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GREEN DEAL AND SOLAR ENERGY- PROSPECTS FOR BULGARIAN RURAL AREAS

Krum HRISTOV, Rositsa BELUHOVA-UZUNOVA, Dimo ATANASOV, Svetoslav LAVCHIEV, Georgi MRANKOV

Agricultural University -Plovdiv, 12 Mendeleev Str., 4000, Plovdiv, Bulgaria,
E-mails: rosicab_uzunova@abv.bg, krumhristov@abv.bg, atanasov_phd@gmail.com, s.lavchiev@abv.bg, jorjo87@abv.bg

Corresponding author: rosicab_uzunova@abv.bg

Abstract

Renewable energy is essential for the European Union. The targets presented by the Green Pact are closely related to the development of renewable energy, and it has a vital role in achieving climate neutrality in the EU. Solar energy's importance has increased in the past years. It can help achieve the goals presented in the EU and contribute to the sustainable development of rural areas with unrealized potential. The aim of the study is to outline the dynamics and tendencies in solar energy development in the EU and Bulgarian energy mix and highlight perspectives in the context of rural areas. The results show challenges related to green transition in Bulgaria. Renewable energy, especially solar and wind, has increased in its role in the last few years. However, it should be noted that the country's development began from a lower starting point. Bulgaria is dependent on fossil fuels, and more than 80% of electricity is produced from coal, which is one of the substantial sources of pollution. However, some positive tendencies and possibilities exist for boosting rural economies and employment creation.

Key words**:** *regional sustainable development, energy mix, renewables*

INTRODUCTION

The United Nations' 2030 Agenda and Sustainable Development Goals [37] outlined the path towards sustainability and circularity. In addition, the Intergovernmental Panel on Climate Change (IPCC) publication on the impacts of global warming highlights the climate change challenges. It reports the need for well-targeted actions to overcome these emerging issues [27]. As a leader in this field, in 2019 the EU presented the European Green Deal. The framework focuses on achieving "climate neutrality by 2050 and a 55% reduction in greenhouse gas (GHG) emissions by 2030 compared to 1990 levels" [9]. In addition, The Fit for 55 package [10, 11], which involves different cross-sectorial actions and encourages the EU Member-states to meet the ambitious targets.

Solar energy is one of the fastest-developing renewable energy sources in recent years. It is considered an opportunity to achieve clean production and sustainable development [22]. According to the International Energy Agency, solar power could provide about 11% of the world's electricity production by 2050. [16]. Solar energy can help achieve the goals presented in the EU Green Pact and contribute to the sustainable development of rural areas with unrealized potential.

The aim of the study is to outline the dynamics and tendencies in solar energy development in the EU and Bulgarian energy mix and highlight perspectives in the context of rural areas.

The survey has the following structure: The first part introduces the methodology. The second part outlines a literature review on the linkages between renewable energy and rural areas. Third, the trend in renewable energy development focusing on solar energy is discussed. Based on the analysis, conclusions and recommendations are highlighted.

MATERIALS AND METHODS

The survey is based on EUROSTAT data [13] for energy statistics covered by Regulation (EC) No 1099/2008. In addition, reports and data from EMBER are used in the survey [4, 5, and 6]. The systematic literature review

includes study of legislation, reports and publications based on the framework proposed by Romero-Castro [38].

RESULTS AND DISCUSSIONS

Literature review

As a key goal of EU climate ambitions, energy transition is considered an opportunity for rural communities. On the other hand, the availability of land and natural resources make rural areas important for renewable energy prospects [26, 48]. Some authors [24] consider rural areas essential for new local development models based on renewable energy. Rudolph and Kirkegaard, 2019 explain the relationship between rural development and renewable energy [39]. On a political level, several documents highlight the role of renewable energy in supporting rural economies and achieving sustainable development. [3, 19, 32]. The EU legal framework outlines the opportunities, "especially in rural and isolated areas" [3].

