ANALYSIS OF THE POTENTIAL OF SOLAR ENERGY IN THE COASTAL AREA. CASE STUDY: THE BLACK SEA COAST OF ROMANIA

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Abstract

Solar energy is one of the newest and friendliest ways to obtain energy, being a new way to fight against the increasing of pollution by everyday urban activities, but also against increasingly threatening climate change. Still in an early stage of development, solar energy is gaining ground for the public energy sector, not just for private businesses or private homes, which translates into an increasing number of photovoltaic panels in the areas where solar radiation has high values, and solar energy has the potential to be an supplement for the energy circuit of urban centers or even a substitute. In the area of the Romanian coast, the solar radiation is extremely high, which translates into a huge solar potential, but also through a high degree of success for the implementation projects of this type of energy. The central objective of the study is to identify the potential of solar energy and opinions from locals about a landscape filled with photovoltaic pannels, while the central goal of the study is to raise awareness of the need to promote renewable energy and and to embrace the beauty of the sustainable development of renewable energy, regardless of the impact on the landscape.

Key words: pollution, nature, sustainability, ecology, renewable energy

Introduction

Promoting renewable energy is one of the keys to success for a more sustainable future, where pollution from burning fossil fuels for energy is extremely limited, which would facilitate the creation of more consistent and eco-friendly sustainable development strategies. Through the ability of renewable energy not to run out and not to pollute, its popularity is growing in direct proportion to researchers' concern about current climate change, where man is putting extremely high pressure on the natural environment, which is becoming more and more prone to irreversible changes. since nature is indispensable to human life. The popularity of solar energy can be seen not only at the macro level, but also at the level of individual households of people in regions where the amount of solar energy is high enough to be able to self-sustain electricity in a home. One of the most important advantages of solar energy is the possibility of supplementing the traditional electricity circuit, whether it is municipal structures or individual households, and the capacity of votovoltaic panels can be constantly increased. Romania is an extremely tender country for the development and implementation of solar energy projects, through a high amount of solar radiation during the year in the southern and south-eastern regions, as is the case with the Black Sea coastline. The Black Sea coast benefits from a significant number of clear days during the year, especially in the summer season, and the support of seasonal households, which are not used outside the summer season, could be achieved with renewable energy sources, especially wind energy or solar. Awareness and understanding of the concept of sustainability in local or national strategies need to be known, and current trends are to embrace the forms of renewable energy for the territory analyzed, for the reliability of photovoltaic panels and for low maintenance and installation costs, which are accompanied by a series of important benefits, especially financial ones. (Ducman et al., 2021; Ducman et al., 2021; Dumitrascu et al., 2021; Mocanu et al., 2019)

Material and methods

The data needed to conduct the study were collected from an online statistics platform, namely the Global Solar Atlas platform, where all data on solar energy are centralized at the local level, and the sustainability of solar energy can be easily viewed. Also, the research proposes to visualize the data in four distinct ways, namely:

1) The energy obtained by photovoltaic panels installed in an individual household on the territory of Constanta Municipality, with a total capacity of 1kWh, for 12 PM.

2) Energy obtained by photovoltaic panels installed for industrial use, with a solar installation capacity of 100 kWh, for 12 PM.

3) The energy obtained by the photovoltaic panels on the ground, where the land is exclusively intended for obtaining solar energy, and the distances between the photovoltaic panels are small, with a total capacity of 1000 kWh, for 12 PM.
4) Energy obtained by floating panels that could be installed directly on the aquatic surface of the Black Sea, with a total solar capacity of 1000 kWh, for 12 PM.

