Financing of Wind Energy Projects in Serbia: Current Status and Future Prospects

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Abstract In recent years, renewable energy deployment is becoming an important goal for increasing number of countries including Serbia. Owing to an outdated energy infrastructure that is inherited from Socialist Federal Republic of Yugoslavia and a slow pace of energy transition, approximately 66% of Serbia's electricity is still generated by coal-fired power plants. Serbia's energy strategy is oriented toward clean energy, whereby wind energy has increasing role for energy transition. This study investigates the current practice of wind energy project finance in Serbia based on a case study approach. We conclude that significant progress has been made over the last decade. However, future development is strongly dependent on the update of national legislation, energy sector stability and the availability of suitable financing sources to support new projects.

Keywords: • renewable energy • energy transition • energy investment • project finance • project risk

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1 Introduction

To reduce greenhouse gas emissions and energy dependency, the European Union (EU) and non-EU countries have committed to enhancing energy production from renewable energy sources (RES). According to Eurostat data (2022) the share of energy from RES reached 22% in gross final energy consumption at the EU level in 2020. In Europe, Iceland accounts for the highest RES share (84%) followed by Norway (77%), Sweden (60%) and Finland (44%). At the bottom of RES share in energy consumption are Bulgaria (13%), Hungary (12%) and the Netherlands (11%).

With 17 GW of new wind capacity addition and 236 GW of total wind capacity (207 GW and 28 GW is onshore and offshore wind capacity, respectively) wind energy satisfies 15% of Eruope's electricity demand in 2021. Traditionally, wind capacity in Europe is highest in Germany, followed by Spain, the United Kingdom, France, and Sweden. Countries with more than 5 GW installed capacity are Italy, Turkey, the Netherlands, Poland, Denmark, Portugal, and Belgium (WE, 2022a). The size of turbines installed in Europe varies from the average of 2.6 MW in Greece to 5.1 MW in Turkey. The data for the most contributing countries in Europe with the respect to wind energy are presented in table 1.

Table 1: Wind capacity in Europe for selected countries (WE, 2022a)

Country	Capacity (GW) in 2021	% of electricity production	Expected capacity (GW) in 2025
Germany	64	23%	85
Spain	28	24%	36
United Kingdom	26,7	22%	42
France	19	8%	31
Sweden	12	19%	19
Italy	11	7%	14
Turkey	11	10%	16
Netherlands	8	15%	13
Poland	7	9%	11
Denmark	6	44%	8
Portugal	6	26%	6
Belgium	5	13%	7

According to Spasenic et al. (2022a), energy infrastructure of post-Yugoslav countries is inherited from Socialist Federal Republic of Yugoslavia, and it was dominantly relied on outdated coal-fired thermal power plants. Consequently, the most of electricity in Serbia is generated from conventional energy sources such as fossil fuels (>68%), followed by RES such as hydropower (27%) and wind (2,5%) while the reminder is produced by combined heat and power plants and small power plants. Đurašković et al. (2021) emphasized that Serbia has significant RES potential that consist roughly of 63% of biomass, 14% of hydropower, 14% of solar energy, 5% of wind energy and 4% of geothermal energy.

The early research on wind power capacity in Serbia dates back in 2002 and it is conducted for the needs of the Electric Power Industry of Serbia. The research is based on measurements of wind speed from 20 meteorological stations. In 2008, the first *Wind Atlas of Serbia* is prepared by Faculty of technical sciences, University of Novi Sad and it in details covers the territory of Vojvodina (Faculty of Technical Sciences, 2008). According to the *Atlas*, the best wind energy potential exists in Pannonia lowland north from Danube and Sava rivers, East Serbia (Stara planina, Vlasina, Ozren, Rtanj, Deli Jovan, Crni Vrh) and mountain areas in West Serbia (Zlatibor, Kopaonik, Divčibare). Additional study from 2011 focused on 16 potential macro locations and showed that Serbia could produce ~50% of the annual energy needs from RES and stressed that wind energy parks and small hydropower plants are the most cost-effective facilities for RES deployment (Potić et al., 2021). The prevailing conclusion based on conducted studies is that the majority of wind energy potential exist in Vojvodina (North Serbia) and East Serbia (around Municipality of Knjaževac).

