

ORIGINAL SCIENTIFIC PAPER

Energy transition, coal and EU integration in Bosnia and Herzegovina and Serbia

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Abstract

This paper analyzes the perspectives of energy transition in Bosnia and Herzegovina and Serbia within the context of European integration, with a particular focus on the role of coal and the thermal power sector. The main hypothesis is that the transition can be accelerated without jeopardizing energy security, provided that socially just measures are implemented and investments are made in renewable energy sources. The methodological framework includes an analysis of strategic and legal documents, a comparative review of energy policies, and an empirical survey conducted among thermal power plant workers. Survey results show that employees still perceive coal as a key energy resource, but they also express readiness to participate in training and requalification programs, which confirms the potential for a just and sustainable transition. The conclusion emphasizes that alignment with EU norms and climate policies is essential, but it must be achieved while preserving energy stability and the socioeconomic security of local communities.

Keywords: coal, energy transition, thermal power plant, European Union, Bosnia and Herzegovina, Serbia

1. INTRODUCTION

Coal has been the backbone of the energy sector in the Western Balkans for decades, particularly in Bosnia and Herzegovina and Serbia, where coal-fired power plants play a central role in electricity production. While this energy mix ensures supply stability and supports the economy, it raises serious concerns about sustainability, environmental protection, and alignment with European and global climate targets. The gradual phase-out of coal, commonly referred to as energy transition, has become one of the most pressing challenges for both countries on their path to EU membership.

Despite numerous strategic documents and plans promoting renewable energy, coal-fired power plants continue to form the core of the energy system. These plants not only provide the majority of domestic electricity but also employ large numbers of workers and contribute significantly to local economies, especially in regions dependent on mining and coal-based energy production. Therefore, energy transition cannot be considered merely a technical or environmental process; it is a

socio-economic challenge that requires careful planning, responsible policy-making, and fair compensation for affected communities and workers. Another important aspect is the geopolitical dimension of energy transition, since both countries face the dual challenge of aligning with EU climate policies while maintaining regional energy stability in the Western Balkans.

This paper aims to analyze the prospects of energy transition in Bosnia and Herzegovina and Serbia from the perspective of supply security, environmental responsibility, and social justice. Special attention is given to realistic timelines for coal reduction, compliance with European integration processes, and the readiness of the energy sector to respond to transition requirements without endangering jobs or energy stability. The study relies on the analysis of strategic and legal documents, a comparative review of policies in the two countries, and relevant academic and professional literature. By combining these approaches, the paper seeks to provide a comprehensive overview of the challenges and opportunities of energy transition in Bosnia and Herzegovina and Serbia.

1.1. Legal and Strategic Framework of Energy Transition in Bosnia and Herzegovina and Serbia

Bosnia and Herzegovina, as a signatory to the Energy Community Treaty, has undertaken the obligation to align its energy legislation with that of the European Union (EU), which includes market liberalization and the promotion of sustainability ([Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina 2018](#)). The planning and implementation of the energy transition in Bosnia and Herzegovina is based on the conclusions of the 16th Ministerial Council meeting of the Energy Community (November 2018), where member states committed to preparing integrated climate and energy plans for the period 2021–2030 by 2019 ([NERDA 2019](#)). The primary goal is to ensure sustainable development through the use of renewable energy sources (RES), while maintaining fiscal responsibility and compliance with European standards. However, the lack of a unified energy policy framework at the state level continues to slow down implementation, creating discrepancies between entities and delaying full compliance with EU directives.

Despite some efforts toward decarbonization, Bosnia and Herzegovina still relies heavily on coal as its main energy resource. According to the Agency for Statistics of Bosnia and Herzegovina, total coal production in 2023 exceeded 13 million tons, with lignite accounting for 51% and hard coal 40.5% of total energy consumption ([Agency for Statistics of Bosnia and Herzegovina 2024](#)). This energy structure further complicates the implementation of green policies and alignment with EU climate goals.

