natural gas imports by 2030, and starting in the second half of the next decade, to even become a net energy exporter.

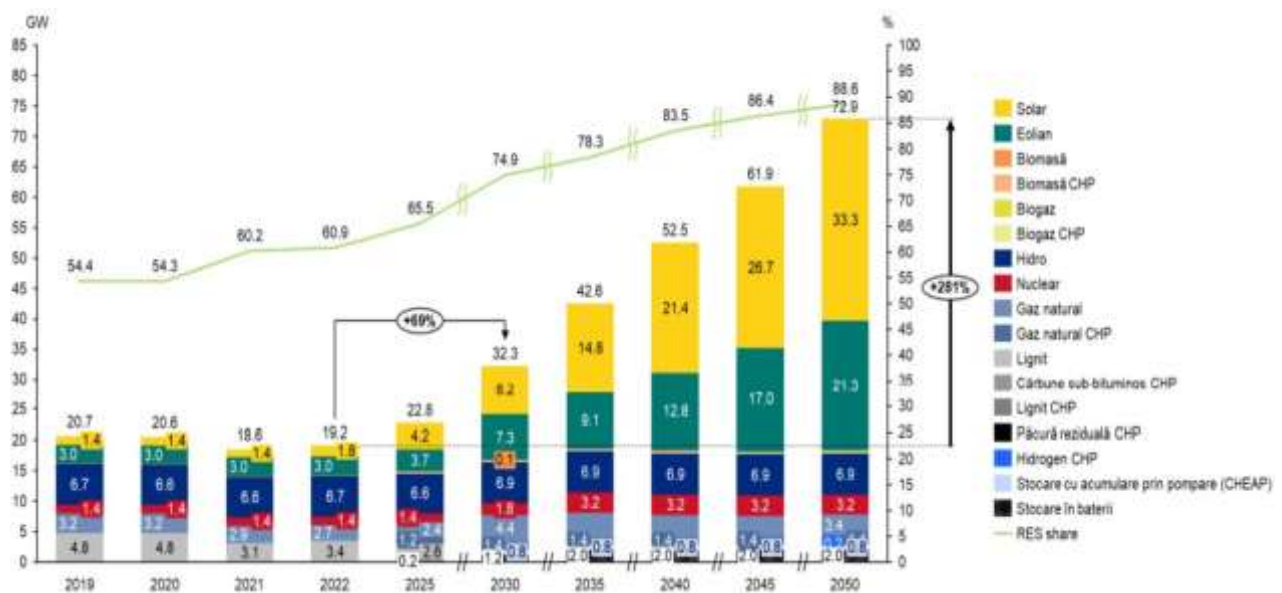


Figure 3. A possible electricity generation mix in Romania

Source: PNIESC (2024)

The exploitation of natural gas resources in the Black Sea (Neptun Deep project) will play a key role in reducing Romania's dependence on natural gas imports. Romania is expected to become a net exporter of natural gas by 2030 and maintain this status until at least 2040.

Overall, Romania wants to transform its energy sector to reduce carbon emissions and ensure its long-term energy security, becoming a net energy exporter in the coming decades. The plans reflect a significant transition, with a cleaner and more diversified energy mix (Figure 3).

3. Conclusions

Romania lacks an integrated and coherent national vision on reducing GHG emissions across the economy. The report launched by the Presidential Administration “Limiting

Climate Change and Its Impact: An Integrated Approach for Romania” provides an overview of the national needs for managing climate change, and in order to improve climate policies in Romania, there are several strategic and operational measures that can contribute to a more coherent and integrated national vision in addressing climate change, in line with European requirements and international recommendations, such as those formulated within the framework of the accession process to the Organization for Economic Cooperation and Development (OECD). These can be grouped into several main directions:

A national climate law would ensure a clear legislative framework, with precise objectives for reducing greenhouse gas (GHG) emissions in the short and long term. It could also set up a scientific advisory board to support decisions based on research and up-to-date data. An effective monitoring and reporting mechanism would be needed to assess progress in implementing climate policies and specific measures.

Transposing and implementing the Emissions Trading System (ETS 2) by extending its applicability to the buildings and transport sectors is crucial to support their decarbonization. Carbon pricing can create economic incentives to reduce emissions and to replace fossil fuels with electric and sustainable solutions. In implementing ETS 2, it is important to ensure constant monitoring of carbon prices so as to minimize the impact on sensitive sectors without expose to danger their competitiveness. Also, creating support mechanisms for sectors vulnerable to rising carbon prices and implementing a “Social Climate Plan” can mitigate the socio-economic impact on vulnerable populations.

To offset the socio-economic impact of the transition to a green economy, support mechanisms for vulnerable groups (e.g. low-income households or people working in sectors dependent on fossil fuels) can be introduced when carbon prices rise, and social protection measures, such as a Social Climate Plan, should be adopted. The gradual reduction of fossil fuel subsidies can be followed by incentives for decarbonising technologies, such as transport electrification and energy efficiency in buildings.

Romania should gradually reduce fossil fuel subsidies, targeting them towards vulnerable consumers. It is important to rethink support schemes for the transition to a greener economy, including through incentives for building renovation, creating renewable energy infrastructure and supporting the adoption of new technologies such as hydrogen and carbon capture, and by abandoning barriers that hinder the energy-efficient renovation of buildings and implementing policies to make centralized energy systems more efficient are essential.

Preserving and expanding forests and other ecosystems that can contribute to carbon dioxide absorption are essential for achieving climate goals. Romania should adopt measures to prevent illegal deforestation and to rehabilitate degraded lands. Also, integrating forest and degraded land management into a coherent national biodiversity conservation policy could support both GHG emission reductions and environmental protection. Rehabilitating degraded lands can also contribute to reducing net carbon emissions.

Improving strategic planning capacity, including through the development of economic and climate models that include essential economic sectors, is necessary to ensure a just transition, involving all stakeholders: public authorities, the private sector, non-governmental organizations and citizens, in a transparent planning and implementation process can increase the acceptance and effectiveness of measures to combat climate change.

Green Energy Infrastructure Development can be achieved in parallel with the increase in carbon prices, but money must be invested in the development of electricity, renewable and hydrogen infrastructure to support the electrification of the transport sector and buildings. Electricity networks must be expanded and modernized to support the

integration of renewable energy sources and to cope with increased consumption demands. These investments will support the increase in electrification of key sectors and will contribute to their decarbonization.

Romania must implement measures to increase resilience to climate change, including by investing in infrastructure to protect against extreme weather events and by developing policies to adapt to high temperatures and prolonged drought.

The implementation of a national mechanism to monitor and report on progress in achieving decarbonization objectives is essential. This should be supported by technology and an

In parallel with technical and economic measures, it is essential to place greater emphasis on environmental education and public awareness about the importance of reducing emissions and how citizens can contribute to the ecological transition.

Improving climate policies in Romania by strengthening these directions and by creating a strong legislative and institutional framework, investing in infrastructure, developing an efficient and participatory government framework and social protection, will be able to ensure a fair and sustainable transition, strengthening Romania's position in the transition towards a green economy, integrated into the European single market.

In conclusion, the Romanian energy sector has made significant progress in reducing GHG emissions, but challenges remain, especially in the context of geopolitical changes and the energy crisis, which may further hinder the transition to a low-carbon economy. These developments highlight the need for an integrated approach, including both energy efficiency measures and investments in renewable energy sources and innovative technologies.

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