The UN Environment Program (UNEP) outlines actions and competencies among stakeholders from various sectors [47]. In addition, in the scientific literature, different studies present factors for developing renewable energy in rural areas. Garrod et al. [14] consider the rural capital for essential. The authors pointed out that using rural areas environment can bring economic and social benefits. Surveys analyze the influence of economic and human capital and cultural, psychological and social factors on rural development [1]. In addition, [28] outlines the local context in renewable energy development and includes physical, community and financial capital as leading drivers. The success of the implementation of renewable energy projects in rural areas is related to trust and relationships between the members of the local communities [15].

On the other hand, there are a number of drivers, challenges and barriers for adopting renewable energy and, particularly, solar energy technologies [33]. The latter is an object of serious debate among scholars due to the growing importance of the topic. Clausen and Streimikiene et al. [2] observe drivers and barriers to adopting renewable energy technologies in rural areas. The transition from fossil energy to renewable is difficult due to new infrastructure construction and operational and start-up expenses [21, 23]. [17] was focused on energy-storage technologies and electricity generation. Financial factors and the higher risk of the investments are critical for developing these projects [29]. In addition, Wall et al. [49] conclude that the cost of renewable energy affects the acceptance of these sources.

Furthermore, networks can stimulate contact and cross-sectorial collaboration [31]. Ryghaug et al. [40] highlight the importance of public acceptance of these technologies. In addition, some authors identify the lack of public knowledge as a barrier [8]. The social disagreement with the renewables in rural communities can be a challenge. According to Irfan et.al. [20], there is a gap between public acceptance and the goals for increasing the share of renewable energy. Simpson et al. [42] points out that incentives and a realistic plan are vital to adopting renewable energy in rural areas. However, the discussions and misconception can encourage the transformation of these issues into practices and rules [43].

While there is a regulatory framework with legislation for renewable energy promotion, often barriers related to planning and implementation occur [7]. Streimikiene et al. [46] consider the underdeveloped business models and a lack of transparency a challenge. Consumers have to play a more significant role in the new energy models [30]. In agriculture, the transition can be encouraged by farmers who can be energy producers rather than just consumers [36]. However, these opportunities are related to the need for capacity building and new business models.

Another important aspect is the new type of land rivalry that occurs with renewable energy development. It can impact forests, environmental assets, and agricultural land [35]. Agriculture, fishery, and tourism can be influenced negatively [25]. Solar photovoltaic power development has changed and can

further influence land use [30]. Institutional factors also are important.

According to some authors, national strategies are lacking behind the ambitious goals. The most severe barrier is the inconsistency of policy and the lack of trust alongside with the difficulties related to the administrative capacity [27, 34, 45].