The regulatory framework in Bosnia and Herzegovina acknowledges the role of end users in the transition toward sustainable energy. Consumers have the right to connect RES installations for self-consumption, subject to installed capacity limitations. They also have access to net metering and the possibility of forming Renewable Energy Communities (RECs), which can produce, consume, and exchange energy. However, access to incentives differs among the entities, while the Brčko District applies more restrictive rules compared to the Federation of Bosnia and Herzegovina and Republika Srpska. The distribution system operator plays a key role in this process, being responsible for grid connections, billing, and balancing electricity production and consumption.

Even without a detailed analysis, it is evident that energy transition in Serbia lags behind EU member states. Its content is still not sufficiently harmonized conceptually or officially, and is often not publicly available, even to those most affected — employees in energy companies ([Đukić 2022](#)). Compared to Bosnia and Herzegovina's complex governance system, Serbia's energy transition occurs within a centralized regulatory framework,

allowing for more efficient implementation of legal and strategic measures.

Serbia has initiated the process of aligning national legislation with EU law, giving priority to establishing monitoring, reporting, and verification (MRV) systems ([Mirković & Lukić 2018](#)). The Serbian legal framework largely relies on EU strategic directions. The Just Transition Mechanism and the “Fit for 55” package provide the main instruments for reducing greenhouse gas emissions and gradually steering the energy sector toward climate neutrality ([Privredna komora Srbije 2023](#)).

These instruments also serve as a basis for defining domestic reforms aimed at aligning with EU policies and modernizing the regulatory framework. A significant legal step in this regard was the adoption of the Law on the Use of Renewable Energy Sources, effective from April 30, 2021. This law, the first *lex specialis* in the field of RES, introduced a set of market-oriented incentive mechanisms ([Rajić, Veljović, & Savičić 2023](#)). Although the law envisages subsidies, producer balancing responsibilities, and the role of prosumers, its full implementation has been delayed due to the late adoption of secondary legislation — specifically the decrees governing the status of prosumers and the criteria for market premiums (auctions) — as well as certain inconsistencies with the main Energy Law.

Each country develops national plans and strategies that define how energy transition will be implemented in practice. These plans include targets for reducing harmful gas emissions, promoting renewable energy, and adapting to new climate conditions. In this way, Bosnia and Herzegovina and Serbia set clear directions and measures to align with broader international and European climate policies. By harmonizing with the EU legal framework and Energy Community requirements, Bosnia and Herzegovina and Serbia are gradually building the regulatory, technical, and institutional prerequisites for a transition to climate-neutral and sustainable energy systems.

1.1.1. Current Status and Role of Coal in the Thermal Power Sector

Coal continues to play a dominant role in the thermal power sector of Bosnia and Herzegovina, as evidenced by high production rates and intensive use in fossil-fuel power plants. In 2023, Bosnia and Herzegovina produced a total of 13,074,737 tons of coal, 6,684,659 of which were lignite, and the remaining 6,390,078 tons were hard coal ([Agency for Statistics of Bosnia and Herzegovina 2024](#)). The majority of the produced coal is consumed by the energy sector, with lignite accounting for 51% and hard coal for 40.5% of total consumption. Coal mining is concentrated in mining-energy basins across both entities. In the Federation of Bosnia and Herzegovina, the most

significant mines are Kreka, Đurđevik, Banovići, Kakanj, and Zenica, whereas in Republika Srpska, key mines are technically and operationally linked to the thermal power plants in Ugljevik, Gacko, and Stanari. This organizational structure illustrates the strong interdependence between mining and coal-based electricity production, making the thermal power sector one of the main pillars of the country's energy balance.

The major thermal power capacities in Bosnia and Herzegovina include the Ugljevik, Gacko, Stanari, Tuzla, and Banovići power plants. These facilities rely exclusively on domestic coal, ensuring a high degree of energy self-sufficiency, but also complicating the transition toward cleaner energy sources.