Despite significant wind energy potential there are only 8 operational wind power parks in Serbia with total combined capacity of 398 mW. Devreč 1 is the first wind park consisting of only one wind turbine that is installed in Leskova village, municipality of Tutin. The turbine is installed in 2012. The first Serbian wind park that has more than one turbine was built near the city of Kula in 2016 while significant wind capacity is added in 2019 when 3 new parks are constructed.

While there are numerous studies that deal with wind energy potential in Serbia and evolution of national legislation (see Literature review section), the literature is very scares on current practice related to financing of wind energy projects in Serbia. Following the identified research gap, this study contributes to the existing literature in at least twofold: (*i*) it offers a detailed overview of the current wind farms in Serbia from the perspective of financing sources used for development and (*ii*) it confirms the importance and contribution of project finance structure for RES harvest, particularly wind energy, in developing countries.

After the introduction, the reminder of this paper is divided into following four sections; Section 2 is literature review; Section 3 explains the research method in detail; Section 4 analyzes the existing wind energy projects in Serbia according to the chosen criteria; finally, the last section presents conclusions, policy implications and research limitations.

2 Literature review

The public company Electric Power Industry of Serbia (EPS) is the trailblazer in wind energy research. The study from 2002 showed that Serbia has considerable potential for wind farms development (Zlatanović, 2009). On contrary, scholarly interest in wind energy potential in Serbia intensified during the last decade.

The research of Golusin et al. (2010) showed that geothermal energy and energy from biomass in Serbia might be considered as priority while other RES are also available for deployment but would require substantial foreign investments that may be attracted by stimulative and updated legislation. Many other studies show that the current potentials for energy production from RES in Serbia, and particularly from wind, are favorable. Micić et al. (2014) and Pekez et al. (2016) confirm that region of Vojvodina has the highest wind power potential. Similar conclusions are derived by Đurišić & Mikulović (2012) who showed that the region of South Banat in Vojvodina has good wind energy potential that must be utilized with future energy infrastructure development. The model that helps investors to choose the optimal micro-location for the installation of wind power plant is developed by Gigović et al. (2017). According to multicriteria optimization model, the authors claim that the most favorable locations are in the vicinity of the Laudonovac village while additional area of 321 km^2 in Vojvodina has considerable potential for the development of wind farms.

While Vojvodina region is undoubtedly in research focus when searching for the most suitable locations for the installation of wind turbines, Potić et al. (2021) combined analytic hierarch process and geographic information system to identify the most appropriate macro sites in Municipality of Knjaževac. Contrary to the results of previous studies, the authors revealed very limited and geographically narrow wind potential to produce energy confirming that Vojvodina has the strongest wind potential in Serbia.

Except obvious positive impacts on energy mix and reduction of greenhouse gas emission, wind energy deployment may cause damage on the environment and society. The possible impacts during the construction and exploitation phase of wind farm with special focus on environmental impact sare analyzed by Josimović & Pucar (2010) and Josimovic et al. (2014). The authors indicated that the greatest impact of wind farms is on the most frequent species of birds flying at critical heights over the area of where wind turbines are installed. Project design (i.e. optimal micro-location of wind turbines within the boundaries of wind park) is of paramount importance to develop environmental friendly plant that is, at the same time, able to maximize energy production.

Legal framework is thoroughly analyzed by Ljubojev et al. (2018). The study is focused on the harmonization of Serbia's legal framework with EU countries as well as RES targets accepted from international documents ratified as a part of EU integration process. Research results show that utilization of wind energy in Serbia is insufficient due to numerous economic, political, and social barriers. The authors believe that there are enough prospective investors, but they are faced with unfavorable investment environment that may be improved only if multidimensional set of measures is employed such as legal and administrative measures, financial measures, awareness raising and permanent education. Certain progress is made during the last decade but significant room for improvement in legislative framework still exist (Sabic et al., 2017).