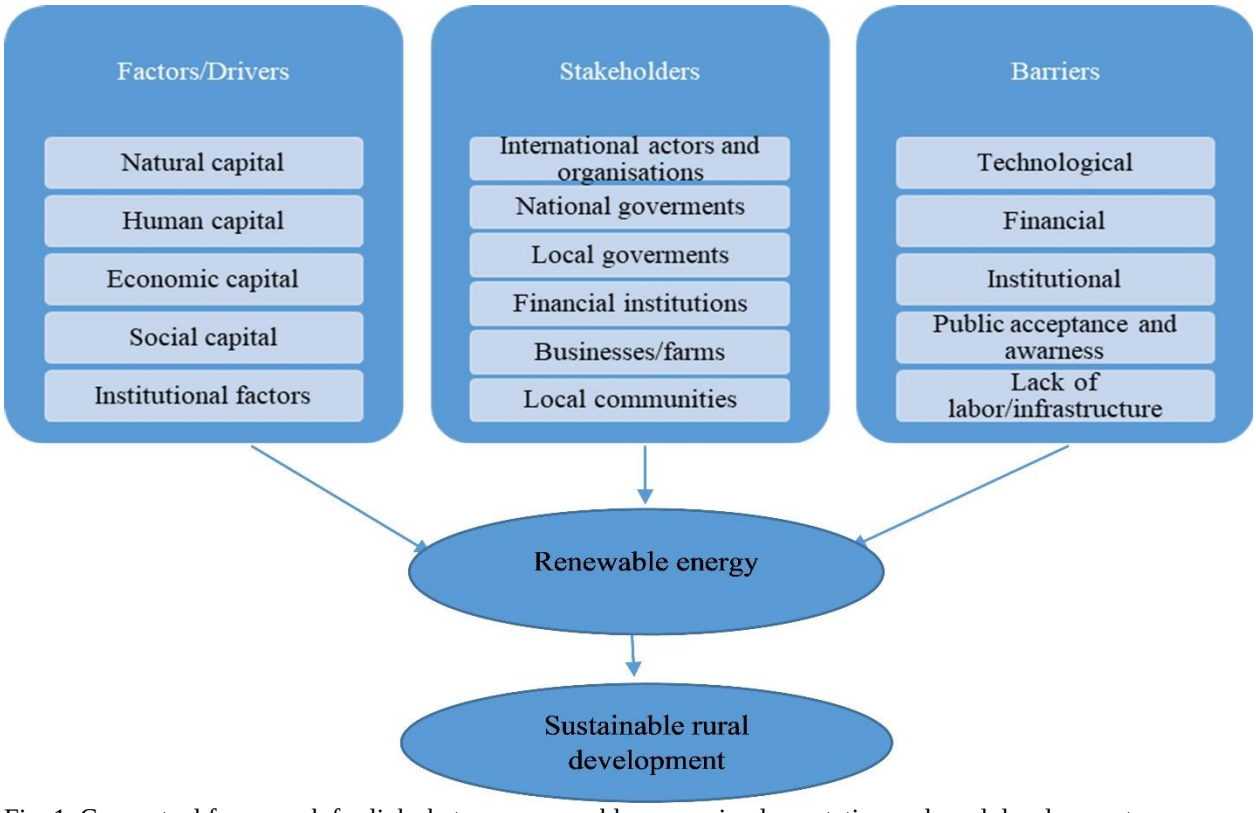

Fig. 1. Conceptual framework for links between renewable energy implementation and rural development
Source: Own survey based on [38, 41, and 47].

Based on the literature review, a conceptual framework that presents the linkages between different actors, barriers and drivers is developed.

The framework explains the role of rural areas and renewable energy in achieving sustainable development, especially in meeting the targets related to the EU climate ambitions.

The innovations and new renewable energy technologies, along with the increased role of renewables in the energy mix, are vital parts of the sustainable development of rural areas. However, some challenges have to be overcome, and opportunities to be taken advantage of in order to achieve the Agenda 2030 targets.

Trends in renewable energy development in the EU and Bulgaria

Renewable energy is seen as a main factor in achieving global climate goals and reducing greenhouse gas emissions.

In 2022, in the EU, the share of consumption from renewable sources was more than 22%, which is slightly higher than in 2021. (Figure 2) The indicator increased significantly for the period 2004-2022.

In addition, EU Directive 2023/2413 has revised the 2030 target from 32% to 42.5%. In this regard, the member states need a more significant growth of around 20 percentage points. That requires well-target initiatives and actions.

According to Eurostat data [13], the highest share of the indicator is recorded in Sweden (66%), the leading country in the EU and far ahead of the other Member states. It is followed by Finland (47%) and Latvia (43%). By contrast, the lowest share is registered in Ireland (13%), Malta (13.4%) and Belgium (14%).

Bulgaria is below the EU average with a share of 19%. However, there is an increase of ten percentage points compared to 2004. The

results indicate rising tendencies in the EU and some dynamics in Bulgaria. The share of renewable energy was above 20% for the 2018-2020. However, it reduced in the following years.

