SOLARNA ENERGETIKA – STANJE I PERSPEKTIVE

SOLAR ENERGETICS - STATE AND PERSPECTIVES

Zoran STEVIĆ[1,2,*], Predrag STOLIĆ[1] , Ilija RADOVANOVIĆ[2,3], Miša STEVIĆ[4], Zdravko STANIMIROVIĆ[5], Ivanka STANIMIROVIĆ[5]

[1] University of Belgrade, Technical Faculty in Bor, Bor, Serbia
[2] University of Belgrade, School of Electrical Engineering, Belgrade, Serbia
[3] Innovation Center of Faculty of School of Electrical Engineering, Belgrade, Serbia
[4] ELSYS, Belgrade, Serbia
[5] University of Belgrade, Vinča Institute of Nuclear Sciences , Belgrade, Serbia
* Corresponding author's email: zstevic@live.com

Solarni sistemi u poslednje vreme beleže esponencijalni rast instalisane snage. Ostvareni ekonomski efekti podstiču dalji razvoj tehnologije, tako da se postiže sve veća energetska efikasnost uz sve niža investiciona ulaganja. Države dodatno pomažu merama podsticaja, posebno u uslovima krize drugih energenata, tako da se očekuje još veći rast u budućnosti. U radu je dat pregled stanja tehnologije i regulative, kao i projekcije za budućnost u Evropi i Srbiji.

Ključne reči: *Solarni sistemi, energetska efikasnost, pregled stanja, nove tehnologije*

Nowadays, solar systems have recorded in an exponential increase in installed power. The achieved economic effects encourage further development of technology, so that increasing energy efficiency have been achieved with lower investments. Countries additionally help with incentive measures, especially in the states of the crisis of other energy sources, thus the greater growth is expected in the future. The paper provides an overview of the state of technology and legal regulations, as well as projections for the future in Europe and Serbia.

Keywords: Solar systems, energy efficiency, state of the art, novel technologies

1 Introduction

The installed power of RES in the world is growing rapidly (Figure 1) [1]. At the same time, the share of solar systems in the increase in the use of RES is over 50%.

The great penetration of RES is achievable due to the following reasons [2]:

- The sun is practically an inexhaustible source of a large amount of energy;
- Ecological superiority in relation to other sources;
- Favorable climatic conditions in this region;
- Development of new technologies and drop in prices;
- Development of local economy and strengthening of energy independence;
- State support and improvement of legislation.

By passing a law that has as its subject exclusively the issue of RES, the Republic of Serbia shows greater determination towards creating the conditions for the production of electricity from RES on the largest possible scale. In particular, it should be borne in mind that the National Action Plan for the use of RES is planned for the Republic of Serbia to reach a share of 27% of RES in the total gross final energy consumption by 2020 and in 2021 only 20% was reached [3].

This paper provides an overview of the state of technology and legal regulations, as well as projections for the future in Europe and Serbia.