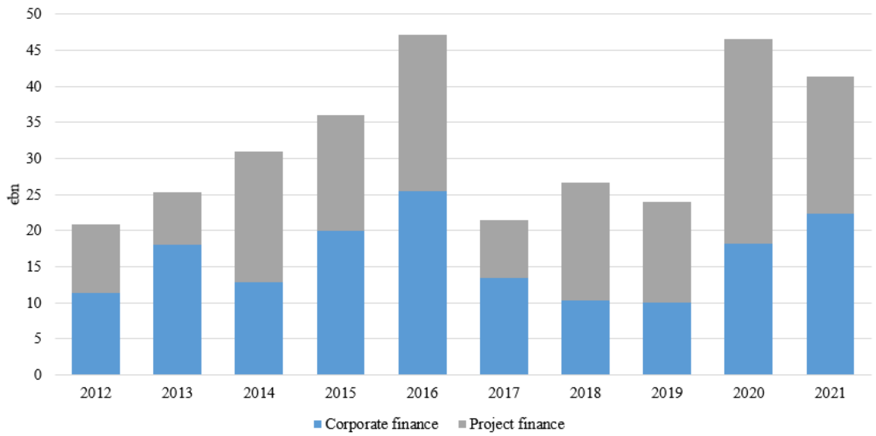
More recent studies deal with the other aspects of wind energy utilization. Podrascanin & Djurdjevic (2020) analyzed the influence of future climate change on wind energy potential and showed that the annual wind speed will decrease in Serbia compared to period 1971-2000 that was used as a reference. Again, Josimović et al. (2021) stressed the importance of strategic environmental assessment in the early stages of project development to successfully identify and manage environmental risks. While the environmental concerns of wind projects are becoming more important globally (Hamed & Alshare, 2022) in Serbia it seems that other RES such as small hydropower plants are in more severe conflict with the nature (Spasenic et al., 2022; Spasenic et al., 2022a).

Based on literature review it may be concluded that the main research streams are related to the optimal choice of location for wind farm and the evolution and status of national legislation. The study that deals with financing of wind projects is done by Loncar et al. (2017). The authors employed compound real options valuation for investment project appraisal. To the authors best knowledge there are no studies that deal with the current practice of wind energy projects financing in Serbia.

3 Methods

Two main financing structures for RES projects are corporate finance and project finance (Steffen, 2018). In corporate finance transaction a company raises the capital on its own balance sheet to finance the construction of a wind farm. On contrary, project finance is non-recourse financing that is completely dependent on project performances. It means that the creditor is relied on the revenues generated by a single project as the only source of loan repayment (Spasenić et al., 2022). In Europe, corporate finance accounts for 50-70% of the capital raised for onshore wind farms and 10-30% for offshore wind farms. Generally, offshore wind farms are much larger than onshore wind farms what makes them to be better candidates for project finance. This stands because only minority of prospective developers can obtain the necessary funds on their own balance sheet (Barroco & Herrera, 2019). The share of corporate finance and project finance in financing wind energy projects in Europe is shown in figure 1.

Figure 1: Wind corporate and project financing in Europe 2012-2021 (WE, 2022a)



Project finance has increasing contribution to RES financing (Elie et al., 2021; Spasenic et al., 2022b). A typical structure of project finance in Serbian market includes a project company which will be the formal legal owner of the power plant and project finance debtor. Project finance in Serbia may be divided in 4 general phases.

A. The first phase includes the analysis and final selection of the location for wind farm plant and acquiring all the necessary permits, licenses, and approvals from competent government authorities. The complete set of documents includes, but it is not limited to, technical documentation (feasibility study, conceptual design, and main design), energy permit and construction permit.
B. The second phase is related to financing. The SPV, which is the owner of previously obtained permits submits a credit request for project financing of the plant. The creditor decision depends on the outcome of credit risk analysis. If project finance is supported the collateral is established on behalf of the creditor – a mortgage on the facility under construction and a pledge on future equipment and receivables. Most commonly, no third parties nor property outside of project structure is offered as collateral.
C. The third phase includes construction works in compliance with the construction permit. When plant is constructed, an operation permit should be obtained.
D. The fourth phase is exploitation phase. Upon obtaining operation permit, the investor applies for the status of a privileged power producer and concludes a power purchase agreement. The agreement is pledged on behalf of creditor and the produced electrical power is sold an charged at agreed terms.

The above-described project finance structure in Serbia is in line with the research of Barroco & Herrera (2019) according to which financing in emerging economies may be considered as project finance only if it meets the following five criteria: (*i*) there is a project company, (*ii*) the debtor is project company and not another entity such as mother company or affiliated company, (*iii*) the loan is non-recourse or limited recourse to related or third parties, (*iv*) credit collateral is project property, movable and immovable and (*v*) financing is classified as a project finance by a creditor. In case that some of those conditions are not met, the financing should be considered as corporate finance.