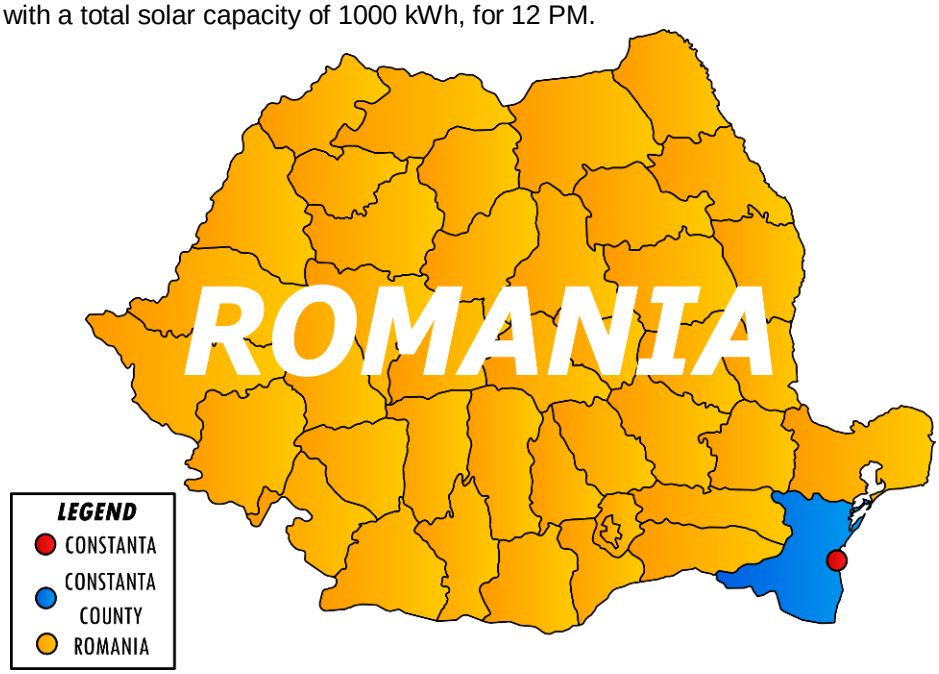

Fig. 1: Localization map of Constanta Municipality (at local, regional and national level)

By selecting the time of 12 PM the study wants to analyze the direct solar capacity, as the position of the Sun relative to the ground is perpendicular, and in this time interval the maximum solar energy can be obtained during a day, thus obtaining the maximum solar power output. Through the success of the study to show that solar energy in Constanta is suitable for supporting an industrial platform, an individual household, an extensive electricity grid, but even by occupying a segment of the Black Sea, the study promotes the idea that renewable energy it is extremely reliable for the Black Sea coastal area on the Romanian territory. The inkScape 0.91 and Microsoft Excel software were used to create the graphics.

Results and Discussions

The middle of the day will bring a solar power output between 0.3 and 0.63 kWh, which means that solar energy is an important supplement to traditional electricity or may even be a substitute for homes where consumption is not very high. The average solar power output is about 0.48 kWh for an individual household, which would have a solar installation capacity of 1 kWh. The most favorable period for the maximum use of solar energy is the period March - September, which has values above the annual average. The total annual capacity of solar energy obtained through a solar installation with a total capacity of 1 kWh would amount to 1.3 MWh, which is extremely reliable for the implementation of solar energy in an individual household on the Black Sea coastline. (Figure 2)
Economic activities have a much higher need for electricity, but by installing a higher capacity of the solar installation you can easily get a majority supplement in the energy circuit, because for 12 PM, a solar installation with a total capacity of 100 kWh produces between 30.4 and 64.5 kWh, which could be a success for the implementation of renewable energy in the industrial field of a medium scale. A solar installation with a total capacity of 100 kWh can produce an annual average of 49.5 kWh, which highlights the ability of solar energy to represent an important shoulder to the sustainable development of small and medium-sized industrial companies. A main disadvantage for the implementation of solar energy in an industrial business is the fact that calculations on solar power output must be made for each period of the year, so that there is no risk of power outages. These values could give the courage needed by companies on the Black Sea coast to embrace and install photovoltaic panels for sustainable development. (Figure 3)
The creation of a much denser solar electricity network can be achieved by offering an exclusive land for the installation of photovoltaic panels, which can obtain a total monthly amount between 314.9 and 660 kWh, which could be a primary energy source for many economic activities, such as agriculture, farms or any small or medium-sized industrial activities. The main disadvantage of the spaces for

photovoltaic panels is that they require a very large space, but by creating a belt of solar installations near urban centers could supplement an impressive number of individual homes connected to the public energy system or multifamily homes, which is an important starting point in creating a more eco-friendly environment in Constanta. An installation of 1000 kWh from a land of approximately 10 hectares can obtain an average monthly solar power output for 12 PM of 510.7 kWh, this average being exceeded mainly during the spring, summer and autumn, thus guaranteeing the supply with electricity in a high share for a large number of homes. (Figure 4)

