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ACHIEVING RENEWABLE ENERGY TARGETS IN THE CONTEXT OF THE REPowerEU PLAN

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Abstract: *Following the invasion of Ukraine by Russia in late February 2022, the European Union acknowledged the urgent need to increase efforts to switch to clean energy sources and become energetically independent from suppliers that can be deemed unreliable and from volatile fossil fuels. Through the "REPowerEU" plan, first presented by the European Commission in May 2022, the European Union aims to reach fuel neutrality from Russia before 2030. The plan sets out a series of measures meant to quickly reduce fossil fuel dependency and accelerate the green transition. This article presents the short and medium time measures proposed by the "REPowerEU" plan. As a personal contribution, the author aims to analyze and review the targets included in the plan, in the context of a rapidly changing sector, as well as to propose some local measures to be considered for the following years.*

Keywords: renewable technologies, green energy transition, carbon neutrality

INTRODUCTION

Today's society is facing multiple challenges caused by recent events that have made governing bodies from around
As early as the end of the 1950s the world acknowledged that rapid societal development is taking a serious toll on the stability and well-being of the surrounding environment [1]. The concerns began to spread in the 1980s, and concrete action followed in 1997, when the "*Kyoto Protocol*" was signed by the members of the United Nations [2]. The treaty represented the commitment of its signers to reduce greenhouse gas emissions to avoid the increase of global average temperatures.

Despite the apparent failure of the Kyoto Protocol, caused by the fact that some of the originally committed countries have withdrawn their support due to the inability to achieve the targets set out by the treaty, and the fact that other nations like China and Brazil are not bound by the targets due to their support of industrial economies and the average, it is undeniable that the initiative is still considered to be a symbol of the commitment of the nations of the globe to combat global warming [3].

In recent years, in Europe, the European Union has made great efforts to continue the path set by the 'Kyoto Protocol" by elaborating multiple legislative packages meant to be implemented by the member states through local directives and regulations.

If the first two decades of this century saw multiple initiatives meant to bring renewable energy technologies (mainly wind turbines and photovoltaic panels) at the same competitive level as conventional technologies (coal and gas power plants) used to produce energy, in 2019, the most recent package, "Clean energy for all Europeans" kicked off the path towards the decentralization process.

A decentralized energy system allows for renewable energy to be produced locally by a new actor in the power sector, called prosumer. This new system is aided by storage and other innovative technologies (smart meters, smart grids, electric vehicles) to gradually decrease greenhouse gas emissions [4].

After 2020, Europe managed to achieve its 20-20-20 [5] goals for reducing greenhouse gas emissions by 20%

compared to 1990 levels, increasing the share of renewable energy use to 20%, and improving energy efficiency by 20%, the EU decided to set the ambitious target of making the European Union climate neutral by 2050 through the "*Green Deal*" accord.

In response to energy market disruptions caused by Russia's invasion of Ukraine, the European Commission released the "*REPowerEU*" plan in May 2022 aimed at rapidly reducing dependence on fossil fuels by 2027.
Although "*REPowerEU*" aims at accelerating Europe towards reaching climate neutrality by 2050 by building upon existing initiatives, the scope, and ambition of the plan, there are some who believe that the measures may have the opposite effect and cause more problems on the path towards decarbonizing the energy sector.

METHODOLOGY

During the establishment of the methodology for the research activity, the author respected the following steps:

- define the general objective of the paper: to briefly review the main targets set up in the "*REPowerEU*" plan and propose several measures that can help achieve said targets at a local level (Romania);
- set up several specific objectives that support the satisfaction of the main objective: the identification, systematization and analysis of the targets set up in the "*REPowerEU*" plan and the exploration of Romanian energy sector in relation to the main directions of reaching the targets of the "*REPowerEU*" plan;
- conduct secondary research by studying relevant papers from both academic and industry level to obtain a better understanding of both theoretical aspects and the current framework of the European energy sector;
- define a set of recommendations based on secondary research and personal knowledge from the Romanian power sector.

EU POLICIES

EU member states have declared their commitment to making the EU the first climate-neutral continent by the end of 2050 [6]. The first step towards achieving this ambitious goal is the reduction of greenhouse gas emissions by at least 55% by 2030 compared to the levels measured in 1990 [7]. To meet this target, the European Union encourages the integration of renewable energy sources within the "decarbonization" dimension, one of the five dimensions of the Energy Union (alongside the security of supply, internal energy market, energy efficiency, and innovation).