In Serbia, coal production remains a key component of the energy sector, with over 30.7 million tons produced in 2024, primarily from the Kolubara and Kostolac basins (Elektroprivreda Srbije 2024, p. 3). According to the same EPS data, thermal power plants under EPS management — including Nikola Tesla A and B, Kolubara, Kostolac A and B, and Morava — have a total installed capacity of 4,360 MW and contribute 21,274 GWh to total electricity production. Open-pit mining reached 103.7 million m³, reflecting intensive resource exploitation to maintain energy stability. Serbia continues to rely on coal as the primary energy source in its thermal power sector.

Thus, it is evident that Bosnia and Herzegovina operates predominantly through interconnected mining-energy systems at the entity level, whereas Serbia relies on a centralized model of large thermal blocks managed by EPS, with a substantially higher production volume.

1.2. Challenges of Just Transition from Coal to Renewable Energy Sources

1.2.1. Strategic, Institutional, and Regulatory Challenges

The energy transition in Bosnia and Herzegovina and the Western Balkans represents a complex process that requires alignment of national policies with international obligations, economic realities, and environmental protection goals. Key demands emerging from civil society campaigns directed at competent institutions emphasize compliance with international commitments, the incorporation of full energy costs (including environmental and health impacts) into economic analyses, and the cessation of new coal power plant construction in favor of improving energy efficiency and promoting renewable energy sources (Center for Environment 2020).

The energy sector in Bosnia and Herzegovina is not merely a market activity but is also heavily influenced by

geopolitical and political factors. Therefore, a clear strategic vision and alignment with EU directives and climate policy goals are essential. As a signatory of the Energy Community Treaty, BiH is obliged to implement European legislation in the fields of energy and environmental protection. Moreover, due to the significant economic role of the EU as a partner, Bosnia and Herzegovina needs to accelerate the process of green energy transition to keep pace with European trends and achieve sustainable development.

Historically, the EU has evolved from a Coal and Steel Community into a global leader in climate change mitigation, illustrating the importance of aligning energy and environmental policies. The EU has set ambitious targets for reducing greenhouse gas emissions, increasing the share of renewable energy sources, and improving energy efficiency, providing a clear framework that Bosnia and Herzegovina can adopt to ensure a just and economically sustainable energy transition. Mechanisms such as the EU Emissions Trading System (EU ETS) and other EU climate tools serve as models for policies that should be implemented in Bosnia and Herzegovina to facilitate a fair transition. It is also important to note that in Republika Srpska, as well as across Bosnia and Herzegovina, various incentives exist for renewable energy production.

In the context of the energy transition, specific challenges in Serbia must also be considered. Numerous professional and academic forums, business meetings, and other channels have highlighted the state of coal exploitation in Serbia (Stjepanović, Đukanović, & Stjepanović 2012). Long-standing stagnation and technological lag in Serbia's mining sector represent obstacles to a just transition toward renewable energy sources. Modernization and restructuring of the mining industry are necessary, but must be aligned with decarbonization goals while ensuring a socially just exit from coal dependence for workers and local communities.

1.2.2. Social and Economic Aspects of a Just Transition

A just transition places social dialogue at its core, emphasizing the creation of new jobs in emerging green sectors, the greening of existing coal-sector jobs, providing workers with access to education and training to acquire skills necessary for employment in a decarbonized economy, ensuring social security through active labor market policies and social protection measures, as well as significant financial investments to establish the foundation for new industries and the transformation of existing ones (Čavor Milev 2022). In regions highly dependent on coal, such as Gacko in Bosnia and Herzegovina and Lazarevac

in Serbia, decarbonization carries the risk of significant job losses and potential economic destabilization.