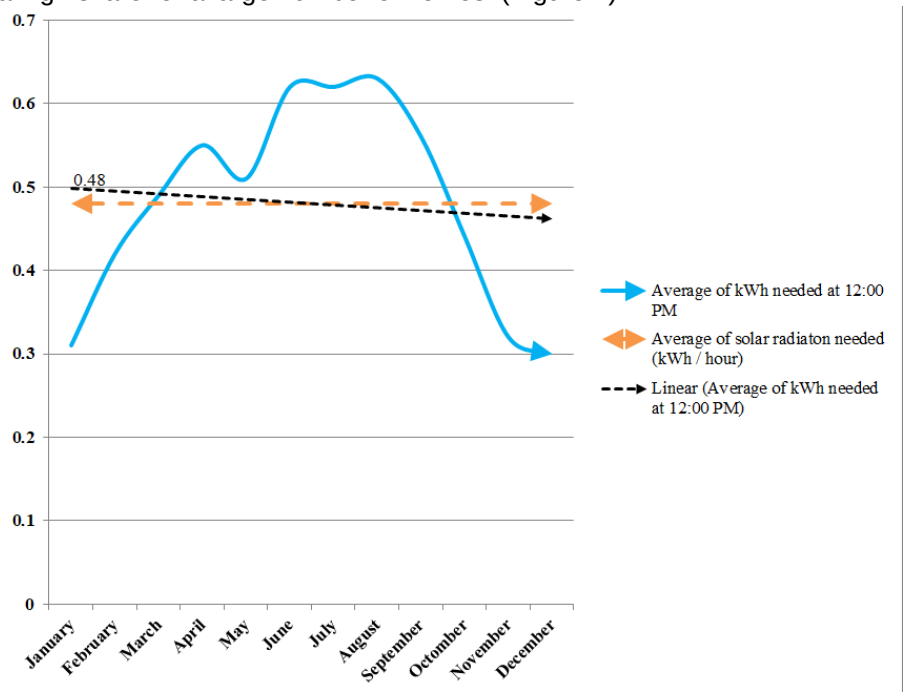

Fig. 2: The monthly evolution of the power output of an individual house at 12 PM in Constanta Municipality, with a solar installation capacity of 1kWh (for 2021)