Considering that in the European Union, the energy sector is responsible for more than 75% of greenhouse gas emissions [8], directive 2018/2001/UE regarding energy produced from renewable energy sources set a new mandatory target for energy consumption of at least 32% sourced from renewable energy sources, with a clause that states that the target may be increased until 2023.

The target was gradually increased, firstly with the revision proposal from July 2021 [8] which proposed a new target of 40% until 2030 and, more recently, in May 2022, following the "*REPowerEU*" plan, the target was increased to 45% (Figure 1.).

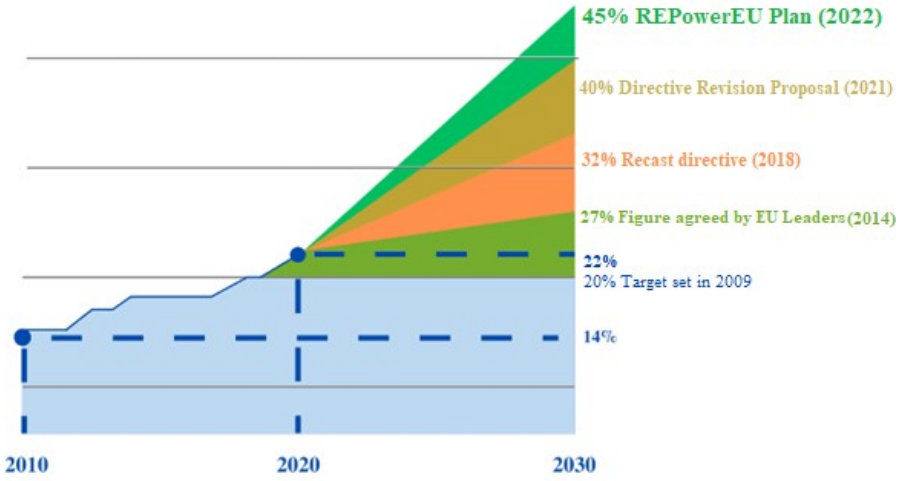

Figure 1. The evolution of EU targets regarding the contribution of energy from renewable sources: Source: Adapted after [9]

One of the components of the EU policies for decarbonization is electrification. Within the background of a global increase in energy consumption, and the urgent need to drastically reduce the contribution of fossil fuels towards

meeting said demand, it is expected that electricity will become the main energy carrier, mainly through the continuous penetration of renewable technologies (photovoltaic panels and wind turbines) and the fact that technologies based on electricity are more efficient than those based on fossil fuels.

The transition from fossil fuels to electricity will be significant in two areas: the energy consumption in buildings and the transport sector. The building blocks of this transition will be represented by replacing gas to heat buildings with heat pumps and electric water heaters and replacing vehicles that use internal combustion engines with electric vehicles.

As energy consumption increases, so does the potential for balancing the intermittent nature of the production schedule of renewable energy technologies. The main sources of flexibility are residential consumers (through demand response), storage, and electric vehicles (which can also be thought of as a form of storage).

If the first two decades of this century saw the gradual penetration of large-scale renewable energy power plants (photovoltaic fields and wind turbine farms), the current decade allowed residential consumers to play a more active part in achieving national and European climate and energy targets. By acquiring distributed energy resources (small-scale power generation or storage technologies), and producing energy for their consumption, consumers become prosumers, thus undertaking an active part in transitioning from fossil fuels to renewable energy.

The ”prosumer” term refers to an energy consumer who produces energy, which is partially used to cover its consumption. The excess energy can be injected into the distribution grid, or stored for later consumption in the case of prosumers who chose to acquire storage systems.

Prosumers have the right to produce energy from renewable sources, including for their consumption, to store and sell their excess production of electricity from renewable sources, including through contracts for the purchase of electricity from renewable sources, through electricity suppliers, and agreements on transactions between parties.

They also have the right to install and operate electricity storage systems combined with renewable electricity production facilities for self-consumption without having to pay any double tax, including network charges for the stored electricity that remains on their premises.

REPOWEREU REVIEW

The “*REPowerEU*” plan was released by the European Commission in May 2022 and increases the renewable energy target of the “*Fit for 55*” package together with other provisions for reducing energy demand. For these targets to be achieved, significant increases in renewable capacity shares across the electricity, transport, and heating and cooling sectors are required.