The lack of developed infrastructure for the production and distribution of renewable energy further slows the transition and increases energy insecurity. The social and political context in Serbia remains fragile, limiting the development and widespread deployment of green energy technologies, while human resources are either unprepared or insufficient for the production and implementation of innovations (Grčić 2024). Consequently, the social consequences of changes in Serbia's energy sector are multifaceted. One aspect relates to the new energy system and pricing mechanisms, which are shaped by updated energy policies and legislation. Another aspect concerns employment, wages, and the standard of living of people, primarily employees in energy companies and their families (Ministry of Mining and Energy of Serbia 2024).

Resistance to energy reforms may also arise from social, economic, and political levels, particularly when local communities feel excluded from decision-making processes. Therefore, the concept of a just transition becomes a crucial tool, entailing measures that ensure no community is marginalized during the process of energy change. EU funds, such as the Just Transition Fund, can play a decisive role in financing worker retraining, developing new infrastructure, and mitigating the social costs of coal phase-out. The challenges of a just transition involve balancing energy security, environmental protection, and the socio-economic needs of local coal-dependent communities. An approach that considers these aspects enables sustainable and inclusive development of the energy sector in Bosnia and Herzegovina, Serbia, and the broader region.

1.3. Strategic Pathways for Energy Transition: Outlook for 2030 and 2050

Complete phase-out of coal in electricity production by 2030 in Bosnia and Herzegovina and Serbia is not realistic given the current energy production structure, the technical and institutional limitations of the system, and the high level of social and economic dependence on the coal sector. Although European policies and the Green Deal have set ambitious goals, a more realistic timeline for the complete shutdown of coal-fired power capacities in the Western Balkans is between 2040 and 2050, provided that the transition begins decisively and strategically during this decade (Gvero 2023). Three main scenarios for the energy transition in Bosnia and Herzegovina and Serbia can be outlined, each comprising several complementary pathways.

The **first scenario** involves the gradual closure of coal-fired power plants, starting with the oldest, least ef-

ficient, and most environmentally burdensome plants, accompanied by mandatory social plans for affected workers and communities. Implementing such social programs and severance packages requires significant financial allocation, potentially supported by the EU's Just Transition Fund, with estimates for similar regions in transition indicating costs of several hundred million euros for comprehensive labor market adaptation.

The **second scenario** focuses on upgrading existing coal plants through decarbonization measures, i.e., implementing modern technologies to increase energy efficiency and reduce greenhouse gas emissions. Specific technical measures include the installation of advanced flue gas desulfurization (FGD) systems and the introduction of biomass co-firing, which can reduce CO₂ emissions by up to 10–15% with relatively moderate capital investment compared to building new capacities.

The **third scenario** emphasizes accelerated development of renewable energy sources, particularly solar and wind power, along with parallel investment in energy storage infrastructure and digitalization of the electricity system. This scenario demands substantial investments in grid stabilization and battery energy storage systems (BESS) to manage the intermittency of wind and solar energy, with projected costs for regional grid modernization often exceeding 1 billion euros to achieve full stability by 2050.

Additionally, considering the structure of the energy systems and geopolitical challenges, bilateral and regional cooperation in energy transition can play a key role. Bosnia and Herzegovina and Serbia have potential for joint renewable energy projects, especially in cross-border zones, as well as for mutual technical and regulatory coordination through platforms such as the Energy Community of Southeast Europe. Furthermore, interconnection of power grids and exchange of balancing capacities can enhance the resilience and stability of the entire regional system. Each potential scenario for the energy transition assumes a strong upward trend in energy demand. If strategic measures are implemented without further delay, there is a realistic chance that both countries could achieve a high rate of decarbonization by 2050, while preserving energy security and ensuring social justice for affected communities.

