STRATEGIC OPTIONS FOR THE DEVELOPMENT OF RENEWABLE ENERGY IN THE CONTEXT OF GLOBALIZATION

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ABSTRACT
The energies that come from sources that either regenerate themselves shortly or are practically inexhaustible sources have put into practice the concept of renewable energy, a concept that is still debated today in the literature and found mostly in current research. Researches in the field concluded that renewable energies refer to forms of energy produced by the energy transfer of energy from renewable natural processes such as solar energy, wind, flowing water, biological processes and geothermal heat that can be captured by to people using different methods. European Union statistics collect data on energy sources typical examples of solar energy, wind and biomass. The statistics include data on renewable fuels such as biofuels or biomass and municipal renewable and non-renewable fuels: hydroelectric power plants; tides, waves or ocean energy; geothermal energy, wind energy, solar energy, or heat pumps. Our research aims to identify strategic options for the development of renewable energies in the context of globalization. Investigating specialized literature coupled with a statistical analysis of Europe's main renewable energy sources has allowed us to capture important peculiarities of globalization. Research findings may seem surprising, but they can be real action paths and development strategies for sustainable development.

KEYWORDS: *renewable energy, strategic options, sustainable development*

1. INTRODUCTION

The Romanian Ministry of Energy has published the Energy Strategy of Romania 2019-2030, with the perspective of the year 2050. "The Energy Strategy of Romania 2019-2030, with the perspective of the year 2050" is a programmatic document that defines the vision and sets the fundamental objectives of the sector's development process energy. The document also indicates national, European and global benchmarks that influence and determine energy policies and decisions.
This document specifies that the development and the increase of the competitiveness of the Romanian economy, the increase of the quality of life and the concern for the environment are inextricably linked to the development and modernization of the energy system. According to the strategy, Romania has the resources necessary for the growth of the energy system, and it must be prepared to support the development of industry and agriculture, the economy as a whole, as well as the improvement of the quality of life in both urban and rural areas. It is considered that these

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resources must be harnessed to move from a paradigm of expectation, into a proactive and courageous one of development, respecting, of course, the principle of sustainability.
The vision of the Energy Strategy of Romania (as provided in Chapter I of the strategy) is to increase the energy sector under conditions of sustainability. The development of the energy sector is part of the development process of Romania. The growth of the energy system means: building new capacities; upgrading and modernizing energy production, transport and distribution capacities; encouraging the growth of domestic consumption under energy efficiency conditions; export. The national energy system will thus be stronger, safer and more stable.
The Energy Strategy has eight fundamental strategic objectives (presented in Chapter II) that structure the entire analysis and planning approach for the period 2019-2030 and the time horizon of 2050. The achievement of the objectives implies a balanced approach to the development of the national energy sector both from the perspective of national regulations and European, as well as of investment expenses.
The objectives of the Energy Strategy are:
1. Clean energy and energy efficiency;
2. Ensuring access to electricity and heat for all consumers;
3. Protection of the vulnerable consumer and reduction of energy poverty;
4. Competitive energy markets, the basis of a competitive economy;
5. Modernizing the energy governance system;
6. Increasing the quality of energy education and continuous training of the human resource;
7. Romania, regional supplier of energy security;
8. Increasing Romania's energy contribution to regional and European markets by capitalizing on national primary energy resources.

2. THE STATE OF THE ART KNOWLEDGE

From studies and reports in the field of energy, it appears that thermal energy is perhaps one of the most consumed forms of final energy. For example, the annual thermal energy consumption for indoor space air conditioning and hot water production in a typical commercial building in the United States represents more than 40% of the total energy consumption of the building (Dimensioning & Automation, 2019).
Recent work (Leurent, Da Costa, Rämä, Persson, & Jasserand, 2018) evaluates and compares district heating (DH) systems using heat from combined heat and power plants (NCHP) in fifteen European systems, taking into account economic attractiveness and potential to mitigate climate change. It is surprising to conclude that these works suggest that the rehabilitation of buildings, the modernization of individual boilers / heaters and the implementation of DH systems with low carbon emissions should be seen as complementary approaches. The Cost Benefit analysis performed in these works shows that perhaps the most important is the choice of the values of the parameters specific to each national and local context, so that the parameters with the greatest impact on the Updated Net Income are, in descending order: the discount rate, the capital costs for distribution and transport, the selling price of heat to final consumers, prices for electricity and natural gas (Jianu et al., 2019).
On the other hand, the concerns of the Norwegian University of Science and Technology materialized in the master's theses held within the Department of Energy and Process Engineering show that the use of renewable energy and waste energy is more than necessary, being imposed by national and international regulations (Shakerin, 2017) and the tendency is for future centralized heating and cooling systems to be based on completely renewable energies from solar energy, waste heat and geothermal energy.
This will, however, involve distributed systems that will be available to provide heat to the central system. In this new situation, a building will be able to be both user and supplier at the same time