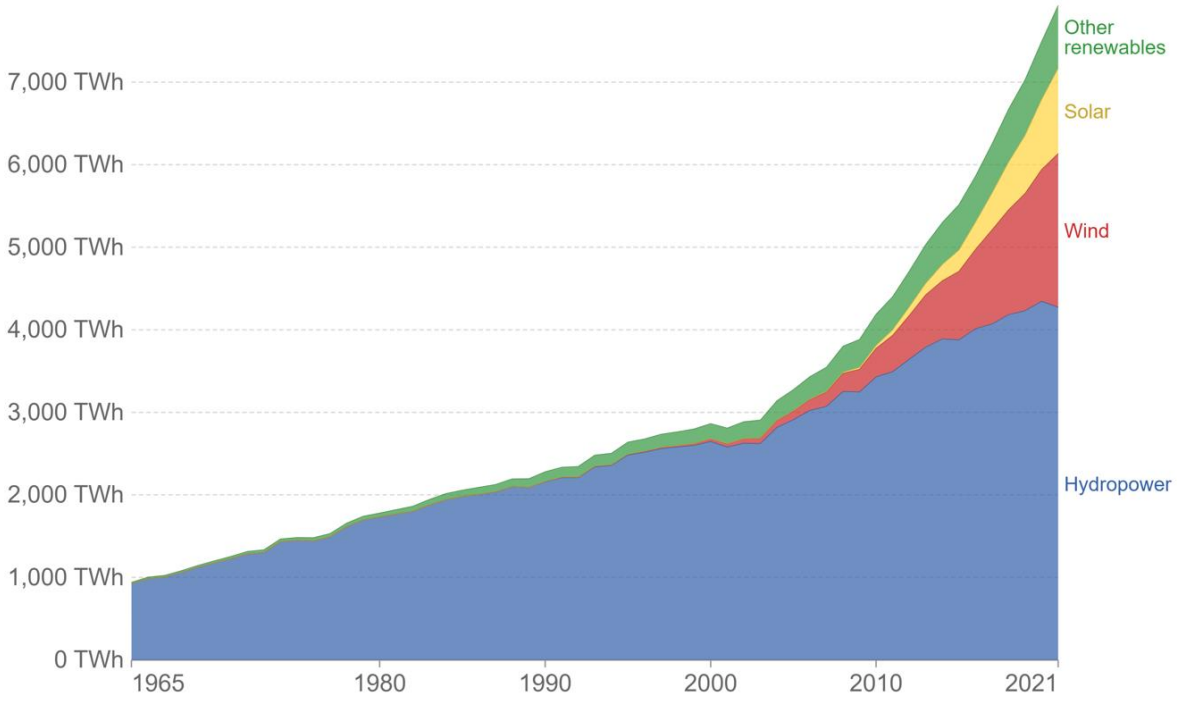

Figure 1. Renewable energy generation in world [1]

2 Status and perspectives

The large increase in RES production in the world is happening thanks to a few countries that recognized in time the ecological, political, and in perspective also economic advantages of such an approach. Figure 2 shows the growth of RES production in the leading countries.

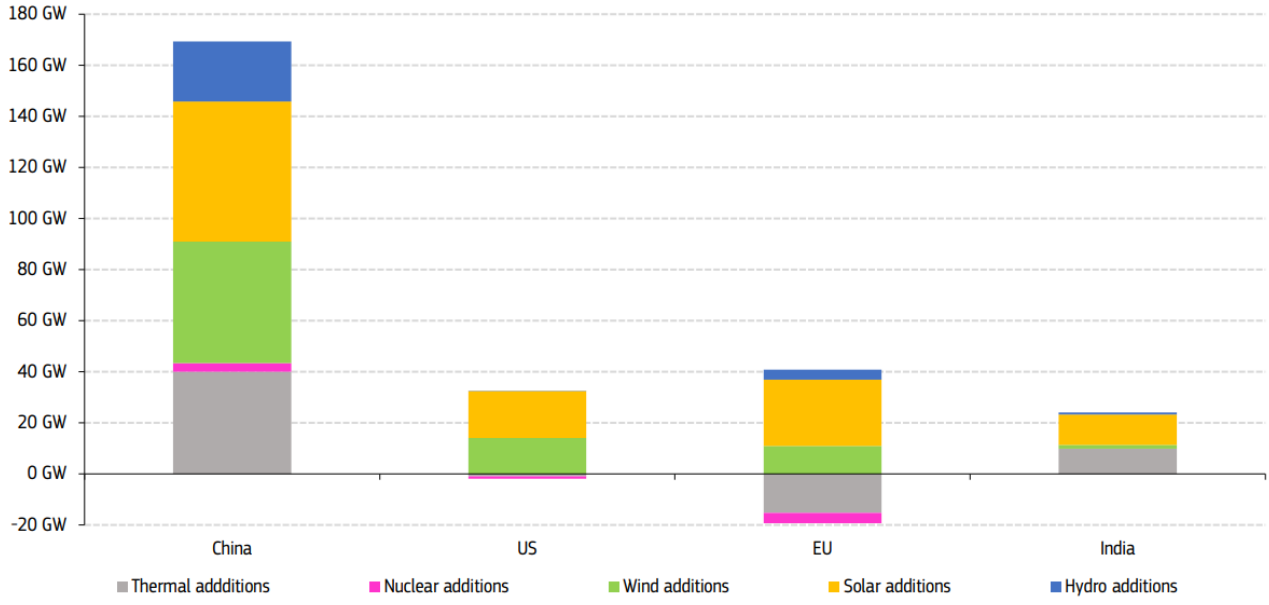

Figure 2. Net capacity additions across major economies in 2021[1]

In the EU, Germany leads the way, with the share of renewable energy reaching almost 50% (Figure 3).