2. EMPIRICAL RESEARCH — SURVEY RESULTS

The research was conducted through an anonymous survey among employees of thermal power plants in Bosnia and Herzegovina and Serbia. A total of 84 respondents participated. Although this sample provides valuable indicative insights into the attitudes of the workforce in the thermal power sector, it represents a methodological

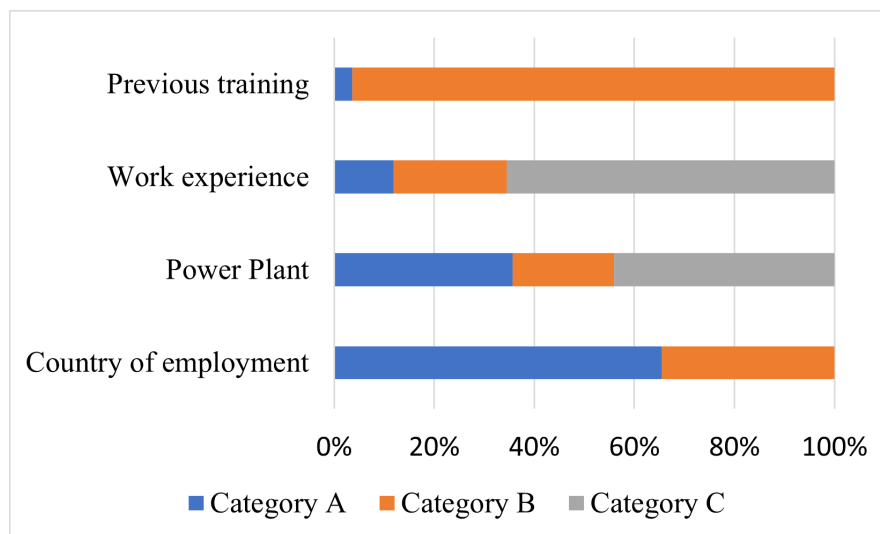


Figure 1. Demographic and professional profile of the survey respondents.

Category A (blue): Country of origin — Bosnia and Herzegovina; Employer — TE Stanari; Work experience — less than 5 years; Training on RES — received.

Category B (orange): Country of origin — Serbia; Employer — TENT; Work experience — 5–10 years; Training on RES — not received.

Category C (grey): Employer — other thermal power plants; Work experience — more than 10 years.

limitation for broad generalization to the entire energy sectors of both countries. The disproportion in the geographical distribution of respondents (65.5% from Bosnia and Herzegovina and 34.5% from Serbia) is primarily a result of greater accessibility to the target group and a higher institutional response rate within the Bosnian energy sector, specifically from the Stanari Thermal Power Plant. Consequently, the cumulative results slightly more closely reflect the perspectives of the workforce in Bosnia and Herzegovina, which was taken into account during the interpretation of the data. The survey consisted of 10 closed-ended questions, aiming to examine workers' perceptions of the significance of coal, the potential impacts of energy transition, and their readiness to shift towards renewable energy sources. The collected data were analyzed using descriptive statistical methods, and the results are presented as percentages.

The data indicates a highly experienced workforce, with 65.5% of respondents having more than 10 years of service. However, there is a significant lack of preparedness for the energy transition, as only 3.6% of workers have participated in any form of education or training regarding renewable energy sources.

The analysis of Figure 2 reveals a deep reliance on traditional energy sources, as 94% of workers consider coal to be a very important resource for their country. This reliance is closely linked to significant employment concerns, with 73.8% of respondents feeling that the en-

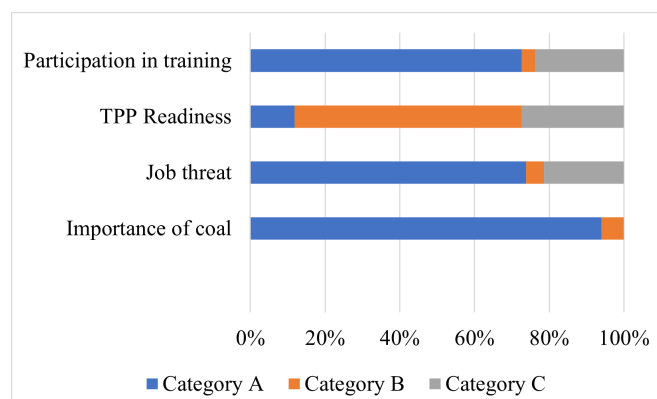


Figure 2. Attitudes of respondents towards energy transition and job security.