what energy specialists call it "prosumator" (Rădulescu et al., 2018a, b). The thesis is based on Danish research that claims that 46% of Denmark's net heat demand is met by central heating and only individual heat pumps could be a good alternative to urban heating because, in the short term, heat pumps are at the same level as urban heating in terms of fuel efficiency, CO2 emissions and costs (Burlacu, Gutu, & Matei, 2018). The analysis indicates that the optimal solution in Denmark would be to extend centralized heating from 46% to 63% - 70%. However, it should be emphasized that the analysis is based on a gradual improvement of heating technologies, the implementation, among other initiatives, of a decrease in temperature in combination with a reduction in the demand for space heating, including a reduction in temperature consumer returns. (Lund, Möller, Mathiesen, & Dyrelund, 2010).

These research also took into account the proposal of the European Commission which sets out the principles according to which Member States could collectively and continuously guarantee that the share of renewable energy in the final EU energy consumption will reach at least 27% by 2030 in a cost-effective way in all the three sectors of electricity (RES-E), heating and cooling (RES-H & C) and transport (RES-T), taking into account the following specific objectives (COMMISSION, 2016):

- addressing investments that take into account the medium and long term decarbonisation objectives;
- ensuring the efficient implementation of the costs and the integration on the market of renewable energy;
- Ensuring the common goal of the EU on renewable energy in 2030, establishing a policy framework coordinated with the Energy Union governance, to avoid any potential gap;
- Development of the potential of renewable energy in the heating and cooling sector.

In line with the ones presented, the Danish Strategic Research Council funded in 2014 research for defining the Territorial Heating System IV (4DH). The researches define the concept of 4th Generation Territorial Heating (4GDH) including the concepts of intelligent energy and intelligent thermal networks. The reason was to identify the challenges of achieving a future renewable source of non-fossil thermal energy as part of the implementation of global sustainable energy systems. It started from the fundamental assumption that centralized heating and cooling play an important role in future sustainable energy systems, which include 100% renewable energy, and the current generation of centralized heating and cooling technologies will have to develop into a new generation to play such a role. Unlike the first three generations, the development of the 4GDH model involves integrating the challenges of more energy efficient buildings, as well as an integral part of the operation of intelligent energy systems, ie integrated electricity, gas and smart thermal networks. As a consequence, the 4th generation heating system (4GDH) is defined as a coherent technological and institutional concept that, through intelligent thermal networks, helps the adequate development of sustainable energy systems. 4GDH systems provide thermal energy supply to buildings with low energy consumption, with reduced losses in the grid, in a way in which the use of low temperature heat sources is integrated with the operation of intelligent energy systems. The concept involves the development of an institutional and organizational framework that facilitates the structuring of costs and motivation. (Lund et al., 2014).

Similar research program on urban heating was funded in 2017 by the Swedish Energy Agency together with the Swedish Heating Association and 4DH, an international research center that develops fourth generation centralized heating technologies, (www.4dh.dk), through the Danish Innovation Fund. The purpose of these researches was to provide an image of the current position on centralized heating and cooling throughout the world, with a deeper perspective on European conditions (Profiroiu et al., 2019). The main conclusions of the research were the reduced use of centralized heating in buildings with a significant variation of implementation around the world, moderate commitment to the fundamental idea of urban heating, limited knowledge of the possibilities of reducing carbon dioxide emissions and low awareness overview of central heating

and the benefits of cooling systems (Bran et al., 2018). The findings of the research show that centralized heating and cooling systems have strong potential to be viable options for heat and cooling supply in a future world, but more efforts are needed to identify, evaluate and implement these potentials recover global benefits with centralized heating and cooling. Another direction of research on urban heating systems is Low Temperature Urban Heating (LTDH). Recent work suggests that this can significantly contribute to the creation of more urban heating networks, being perhaps one of the most efficient solutions for reducing the distribution structure (networks). LTDH offers prospects for both the demand side (lower energy prices can lead to increased global sales) and the supply / distribution side (especially due to the network properties for low temperatures and the diversification of energy sources). Research shows that the temperature levels required for heating and cooling of most types of buildings (residential and non-residential buildings) are generally low (slightly above 23 ° C). In the case of domestic hot water supply, temperatures in the range of 50 ° C should, in principle, be sufficient to avoid the risk of developing bacteria. The researche also evaluated the feasibility of using the heat demand according to the external temperature function through a LowEx approach which involved aligning the quality levels of the supply and the demand for energy to optimize the low temperatures needed to heat the space, concluding that the use of the temperatures smaller can reduce losses in pipes and increase the total efficiency of the total energy chains used in urban heating. However, the findings of the research indicate that a number of issues need to be addressed in terms of correlating the demand created by space heating (SH) and domestic hot water (DHW) on the building side with the available energy from the supply side to develop advanced heating at temperatures low and that the latest evolutions of urban heating systems tend towards LTDH systems and the integration of renewable energy sources. (Schmidt, 2018).