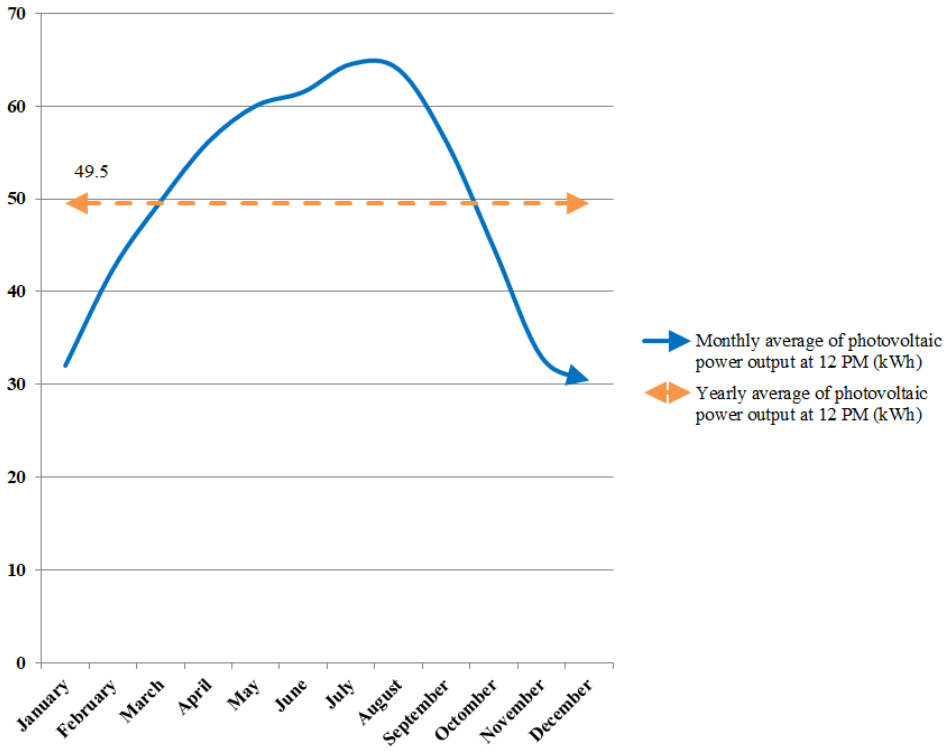

Fig. 3: The monthly evolution of the power output of an industrial platform at 12 PM in Constanta Municipality, with a solar installation capacity of 100 kWh (for 2021)

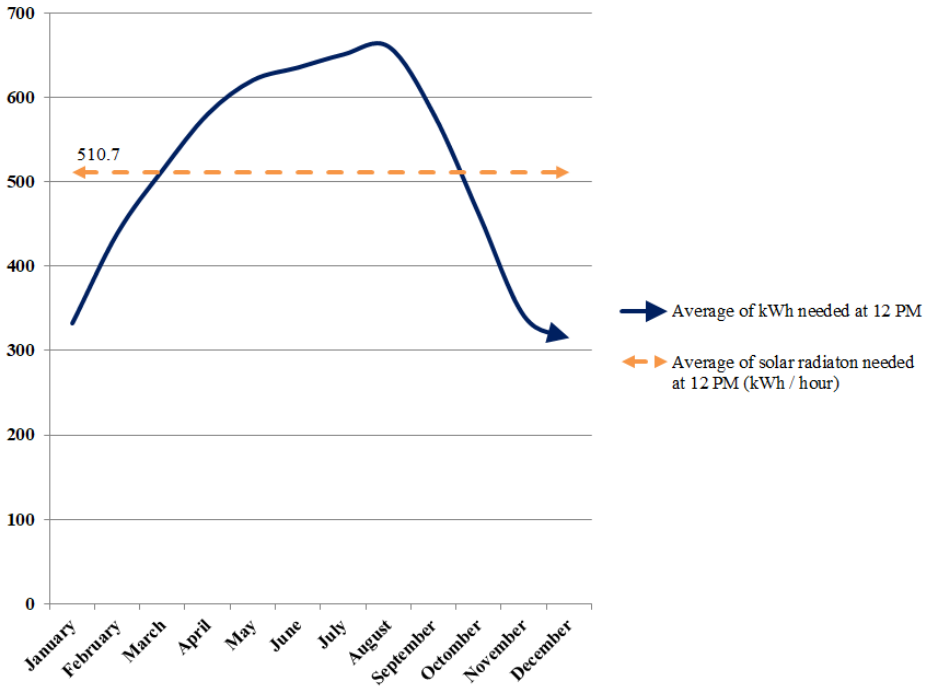

Fig. 4: The monthly evolution of the power output of an exclusive field of photovoltaic panels with a capacity of 1000 kWh, at 12 PM in Constanta Municipality (for 2021)

The possibility to develop solar energy installations on water wanted to solve the problem of large space needed to build large capacity installations, and the proximity of Constanta to the Black Sea could create a partnership between the terrestrial panels around city and aquatic photovoltaic panels. The values of the aquatic panels are lower compared to the terrestrial ones, but they can represent an extremely vital space for the implementation of the sustainable development strategies in the field of renewable energy. The values obtained by the floating installations with a total solar capacity of 1000 kWh are between 208.8 and 602 kWh for the middle of the day, while the average solar power output for the middle of the day is 426.1 kWh. (Figure 5)