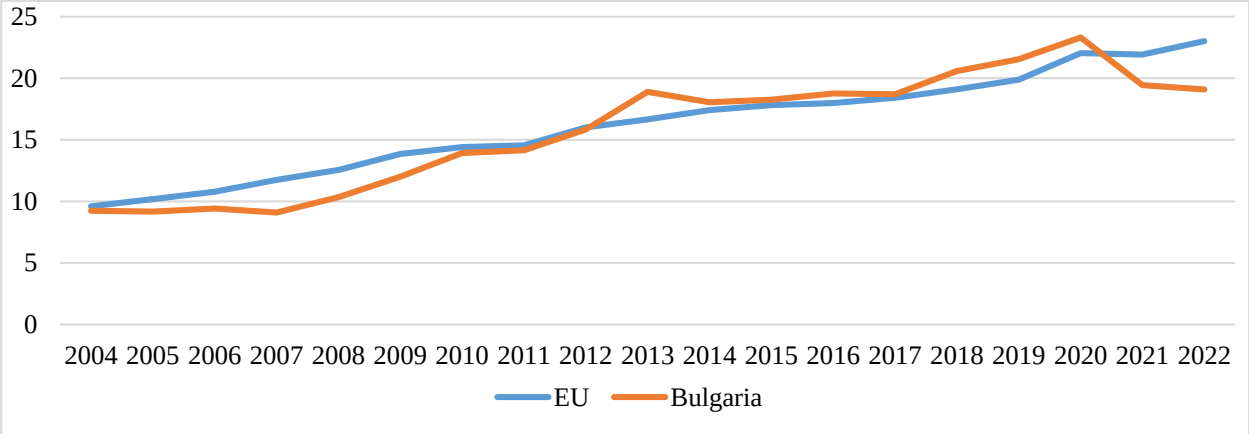

Fig 2. Share of energy from renewable sources, 2004-2021 (% of total energy consumption).
Source: [13].

Based on Eurostat data [13], it should be noted that the highest increase in the indicator for 2004-2022 is registered in Sweden (28 pp), followed by Denmark (27 pp) and Finland (19 pp). The lowest increase is recorded in Slovenia (5pp) and Croatia (6pp).
According to the Eurostat data [13], the highest share of electricity consumption from renewables is registered in Sweden (83%), followed by Denmark (77%) and Austria (75 %). By contrast, the lowest value of the indicator is in Malta (10%), Hungary (15. %), and Czechia (16%). Norway is the leading country in Europe in 2022, with a share higher than 100 %. This means that it produces more than its consumption. In Bulgaria, the share is 29%, more than 12 pp lower than the EU average (40%).
In 2022, the share of renewable energy in transport is almost 10%. This means that the target set by the EU is unlikely to be achieved with the reported growth rates. The share of renewable energy in transport is the highest in Sweden and Finland. On the other hand, it is the lowest 2.4 % in Croatia and 3% in Latvia. In Bulgaria, the share is close to the EU average- 7.8%.
Becoming a world leader in addressing climate change issues and reaching the Green Deal targets requires ambitious actions. In 2022, the EU developed the REPowerEU plan to encourage the transition to clean energy [12].

Based on Ember data [4], it can be concluded that in the last few years, Europe has seen uneven progress in decarbonization. Fossil-generated electricity has declined by 25% since 2015, primarily replaced by wind and solar power. However, this transition is driven mainly by Western Europe, with much more limited progress in Eastern and Southeastern Europe. Overall, fossil fuels still account for nearly half of electricity generation in these parts of Europe.
The results show challenges related to green transition in Bulgaria. Renewable energy, especially solar and wind, has increased in its role in the last few years. However, it should be noted that the country's development began from a lower starting point.
The data show a change in the energy mix in Bulgaria. For the last ten years, non-renewable sources have started to be displaced by renewable ones.
The country expanded renewable energy in 2007, most of which was hydroelectric. Solar installation started in 2009 and reached 100 (MW) in 2011. [4] However, due to changes in the institutional environment and government price policy, only around 12 MW were installed between 2013 and 2014, and capacity has not increased substantially until 2020 [4, 50]. However, the country's dependence on fossil fuels is exceptionally high [50]. It is impressive that more than 80% of electricity is formed from nonrenewables, which are pointed out as one of the biggest

polluters and generators of greenhouse emissions. Regarding the energy mix, a comparison between Bulgaria and the EU shows significant differences in several directions. First, the share of nuclear power is higher than the EU average. Second, coal has a two times bigger share.