Regarding the simulation of the programs for the production of thermal energy in centralized heating systems, some papers propose a mathematical physical model for the dynamic simulation of the flow and the temperature in the heating networks (DHN). The network structure is described by a graphical theoretical approach in which the network elements are sections of pipelines, consumers and heat sources. The equations governing the hydraulic flows and the distribution of heat through the pipeline networks are presented. It is shown that the proposed methods are suitable for specifying flow and temperature values for each consumer with a minimum average error and, therefore, can be used as a conceptual tool for operational optimization of district heating networks (Grosswindhager, Voigt, & Kozek, 2011).

In the same research direction, the AMBASSADOR project which received funding under the Seventh Framework Program of the European Union (FP7 / 2007-2013) presents a specific application of the urban heating system (DH) in which the models were required of components aimed at designing and optimizing the real-time control of the entire DH system. The challenge was to develop models that properly represent slow dynamics, such as those from thermal phenomena, as well as fast dynamics for control purposes. The model is expected to be validated based on the actual data collected from a centralized cooling network so that the research is continued through the INDIGO project, which received funding from the European Union's Horizon 2020 research and innovation program (del Hoyo et al., 2018).

Other recent researches allow the forecast of the necessary heat required to plan the production and operation of the heating systems (DH). In these studies, a simple regression model is proposed, in which the outside hourly temperature and wind speed predict the demand for heat. The weekly rate of heat consumption as a social component is added to the model to significantly improve accuracy. The research is complemented by another type of model, the seasonal mobile medium autoregressive model (SARIMA) with exogenous variables as a combination that allows the inclusion of meteorological factors and historical data on heat consumption as variables. The findings of the research suggest that the model can be used to plan combined heat and energy (CHP) production to improve energy efficiency (Fang & Lahdelma, 2016). Moreover, a network

simulation tool for centralized heating and cooling systems was developed for the urban heating network in Scharnhauser Park, Germany. It calculates the operating parameters of the system with hourly steps and offers monthly and annual balances of the load and the supply of heat. Entities such as supply and return temperature, flow rate, heat loss and pump energy are calculated and compared for different operating scenarios. It is mentioned that the grid model was also used to analyze the different solar energy supply systems, which currently contribute only 0.3% of the total demand for thermal energy (Hassine & Eicker, 2011). As the energy sector is responsible for a large part of the increase in greenhouse gas emissions and the development of green energy solutions are of particular importance, some works are investigating the possibilities and difficulties of introducing decentralized urban heating production solar collectors and heat pumps (Ionita et al., 2009a,b). The results show that the low supply temperature of "prosumers" can cause migratory temperature fronts leading to increased fatigue in pipes although migratory temperature fronts generally have a reduced impact on pipeline life, as corrosion remains a limiting factor. In conclusion, research indicates that it is possible to introduce prosumers", but it requires management and control (Brand, Calvén, Englund, Landersjö, & Lauenburg, 2014)

3. RESEARCH METHODOLOGY

Our research is an empirical research that is based on the direct observation of reality and starts from established theoretical concepts and models derived from linear optimization models and the theory of vague sets. We have chosen this type of research as a research opposed to fundamental or theoretical research but which through the findings and conclusions obtained verifies the theory and can contribute to its enrichment.

4. FINDINGS

Eurostat, the body that deals with the statistics of the European Commission, presents data on electricity. Figure 1 shows the energy data of Romania from 2004-2017. Since 2011, there has been an increase in the share of wind energy and an increase in solar energy since 2014.

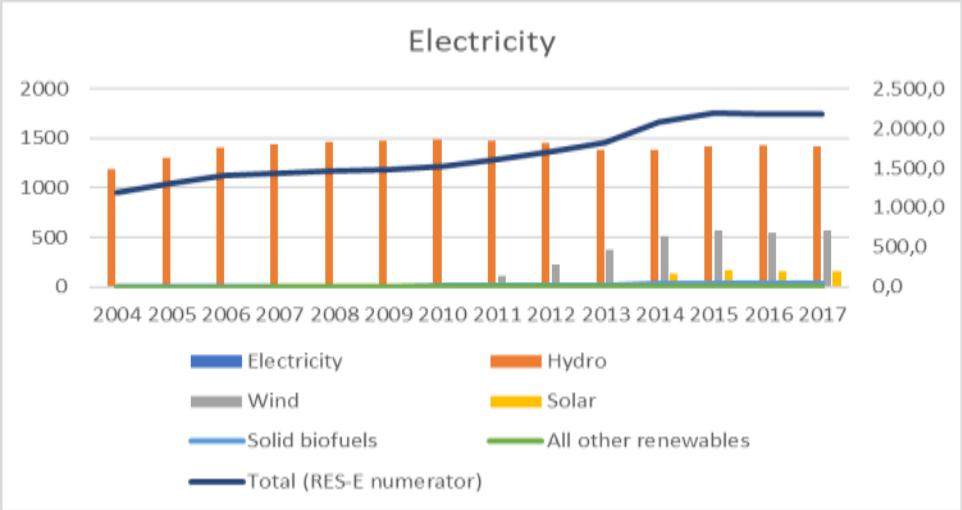

Figure 1. Electricity production in Romania from 2004-2017
Source: Own processing according to Eurostat data