Based on the European Commission’s estimates, the presence of renewable energy in electricity generation must reach 69% by 2030, while for transport, 32% of the fuel must be sourced from renewable energy sources, and heating and cooling in buildings should expand at least 2.3 percentage points every year. It is important to note that the shares for electricity and transport are not explicitly part of the “*REPowerEU*” targets. They are used by the European Commission as estimates of shares required to achieve “*REPowerEU*” goals [10].

However, judging by current projections [10], these numbers are far from being reached in 2030.

Table1. Summary of renewable energy benchmarks by sector in REPowerEU plan and main and accelerated cases

Segment	**REPowerEU benchmarks, 2030**	**Main case**	**Accelerated case Benchmarks 2027**
Electricity	**69%**	**54%**	**n/a**
Photovoltaic Capacity	**592 GW**	**396 GW**	**471 GW**
Wind capacity	**510 GW**	**290 GW**	**316 GW**
Transport	**32%**	**16%**	**20%**
Heating and Cooling			
Share of renewable energy in heating and cooling	**2.3- percentage-point average annual increase to 2030**	**0.9-percentage-point average annual increase to 2030**	
Share of renewable energy in the industry	**1.9- percentage-point average annual increase to 2030**	**0.9-percentage-point average annual increase to 2030**	
Share of renewable energy in buildings	**60%**	**32%**	

sector final energy consumption		

Source: Based on data from the International Energy Agency [10]

As can be seen in Table 1, based on current projections, solar photovoltaic and wind turbine capacity expansion is insufficient to meet the objectives for 2030.

Based on industry analysis, renewable capacity expansion is hindered by three underlying challenges:

- **Limited policy support**: this aspect challenges both large-scale projects and distributed energy system expansion. Firstly, large-scale projects are affected by uncertainty which was enabled by the lack of competitive auctions and limited transparency associated with future auctions. The auction design used by most of the states of the European Union uses bid prices as the sole selection criteria, which has led to very low or negative bids, which have reduced the profitability of manufacturers and developers.
  At a residential level, uncertainty regarding the extension of support schemes, as well as insufficient remuneration of prosumers may lead to a slowdown in capacity deployment [10].
- **Permitting difficulties**: The process of obtaining permits for the development of renewable energy capacities (entering auctions) can be long and difficult. Furthermore, developers are limited by regulations when it comes to the type of land energy systems can be installed on. The permitting process can increase both the duration of projects and the costs to the point where the pace of deployment can be frozen [10].
- **Grid congestion**: installing new capacities (especially in the context of the ongoing decentralization process) requires the strengthening of both the transmission and distribution infrastructure and assets. This is not only a lengthy process due to legal reasons, but it also causes strain on the final consumer who must pay for the expansions [10].

Seeing how these issues have been present in the power sector for more than two decades, it is very likely that they will remain a burden for the deployment of renewable energy capacities in the years leading to 2030.

However, if the member states of the European Union can address some of the challenges, then the values presented in the accelerated case from Table 1 could be achieved.

An analysis financed by the European Union [11] showcases the potential that prosumers have for covering electricity consumption and sets out the dimension of said contribution for three timespans: one leading towards 2015, one leading towards 2030, and one leading to 2050. The latter three have been presented from three different hypotheses.

a) The business-as-usual scenario;
b) The scenario when the technical potential of renewable energy sources is exploited to the maximum (without considering storage);
c) The self-sufficiency scenario, which is similar to the previously presented one, except for the fact that storage is taken into account.

Based on the findings of the report, a total of approximately 630 TWh (out of which 600 TWh can be sourced from residential photovoltaic panels) sourced from rooftop photovoltaic panels can be achieved by 2050.

In the second scenario, solar energy represents 59% of prosumer potential. The development of photovoltaic parks is limited by both climate and urbanistic reasons. The potential is higher in southern countries where the sun is available for longer periods and, in rural areas, more terrain can be used up by photovoltaic parks.

Rooftop photovoltaic systems, including individual homes, multi-family buildings, commercial spaces, and industrial facilities, can make a significant contribution to the energy transition. They compensate for the limitation of the development of ground-based photovoltaic systems by the lack of excessive land use. The economic development potential estimated at the EU level of 467 TWh/year is very close to the forecasted need for solar photovoltaic systems until 2030 of 440 TWh/year, corresponding to a contribution of renewable sources of 65% in electricity consumption [12].