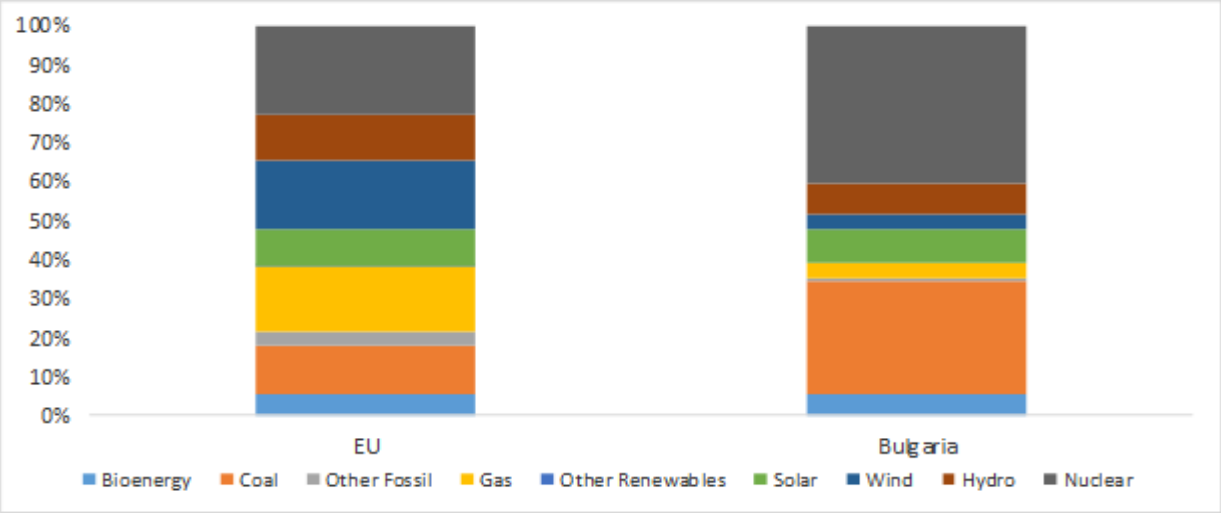

Fig 3. Electricity generation by source (%), 2023
Source: [4].

Third, the share of solar energy in Bulgaria is close to EU-27, while the role of wind energy is insignificant. It can be summarized that Bulgaria is lagging behind despite the EU's set goals and the path towards decarbonization.

Prospects for renewable energy development

The UN climate conference [44] sets a global goal of tripling renewables and doubling energy efficiency. The Net Zero report [18] shows renewable capacity targets as part of policies and strategies worldwide.

According to EMBER data [5], China is developing its green energy sector and aims to double its renewable capacity to 2,461 GW, by 2030.

In the United States, the goals are to reach 938 GW of renewable capacity by 2030 or 59% share of renewable electricity. However, there is a need for more consistent actions.

As a part of the REPowerEU plan, the EU developed a solar energy strategy with the ambition of "over 320 GW of solar photovoltaic capacity by 2025 and almost 600GW by 2030" [12]. However, the REPowerEU renewables target of 69% of energy generation by renewables can only be achieved based on well-directed measures. All Member States must contribute in order to reach the goals.

Bulgaria will receive 480 million euros under the RePowerEU plan, expanding the opportunities for solar energy development. According to Regulation (EU) 2018/1999 requirements, the Member-states had to develop an Integrated Energy plan.

The analysis of the 2030 targets shows the diverse ambitions among member states (Figure 4). Estonia, Denmark, Austria, Portugal and Lithuania have the higher ambitions, with a share above 90% of the energy generated by renewables. By contrast, eight countries (including Bulgaria) set their targets below the EU goals [8].

EMBER report [5] divides a confidence level in achieving the targets. Based on publication analysis, Germany and Sweden are considered countries with high confidence in meeting their goals. On the other hand, Poland, Greece, Romania, and Belgium are classified as countries with low confidence.

The results show different starting points, ambitions and contributions to the EU. Therefore, the 2030 targets raise a number of questions related to the member states' institutional environment, policy, and required actions.