Following the approach of Spasenic et al. (2022a), we applied three out of five criteria defined by Barroco & Herrera (2019) that might be validated based on publicly available data to confirm if financing structure is project finance or corporate finance. *First*, if revenues of an operating plant are generated exclusively from sales of electricity it is strong evidence that the plant is SPV. *Second*, if bank loan is posted as balance sheet liability, we will consider that SPV is debtor. *Finally*, if property (i.e. equipment) and power purchase agreement are pledged by the bank it is concluded that the third condition related to collateral structure is fulfilled. The remaining two conditions (non-recourse or limited recourse nature of the loan and loan classification by the creditor) could not be validated based on publicly available data but, in our opinion, those conditions do not endanger the economic substance of project finance structure.

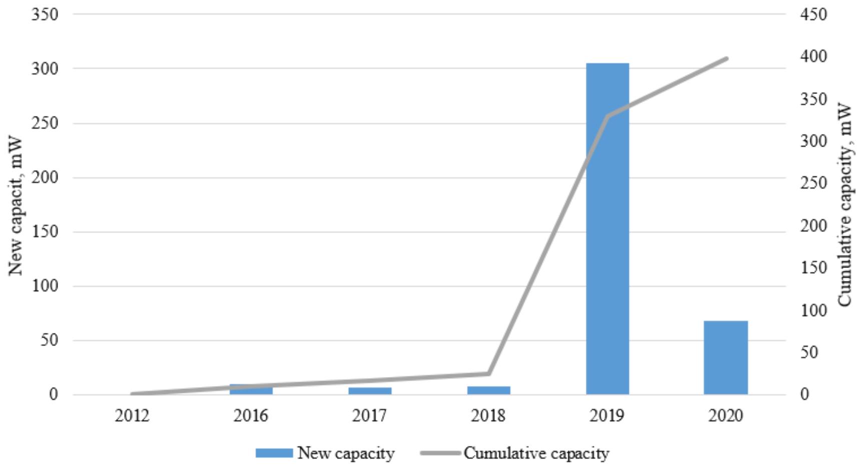
The main sources of information are: (*i*) Serbian Business Register Agency that provides comprehensive database of companies, financial statements and notes to the financial statements, pledges over movable property and rights, (*ii*) https://www.checkpoint.rs/ platform that provides similar information as Serbian Business Register Agency (because it is used as one of sources) but offers additional set of information such as litigations and its outcomes or the list of issued bills of exchange, (*iii*) EPS' reports about the incentives paid to privileged electricity producers, (*iv*) wind energy companies' reports, and (*v*) articles in press.

4 Results

As mentioned above, the first wind park in Serbia is Devreč 1 with one wind turbine and installed capacity of 0,5 mW. The park is operative from 2012. The investor is Hidrowind limited liability company while total investment was ~1 million EUR and it is primarily financed from long term cross border loan – no more details are available. Having in mind that we found no pledges over company's property while there is almost no loan repayment since 2012 it may be concluded that provided loan is quasy equity. The financing structure is more like corporate finance than project finance.

Starting from 2016 there is more investments in wind energy infrastructure. A stronger investment cycle is started by the construction of wind park Kula, followed by La piccolina in 2017, Malibunar in 2018, Kovačica, Alibunar and Čibuk 1 in 2019 while the last project Košava is finished in 2020. New installations and total (cumulative) wind capacity are presented in figure 2.

Figure 2: New installations and cumulative wind capacity 2012-2020



Installed capacity of new investments varies from 6,6 mW for La piccolina to 158,5 Mw for Čibuk 1 which is at the moment the largest operative wind farm in Serbia. Consequently, total investment cost varies from 9 million EUR for La piccolina to 300 million euros for Čibuk 1. Applying the criteria defined in previous section yielded to the conclusion that all new wind developments are financed though project finance scheme. Data are summarized in Table 2.