Exploiting this potential can counterbalance the additional demand for electricity caused by the development of electromobility. Placing photovoltaic systems on rooftops, in the immediate vicinity of the place of consumption, counteracts the potential for congestion and losses in the transport and distribution networks. Self-consumption cannot influence the fixed costs of operating the network, because distribution operators must design the network to deliver the consumption approved by the technical approval of the connection at any time.

Considering the mentioned advantages, efforts should be made to remove the existing barriers, whether they are technical (excess production at certain times of the day should be harnessed with the help of battery storage systems) or financial (lack of attractiveness due to the prospect of non-recovery of the investment due to the low cost of centrally supplied energy should be compensated by incentive policies). Furthermore, local authorities must increase their efforts to encourage distributed generation in the years leading to 2030, as well as come up with ways to make storage systems more affordable and attractive to residential consumers.
When it comes to the transport sector, academic papers point out that electric vehicle aggregation can bring real benefits to grid stability and the true potential of electric vehicle integration in intelligent grids cannot be achieved by individual users [13]. This is because individual loads are below the minimum threshold allowed for bidding in energy markets and the number of individual transactions would be too high.

However, according to other studies [14], the infrastructure for charging and discharging electric vehicles is still severely underdeveloped and requires high investments that imply long-term planning.

Vehicles running on biofuels still make up the largest share of vehicles running on renewable energy [10], with hydrogen still being reduced to mainly busses and trains, while applications for planes are estimated to be implemented after 2030 [15].

The European Union, as well as individual member states, have taken several actions to ensure that electric vehicle share steadily increases leading to 2030. Last year, the European Parliament voted to ban sales of newly produced internal combustion engine vehicles in the European Union beginning in 2035. The ban includes gasoline, diesel, and hybrid gas, such as LPG and CNG, agrofuel like ethanol and agrodiesel, and synthetic fuel engines. Except for luxury vehicles (due to what is known as the "Ferrari amendment"), only vehicles having no CO_2 emissions vehicles will be available for purchase starting with 2035. In Romania, governments are incentivizing the purchase of electric vehicles by paying for up to half of the purchase costs, or by offering owners other benefits (free charging in public spaces, free parking, etc.)

However, given the current projected path, the European Union still falls short of achieving its objectives for 2030 [10]. More ambitious transport policies must be adopted to increase the renewable energy share and ensure the expansion of biofuel production, the development of charging infrastructure for electric vehicles, and the development of hydrogen technologies.

The sector that is most lacking when it comes to reaching the "*REPowerEU*" targets is represented by the buildings sector. Considering that in 2020, heating and cooling in buildings accounted for more than half of the final energy consumption, and that renewable energy sources were used only for 23% of this consumption, it is evident that this sector is of upmost importance for reaching the decarbonization targets for 2030.

Targets were set for each member state through the Renewable Energy Directive in 2018 and gradually adjusted through the proposed revision from 2021, a more recent revision in May 2022 through the "*REPowerEU*" plan, which included a roadmap towards reaching targeted 45% renewable energy share in overall total final energy consumption. Through this roadmap, the European Commission planned to increase the share of renewables in heating and cooling and in district heating and cooling by an average of 2.3 percentage points every year leading to 2030 and by 1.9 percentage points in industry, while the share of renewables in the buildings sector climbs to 60% by 2030 [10]. However, following the proposal of less ambitious targets by the European Council in June 2022, the European Parliament adopted several amendments to revise the Renewable Energy Directive and set an indicative target of 49% renewables in buildings by 2030.

Considering that in the past decade, the European Union share of renewables in heating and cooling managed to increase only by 0.6 percentage points on average, the member states must accelerate their renewable heat uptake by 2030 to reach the latest targets set by the European Union.

This is why, while evaluating of the contribution of the prosumers to the satisfaction of the demand and implicitly to the fulfillment of the assumed targets, the capitalization is prioritized by technologies in the order: cogeneration, solar - photovoltaic panels on the roof, hydropower, solar photovoltaic on the ground and wind. Of these, the last three technologies are associated only with energy communities, as prosumers. Cogeneration is prioritized to ensure a growth in residential heating first, and then cover other areas of consumption.
However, although the market evolution of heat pumps is encouraging [10], there are some aspects such as the availability of skilled installers and the capacity of supply chains to satisfy demand, that may lead to bottlenecks.