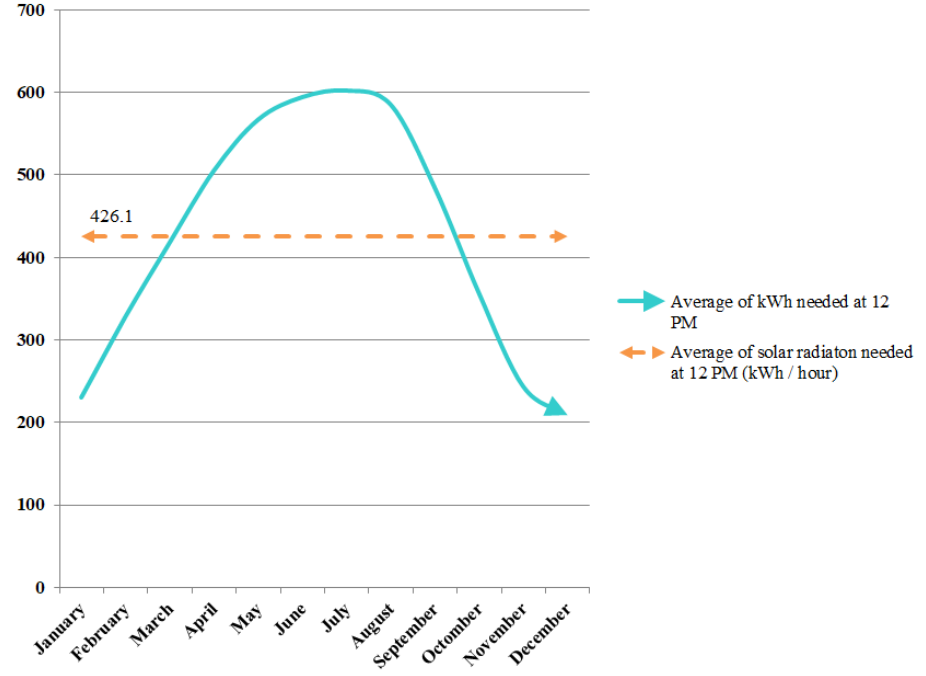

Fig. 5: The monthly evolution of the power output of an exclusive field of floating photovoltaic panels (on the Black Sea) with a capacity of 1000 kWh, at 12 PM in Constanta Municipality (for 2021)

Conclusion

The main success of the study is to confirm the potential of solar energy in the coastal area of the Black Sea in Romania, which can be an important incentive for the traditional energy circuit or even a permanent substitute for individual households or small or firm businesses. A main advantage of Constanta is the fact that it can use areas off the Black Sea to obtain solar energy, through the large number of clear days throughout the year. The research fulfills all the proposed objectives and wants to represent an ambassador of solar energy development on the Romanian coastal area, by raising awareness of the need to implement a much higher supply of renewable energy in urban areas, and beyond.

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Souhrn

Solární energie je jedním z nejnovějších a nejšetrnějších způsobů získávání energie, představuje nový způsob boje proti rostoucímu znečištění každodenní městskou činností, ale také proti stále hrozivějším změnám klimatu. Solární energie, která je stále ještě v počáteční fázi vývoje, se prosazuje nejen v soukromých podnicích či domácnostech, ale i ve veřejném sektoru energetiky, což se projevuje rostoucím počtem fotovoltaických panelů v oblastech, kde má sluneční záření vysoké hodnoty, a solární energie má potenciál stát se doplňkem energetického okruhu městských center nebo dokonce jeho náhradou. V oblasti rumunského pobřeží je sluneční záření extrémně vysoké, což se projevuje obrovským solárním potenciálem, ale také vysokou mírou úspěšnosti realizace projektů tohoto typu energie. Hlavním cílem studie je zjistit potenciál solární energie a názory místních obyvatel na krajinu zaplněnou fotovoltaickými panely, přičemž hlavním cílem studie je zvýšit povědomí o potřebě podpory obnovitelných zdrojů energie a a přijmout krásu udržitelného rozvoje obnovitelných zdrojů energie bez ohledu na dopad na krajinu.

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