In Romania, the electricity obtained from other sources, is presented in figure no. 2. As can be seen, its share has an increasing trend, exceeding 40% in 2017.

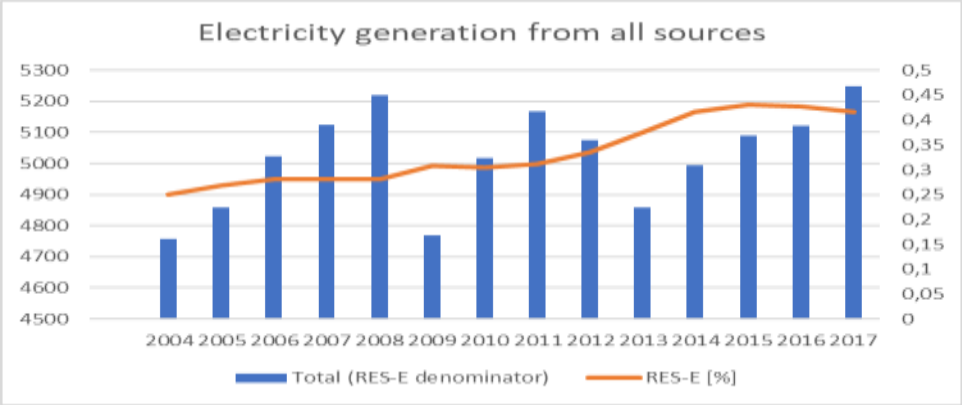

Figure 2. Electricity generation from all source

5. DISCUSSION

Along with the energy strategy of Romania, the General Secretariat of the Government of Romania has published the National Strategy for the Sustainable Development of Romania 2030. The national strategy for the sustainable development of Romania 2030, adopted by the Government of Romania in the meeting of November 9, 2018, through GD no. 877/2018, was prepared under the direct coordination of the Department for sustainable development, with the input of the Drafting Committee, the General Secretariat of the government, ministries and other central public institutions, local authorities, regional development agencies, academic and university forums, national institutes of R&D, employers' associations and trade unions, the private sector, non-governmental organizations and other formations of civil society and interested citizens.

This strategy provides for everyone's access to energy at affordable prices, in a safe, sustainable and modern way. The document specifies that the demand for energy is constantly increasing globally and only through the efficiency and promotion of renewable energy can it meet the current needs and future generations. Moreover, it is considered that the energy sector contributes essentially to the development of Romania by profound influence on the competitiveness of the economy, quality of life and environment. At the same time, it is mentioned that in order to support the long-term expectations of consumers, the Romanian energy sector must become more economically robust, more advanced and more technologically flexible and less polluting.

The 2030 targets presented in the strategy are the following:

• Extension of transport and distribution networks for electricity and natural gas in view of ensuring the access of domestic, industrial and commercial consumers to reliable sources of energy at acceptable prices

• Ensuring cyber security of platforms for monitoring the production, transport and distribution networks of electricity and natural gas

• Decoupling economic growth from the process of resource depletion and environmental degradation by considerably increasing energy efficiency (at least 27% compared to the status-quo scenario) and using the EU ETS scheme extensively under predictable and stable market conditions.

• Increase of the share of renewable energy sources and low carbon fuels in the transport sector (electric vehicles), including alternative fuels

• Ensure a stable and transparent regulatory framework in the field of energy efficiency in order to attract investments

• Strategic support of the share of electricity in total household, industrial and transport consumption by establishing performance standards for installations and equipment.

6. CONCLUSION

The Romanian Academy through the National Institute of Economic Research and Studies presents the work Dynamics of renewable energies in the EU and Romania coordinated by Mariana Papatulică and Petre Prisecaru. This document specifies that the energy market from renewable sources (E-RES) is supported in Romania through interventionism directly on the supply side. It is emphasized, however, that the state does not finance this market and all costs are transferred to the consumer, given that the suppliers are obliged to buy a share of the energy produced. It is concluded that these suppliers will transfer the cost to distributors and, finally, to consumers, but this interventionism does not fit into the usual forms of state aid, because it does not involve public money, although the competition is distorted, as some producers are favored to the detriment others from the regulatory framework.

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