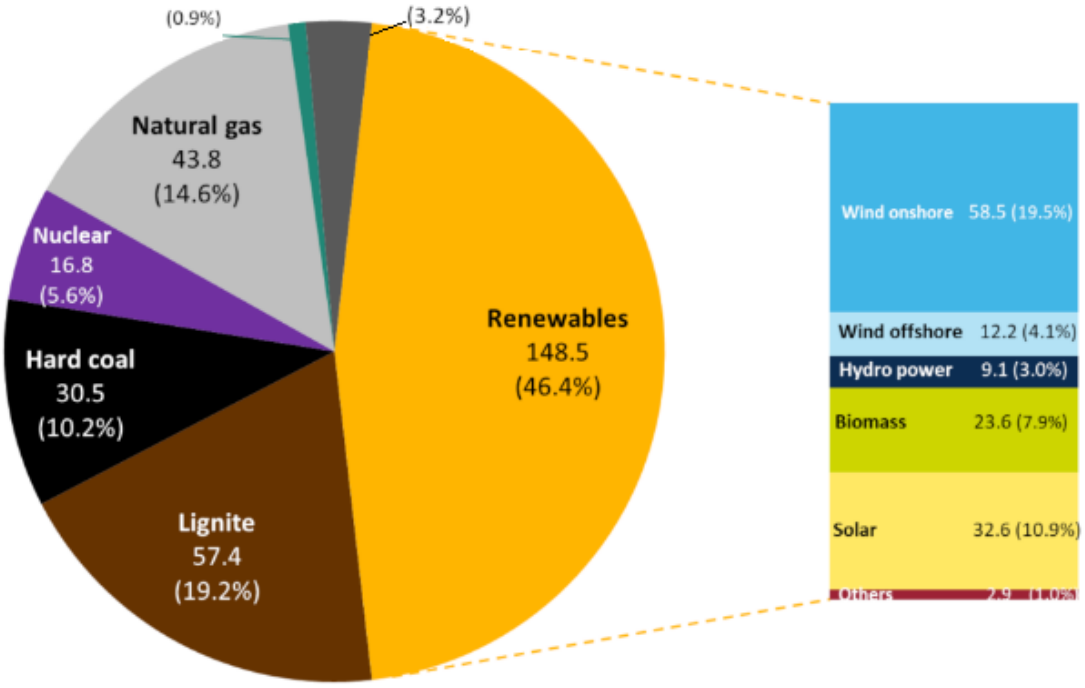

Figure 3. Share of energy sources in gross German power production in H1 2022 [4]

The countries of the SEE region do not follow the sudden trend of increasing the application of RES, despite the clear reasons and conditions for this (Figure 4).

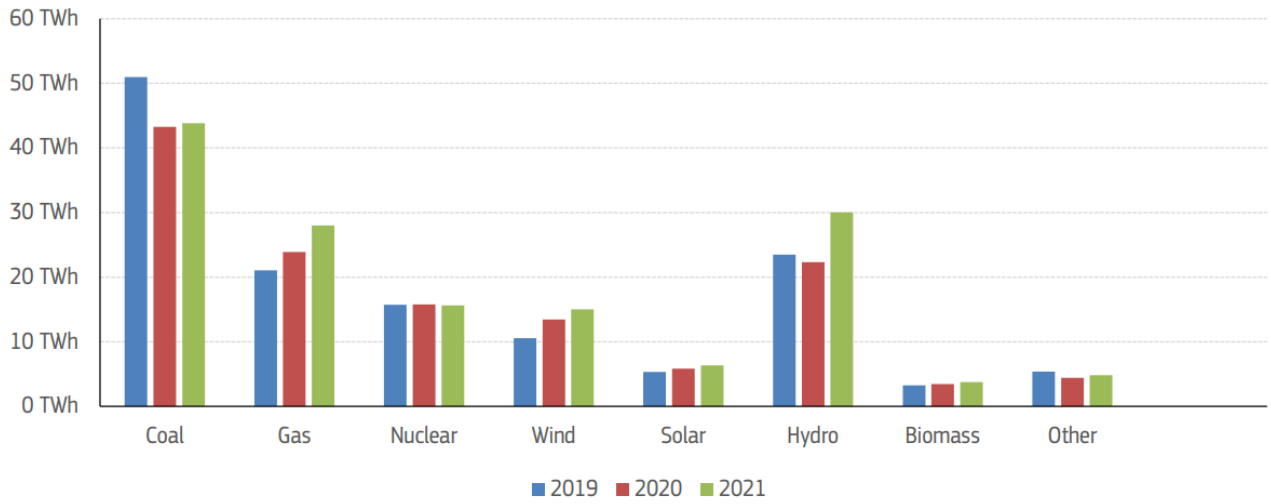

Figure 4. Evolution of the electricity mix in the SEE region in 2019, 2020 and 2021[1]

In Serbia, as a contrast to Germany, the participation of RES is less than planned, and far from desired [5,6] (Figure 5).