Category A: (Blue) Coal importance — very important; Job threat from transition — yes, threatened; Technological readiness — ready; Willingness to retrain — willing to participate.

Category B: (Orange) Coal importance — partially important; Job threat from transition — no, not threatened; Technological readiness — not ready; Willingness to retrain — not willing to participate.

Category C: (Grey) Coal importance — not important; Job threat from transition — not sure; Technological readiness — partially ready; Willingness to retrain — conditional (only with higher salary).

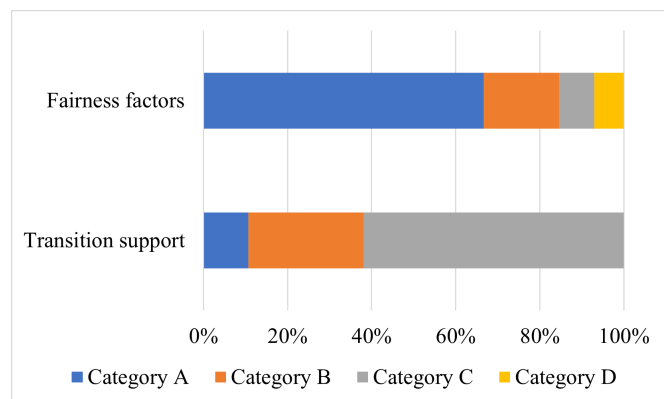


Figure 3. Perspectives on a just transition and critical success factors.

Category A: Feasibility of just transition — yes, transition is possible; Primary condition — job retention.

Category B: Feasibility of just transition — no, transition is not possible; Priority — investment in new equipment.

Category C: Feasibility of just transition — only if the state and the company provide adequate support; Critical success factor — training for new jobs.

Category D: Prerequisite for participation — higher salary or direct financial assistance.

ergy transition directly threatens their current jobs. Despite the fact that 60.7% believe their power plants are not ready yet for new technologies, there is a strong openness to change: 72.6% of workers expressed a willingness to participate in training for the renewable energy sector.

3. CONCLUSION

The energy transition in Bosnia and Herzegovina and Serbia unfolds within a complex environment where economic, social, and environmental challenges are closely intertwined. While coal still plays a dominant role in the power sector and decarbonization progresses slowly, the survey among thermal power plant workers shows both the recognition of coal's importance and a willingness to engage in training and reskilling. This indicates that, with adequate institutional and corporate support, there is genuine potential for a just transition.

The results confirm that the transition can be accelerated and aligned with European integration, provided that social security and fair compensation for workers and communities are given equal weight alongside climate objectives. This is particularly important since EU policies often emphasize climate targets, while the social dimension of the transition often receives comparatively less attention in practice. A gradual approach, supported by investments in education, job creation in the green economy, and renewable energy infrastructure, appears essential. For both countries, the central challenge and oppor-

tunity lies in balancing EU climate goals with the socio-economic realities of their energy-dependent regions.