REPOWEREU AT A LOCAL LEVEL

Romania is one of 11 Member States which in 2017 already had a renewable energy share above their 2020 targets. However, between 2005 and 2021, the country has seen an increase of less than 6 percentage points [16].

When discussing renewable electricity, Romania has seen an unprecedented and unexpected increase in the number of prosumers since the beginning of 2020. If by the end of 2020 there were only 1634 prosumers registered in Romania, at the end of 2022 saw a total number of 40171 (which is an increase of 183% compared to the beginning of 2022) prosumers with a total installed capacity of 423 MW. These numbers are 32% higher than the estimations of the national regulator.
Furthermore, when it comes to large scale renewable energy sources, Romania has the geographic advantage of regions rich in running water and wind. This potential is already being exploited, as can be seen in figure 2.

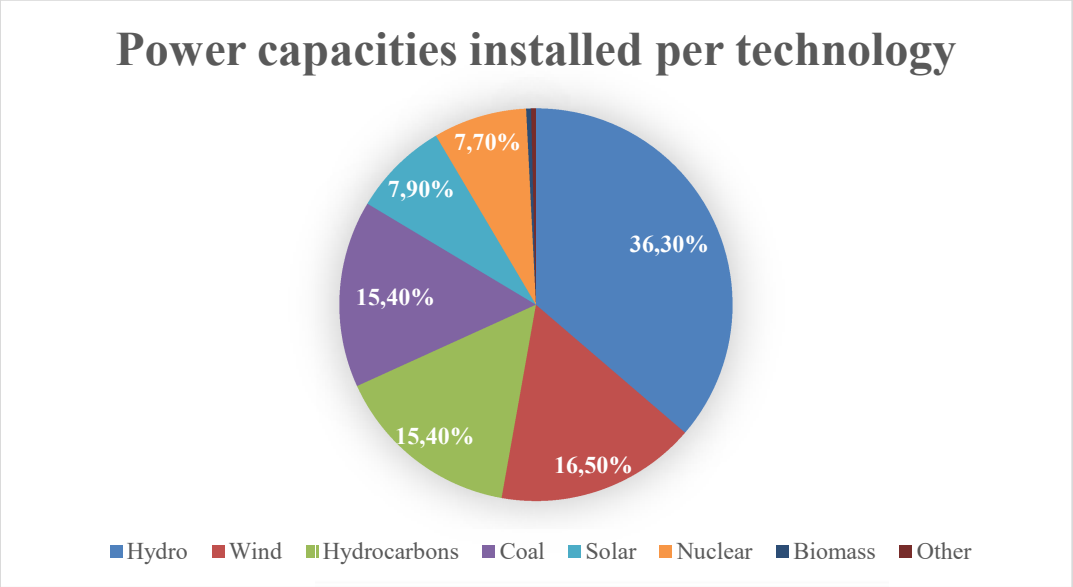

Figure 2. The evolution of EU targets regarding the contribution of energy from renewable sources: Source: Based on data from the National Energy Regulatory Authority [17]

Romania has an exciting potential of renewable electricity sources, which allowed it to fulfill the assumed target for the year 2020 before the deadline. However, like the other EU member states, it is only at the beginning of the energy transition period.

The potential of prosumers in Romania, and the technical potential of installing photovoltaic systems on rooftops, far exceeds the estimated consumption for the time horizons 2030 and 2050. The results are currently modest, although the pace of development is fast. This fact can be explained since, until now, the exploitation of the existing potential for land-based wind and solar resources has been the main objective for which all consumers have contributed considerable costs (found in the energy bills).
However, the Integrated National Plan in the field of Energy and Climate Change aims to reach an increase of 2.5 TWh of energy consumption from solar capacities on rooftops for 2030 . It is an ambitious target considering the current state, which represents only about 7% of the evaluated technical potential.

Table 2. Production capacities installed in Romania divided by technology.