3 Law regulation

European countries have introduced different incentive models for energy production from renewable sources. The primary ones are the binding price system, i.e. the *feed-in tariff* (FiT) where the fee is mainly allocated administratively, then the *feed-in premium* system (FiP) where the premium is allocated through an auction, and the binding quota system, *green certificates quota system* [7].

New EC guidelines for the program to encourage renewable energy sources in the EU

Due to the falling costs of renewable sources and other circumstances, the European Commission considered that the time has come to abolish or reduce classic incentives with a guaranteed price,

and for renewable sources to be either fully or partially on the market [7]. As of May 1, 2016, the following principles must be applied to all new programs and incentive measures:

• incentives can be granted as premiums over the market price, whereby producers sell their energy directly on the market (the exception is plants smaller than 500 kW);

• users are subject to standard balancing responsibilities, unless there are liquid daily balancing markets;

• it is necessary to introduce measures to ensure that producers do not have incentives to produce electricity at negative prices.

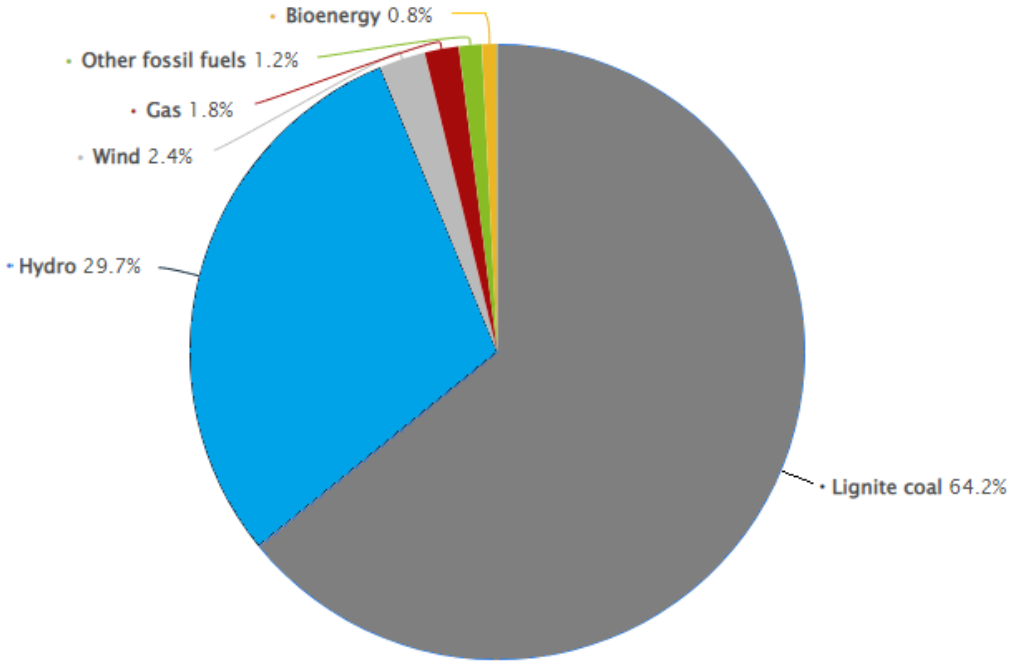

Figure 5. Distribution of electricity generation in Serbia in 2021, by source [6]

Feed-in premiums (FiP) – a market-oriented system for the second phase of the transition

The premium incentive system is cited as an example of a market-oriented incentive system. The privileged producer in that system sells his energy directly on the market and receives an additional amount of premium for it at the price he achieved on the market. Therefore, unlike fixed tariffs, the premium incentive system is more transparent and market-oriented, given that the market price of electricity is part of the total income that privileged producers receive [7].