The main target in the Bulgarian energy plan is for 27% of the total energy consumption to be generated from renewables. The main strategic directions are: (1) Decarbonization, (2) Energy efficiency, (3) Energy security, (4) Internal energy market, (5) Research, innovation and competitiveness [5]. Bulgaria's target for solar energy capacity remains low, as solar energy will only account for 2.6% of electricity in 2040 [6]. However, Bulgaria benefits from high solar irradiation, especially in the southern part of the country, and has a solar potential, which is not reflected in the Bulgarian plan objectives.

There are challenges related to the administrative environment and financing difficulties, with insufficient ambition for a green transition.

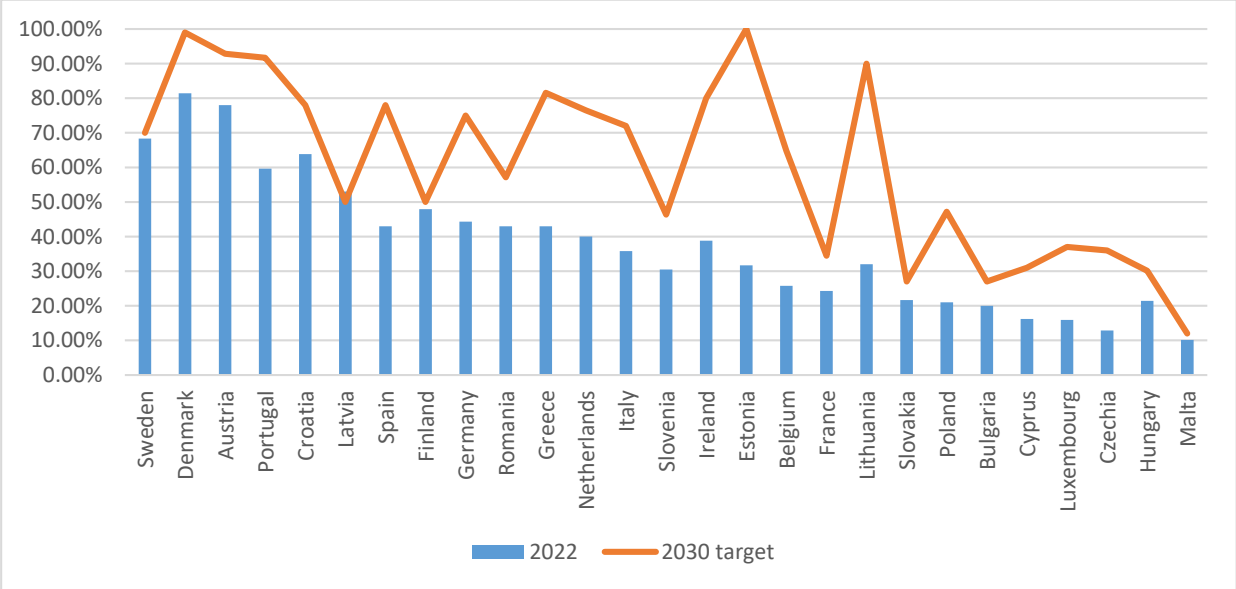

Fig. 4: Share of total electricity generated by renewables: current (2022) and target (2030)
Source: [8].

CONCLUSIONS

Based on the analysis, the following conclusions could be drawn:

(1) Solar energy is one of the fastest-developing renewable energy sources in recent years and an opportunity to achieve Green Deal targets.

(2) Renewable energy development can boost rural economies and provide opportunities for new business models and job creation. However, depopulation and infrastructure are still challenging, along with the question related to the land use dynamics.

(3) The share of renewable energy has increased in recent years in all Member-states. The 2020 target is achieved, and new ambitious goals are developed.

(4) Bulgaria has a share close to the EU average. However, there are dynamics and some variations in the indicator.

(5) In the last few years, Europe has seen uneven progress in decarbonization.

(6) There is a significant difference in the EU and Bulgarian energy mix. The country is still too dependent on fossil fuels as an energy source.

(7) The new Energy plan does not provide an ambitious framework for renewable energy development.

(8) Although Bulgaria has potential for solar energy development, there are unrealized opportunities and inconsistent policy ambitions.

(9) The RePowerEU plan will encourage member states to develop renewable energy capacity. Bulgaria can stimulate PV installation by benefiting from financial support.

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