REFERENCES

- Agency for Statistics of Bosnia and Herzegovina. (2024). *Statistika energije: Ugalj — Saopštenje broj 15/2024 [Energy statistics: Coal — Press release No. 15/2024]*. Sarajevo: Agency for Statistics of Bosnia and Herzegovina.
- Čavor Milev, D. (2022). Pravedna energetska tranzicija [Just energy transition]. In *Heinrich-Böll-Stiftung: Perspektive, političke analize i komentari — Jugoistočna Evropa, Issue No. 9: Zelena tranzicija i socijalna (ne)pravda*. Sarajevo/Beograd: Heinrich-Böll-Stiftung.
- Center for Environment. (2020). *Civil society demands on energy transition in Bosnia and Herzegovina*. Banja Luka: Center for Environment.
- Đukić, P. (2022). Pravična tranzicija energetike Srbije — Održivost reformi u uslovima nove globalne krize [A just energy transition in Serbia: Sustainability of reforms in the conditions of a new global crisis]. *Energija, Ekonomija, Ekologija*, XXIV(3).
- Elektroprivreda Srbije. (2024). *Tehnički godišnjak EPS-a za 2024. godinu: Proizvodni kapaciteti, proizvodnja uglja i električne energije [EPS technical yearbook 2024: Production capacities, coal and electricity output]*. Beograd: Elektroprivreda Srbije.
- Grčić, M. (2024). Energetska tranzicija Srbije i moguće implikacije na geografski pejzaž i životnu sredinu [Energy transition of Serbia and possible implications for the geographical landscape and environment]. In *Planska i normativna zaštita prostora i životne sredine*. Beograd: Geografski fakultet Univerziteta u Beogradu.
- Gvero, P. (2023). Obnovljivi izvori energije i uloga u budućnosti energetskog sistema Republike Srpske [Renewable energy sources and their role in the future energy system of Republika Srpska]. In *Prirodni resursi u funkciji razvoja društva XXI vijeka (Monografija LIII)*. Banja Luka: Akademija nauka i umjetnosti Republike Srpske.
- Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina. (2018). *Finalni izveštaj o konceptu za reformu sistema poticaja za obnovljive izvore energije u Bosni i Hercegovini (Faza A) [Final report on the concept for reforming the renewable energy incentive system in Bosnia and Herzegovina (Phase A)]*. Sarajevo: Ministry of Foreign Trade and Economic Relations of BiH.
- Ministry of Mining and Energy of Serbia. (2024). *Strategija razvoja energetike Republike Srbije do 2040. godine sa projekcijama do 2050. godine [Energy development strategy of the Republic of Serbia until 2040 with projections to 2050]*. *Službeni glasnik Republike Srbije*, br. 94/2024. Beograd: Ministry of Mining and Energy of Serbia.
- Mirković, V., & Lukić, N. J. (2018). Tranzicija energetike u EU i Srbiji: Strategijski pristup klimatskim promenama [Energy transition in the EU and Serbia: A strategic approach to climate change]. *Ekonomski Vidici*, XXIII(3–4). Beograd.

- NERDA — Udruženje za razvoj. (2019). *Energetska tranzicija u Bosni i Hercegovini: Analiza barijera i prijedlog mjera za ubrzani razvoj obnovljivih izvora električne energije — Dio I: Politički aspekti tranzicije [Energy transition in Bosnia and Herzegovina: Barrier analysis and proposed measures for accelerated RES development — Part I: Political aspects of the transition]* (Author: M. Kušljugić). Tuzla: NERDA.
- Privredna komora Srbije. (2023). *Nefinansijsko izveštavanje i EU taksonomija: Vodič za privredu i banke [Non-financial reporting and EU taxonomy: A guide for business and banks]*. Beograd: Privredna komora Srbije.
- Rajić, J., Veljović, M., & Savičić, S. (2023). *Građanska energija u regionu: Srbija, Crna Gora i Bosna i Hercegovina — pravni kontekst [Community energy in the region: Serbia, Montenegro and Bosnia and Herzegovina — Legal context]*. Beograd: Balkanska energetska tranzicija.
- Stjepanović, M., Đukanović, D., & Stjepanović, J. (2012). *Potreba primene novih tehnologija u podzemnoj eksploataciji ležišta uglja u Srbiji [The need to apply new technologies in underground coal mining in Serbia]*. *Rudarski Radovi*, (4). Bor: Institut za rudarstvo i metalurgiju Bor, Komitet za podzemnu eksploataciju mineralnih sirovina.