4 Technology trends

Currently, the maximum efficiency of compound thin film photovoltaic devices is close to 23%, already approaching the technological limit. In order to further increase this value, a combination of solar cells with different spectral sensitivities, called multi-junction device, is necessary. These can convert a higher fraction of the energy of the solar spectrum into electric energy because each individual cell is optimized for a specific part of the solar spectrum. However, these multi-junction devices require new technological solutions like high-efficiency, wide band gap absorbers, transparent materials for charge transport between individual cells, low temperature deposition processes for top cells and absorber materials with matching spectral response (Figure 6) [8]. Technologies with microlenses, bidirectional panels, perovskite technologies are also gaining momentum, but some old ones that have their own advantages are not being abandoned either, for example solar collectors for water heating (Figure 7).

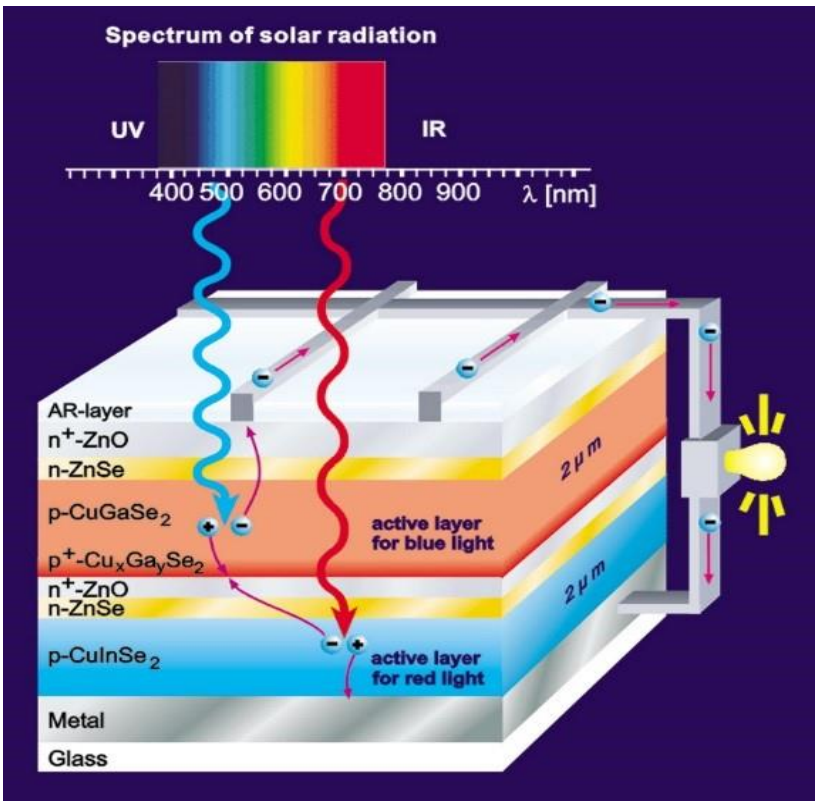

Figure 6. Multi-junction solar cell

Figure 7. Solar collectors for water heating

5 Conclusion

Environmental and geopolitical reasons led to a high demand for solar systems, which required the development of new environmentally and economically acceptable technologies. Most countries in the world support the introduction of RES, both financially and through legal regulations.

6 References

[1] Quarterly report On European electricity markets, Market Observatory for Energy DG Energy, Volume 14 (2021), Issue 4
[2] Čedomir Zeljković, Onovljivi izvori energije – Solarna energetika, Univerzitet u B. Luci, Akademska Misao, 2018
[3] https://www.jpm.rs/wp-content/uploads/2021/04/Law_on_Renewable_Energy_sources.pdf
[4] https://www.cleanenergywire.org/factsheets/germanys-energy-consumption-and-power-mix-chartshttps://www.cleanenergywire.org/factsheets/germanys-energy-consumption-and-power-mix-charts
[5] Serbia Annual Implementation Report, Energy Community Secretariat, 2021
[6] https://www.statista.com/statistics/1237596/serbia-distribution-of-electricity-production-by-source/
[7] https://www.energetskiportal.rs/
[8] Zakon o korišćenju obnovljivih izvora energije, Službeni glasnik RS, broj 40 od 22. aprila 2021
[9] https://www.helmholtz-berlin.de/projects/pvcomb/forschen/cigs/cigsmulti_en.html