Table 2: Financing wind capacities in Serbia

Project	Year	Location	Capacity in mW	Number off turbines	Financing structure	Creditors
Devreč 1	2012	Leskova, Tutin	0,5	1	CF	/
Kula	2016	Kula, Vojvodina	9,9	3	PF	Erste bank
La piccolina	2017	Vršac, Vojvodina	6,6	2	PF	UCI bank
Malibunar	2018	Alibunar, Vojvodina	8,0	4	PF	UCI bank
Kovačica	2019	Kovačica, Vojvodina	104,5	38	PF	Erste group EBRD
VE Alibunar	2019	Alibunar, Vojvodina	42	41	PF	UCI bank IFC
Čibuk 1	2019	Mramorak, Vojvodina	158,5	57	PF	EBRD, IFC
Košava	2020	Izbište, Vojvodina	68	20	PF	Erste group UCI group OeEB

Based on the data presented in table 2 the following conclusions may be derived:
1. The projects are concentrated in Vojvodina while the rest of Serbia remains neglected so far. This is in line with literature review section and findings of existing studies whose research focus is on geographical distribution of wind energy potential in Serbia.
2. All multi-turbine wind parks are financed through project finance structure. All project companies are established as limited liability companies except MK-FINTEL WIND joint stock company that is owner of Košava project.
3. Increasing the project cost that directly depends on project capacity requires involvement of foreign banks and international financing institutions. Local banks were focused on smaller projects (up to 10 mW capacity; up to 15 million EUR investment). Massive project are financed through syndicated loans with involvement of domestic and local banks that are part of the same banking group (Erste group, UniCredit group) and international financing institutions such as European Bank for Reconstruction and Development (EBRD), International Finance Corporation (IFC) and Austrian Development Bank (OeEB).
4. The most active local banks are Erste bank Serbia and UniCredit bank Serbia (UCI). This is in line with recent research that confirm activity of Erste bank and UCI in RES financing (Spasenic et al., 2022; Spasenic et al., 2022a). In Europe, the most active banks/financial institutions are Santander bank, UniCredit bank and ING group.

5 Conclusions

Wind farms are efficient way to increase electricity production from RES. Global growth of wind energy deployment did not bypass Serbia. With the aim to attract more investors, Serbia subsidized electricity from RES through a feed-in tariff system with a guaranteed purchase period of 12 years. The model of fixed purchase price is changed by auction model in 2022. As a result of state support and continuous changes in legal framework total installed capacity from wind energy increased from 0,5 mW in 2012 to 398 mW in 2020. Given the relatively underdeveloped financial market, the prevalent source of financing of wind farms are investor's equity contribution and bank loans extended through the project finance scheme.

The overall result of our study is that there is strong potential for energy production from RES that is large enough as substitution for fossil fuels. It is still open to discuss the adequate strategy for RES deployment and RES mix that is optimal for Serbia to provide stable energy supply. However, some challenges for more intensive RES deployment that are immanent to developing countries still remain (Pekez et al., 2016; Sredojevic, 2017; Josimović et al., 2021): (*i*) understanding of risks, their identification and proper allocation in the project finance structure, (*ii*) reliability of information and statistics for

RES, (*iii*) absence of a coherent RES policy, complex and changing legislation and (*iv*) environmental issues not properly assessed at the early stage of project development.

In the contest of RES financing, it is worth of mentioning the existence of the possibility of the public-private partnerships and concessions. This is a opportunity for the public sector to implement projects of public interest (including capital investment in RES capacities) engaging resources, technology, know-how and capacities of the private sector, of domestic or foreign origin (Sredojevic, 2016; Sredojevic, 2017). However, the further development of such projects is strongly dependent on banks' willingness to provide financial support through project finance scheme (Sredojević, 2016a). Also, certain improvements must be made in legal framework especially in (*i*) environmental protection, (*ii*) issuance of construction permits and (*iii*) adoption of bylaws that will precise and streamline the exploitation of RES.

The study has certain limitations which indicate potential directions for future research. First, the study is focused on wind energy in Serbia. It would be interesting to compare Serbia and neighbor countries with similar development of financial markets and similar availability of financing sources. Second, the study provides general overview of wind energy development in Serbia. Examining RES deployment from the perspective of specific stakeholder (for instance, developers or creditors) would provide valuable insights into the main barriers for future developments. Third, the study is limited to wind energy projects. Future research should analyze other RES project to more reliable predict expected capacity development and financing needs. Fourth, the study is based exclusively on secondary and publicly available data.

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