Technology	Installed Capacity
Hydro	**6642.6**
Wind	**3026.91**
Hydrocarbons	**2821.71**
Coal	**2812.2**
Solar	**1444.63**
Nuclear	**1413**
Biomass	**106.266**
Biogas	**21.357**
Waste	**6.03**
Residual Heat	**4.1**
Geothermal	**0.05**

Total:	18298.853 MW

Source: Based on data from the National Energy Regulatory Authority [17]

There are several technical challenges that Romania will have to face in the following years due to the large number of prosumers that are being connected to the grid in recent years. Due to this exponential increase, distribution system operators are facing an increase in the number of complaints related to invertor overvoltages. This issue can be addressed through major investments, however, since all expenses are supported by the final consumer, this solution poses certain problems at a time when prices are subjected to unexpected increases. Furthermore, the large number of prosumers requires high computational power which distribution system operators may not possess. Thus, distribution system operators must adapt their informatic system to current needs.

The electric vehicle market in Romania has seen a steady increase in the number of registered vehicles in the past years. Even if the charging infrastructure is still severely lacking in multiple regions of the country, the first two months of 2023 saw an increase in the number of registered electric vehicles when compared to the same period from 2022. Furthermore, the number of vehicles with diesel engines has decreased to 12.6% [18].
Finally, in Romania, most households rely on either wood heating or heating systems that run on gas [19]. If the recent years have shown that the population of Romania is interested in pursuing renewable energy in electricity production and transport, there is still a long way to making electric heating the norm.

The main measures that must be taken by both the governing body and players from the power sector value chain in the following years at a local level to ensure that the "*REPowerEU*" targets are met are the following:

- Continue national programs meant to incentivize the population to purchase renewable energy capacities, storage systems and electric vehicles ("Casa verde", "Rabla Plus")
- Distribution system operators must work closely together with transmission system operators to keep up with the number of new prosumers. Furthermore, major investments must be made in the informatic system to be ready for the high computational load required by a large number of distributed energy systems.
- The charging infrastructure for electric vehicles must be expanded to incentivize potential customers.
- Prosumers must be rewarded for their contribution in a way that is attractive, but also competitively fair towards other consumers.

DISCUSSIONS

This article is part of a more extensive doctoral research that aims to examine the larger implications of power aggregators in the European power sector. Through this paper, the author aimed to gain a better understanding of the social, economic, and environmental context in which the process of decentralization is taking place and the elements that may pose interest to aggregators (prosumers, electric vehicles, demand response).

The literature that was referenced in this paper comes from both an academic and industrial background and covered the state of renewable energy sources deployment in the European Union, projections for the achievement of "*REPowerEU*" targets and current barriers that slow down the green transition.

The main limitation of this paper is its reliance on secondary research. However, in order to limit the drawbacks that are inherent to this type of research, the author reviewed only recent papers or literature that attempted to anticipate future developments. Furthermore, to limit the risk of biased opinions, the author used both academic and industry papers in order to crosscheck the information present in both fields.

The study is relevant since there is little academic literature that examines the likeability that the "*REPowerEU*" targets are reached by 2030, even less so for Romania. The study can be expanded by performing comparisons between other eastern European countries, or by narrowing the focus to each of the main areas that contribute to decarbonization (clean energy production, electric vehicles, heating in buildings).

CONCLUSIONS

The "*REPowerEU*" plan comes at an interesting time in the evolution of the European Union's efforts to combat climate change. Following decades of incentive schemes and policies meant to make large-scale renewable technologies cost competitive, the energy sector faces new challenges related to distributed generation and the phasing out of resources like coal and gas.

Although the overarching goal of the European Union is to ensure sustainable development, its individual objectives may be too ambitious and, in some cases, counterproductive. While achieving energy sovereignty is an understandable effort following the conflict in Ukraine, it can be argued that the phasing out of Russian gas may lead to both an

increase in dependency for materials and fuel from other countries outside of Europe during the energy transition.

Furthermore, the targets set by the European Union in electricity production, transport and buildings appear to be far too ambitious given the current growth of renewable energy in each of these sectors.

The road leading to 2020 and the achievement of the 20-20-20 climate targets saw multiple revisions and failures, and most of them were caused by political zeal, poor calibration of supporting schemes and frequent legislative changes that created unpredictability for many member states.

Whether the European Union has learned from past mistakes remains to be seen in the following years, but measures must be taken fast in order to correct the path on which member states are on the way leading to 2030.

The research results of this study are valuable, as there is no academic research that tackles the topic of this article at a local level, and they can be compared to other similar studies from other countries of the European Union. Furthermore, through the synthesis, which was made of the available literature, the paper represents a starting point for future research.

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