The Influence of Organizational Factors on the Adoption of Energy Efficiency Measures in Companies

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Abstract

This paper aims to research the organizational factors influencing the implementation of energy efficiency measures in companies. The analysis was performed on a sample of companies from Serbia included in the World Bank Enterprise Survey. The raw data collected by the World Bank were utilized to analyze the correlation between various organizational factors and the adoption of energy efficiency measures. The analysis revealed a statistically significant correlation between management maturity and the implementation of energy efficiency measures in companies. These findings suggest that improving energy efficiency is not an isolated process but rather closely related to the maturity of management practices, highlighting the importance of comprehensive organizational development for achieving optimal energy management.

Introduction

Energy management in companies appears to be more important now than ever before. Global political, environmental, and economic crises have confronted companies with challenges such as high energy prices, unreliable energy supply, and the responsibility to mitigate climate change (Economist Intelligence, 2023). Embracing renewable energy and enhancing energy efficiency across all sectors of society have been identified as crucial for overcoming today's energy challenges (Mihic et al., 2014). According to the European Commission (2020), approximately three-quarters of the EU's net domestic energy use can be attributed to domestic production activities by European businesses. The high cost of energy supply increases overall business costs, negatively impacting companies' competitiveness. Therefore, improving energy efficiency can contribute to overall organizational efficiency while reducing environmental pollution (Di Foggia, 2021). The energy system in commercial buildings profoundly impacts work and management processes within an organization. Comfort within the building directly affects the productivity of employees and/or users, energy consumption costs are reflected in the overall business, and the level of carbon dioxide emissions affects the image of the company (Mihic et al., 2012). Consequently, implementing energy efficiency measures within

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an organization is a form of organizational improvement and bears similarity to innovation. Hence, it is reasonable to assume that certain factors influencing innovation or corporate entrepreneurship within an organization could also influence the determination and commitment of the organization to adopt energy efficiency measures.

According to Capehart et al. (2006, p. 1) energy management is the efficient and effective use of energy to maximize profits (minimize costs) and enhance competitive positions. The same authors state that some desirable sub-objectives of energy management programs include: 1) improving energy efficiency and reducing energy use, thereby reducing costs, 2) reducing greenhouse gas emissions and improving air quality, 3) cultivating good communications on energy matters, 4) developing and maintaining effective monitoring, reporting, and management strategies for wise energy usage, 5) finding new and better ways to increase returns from energy investments through research and development, 6) developing interest in and dedication to the energy management program from all employees, 7) reducing the impacts of curtailments, brownouts, or any interruption in energy supplies (Capehart et al. 2006, p. 1). Like the previously mentioned authors, Harris (2016, p. 3) points out that energy management attempts to analyze where energy is wasted in buildings and identify cost-effective solutions. In this context, it is essential to mention the definition of the energy management system (EMS), which is, according to ISO (2018), a set of interrelated or interacting elements to establish an energy policy and energy objectives and processes and procedures to achieve those objectives. EMS is an essential tool for energy management as it provides organizations with information that enables them to support better decisions by monitoring and measuring energy consumption, modeling future energy consumption trends, and analyzing current costs. EMS also allows organizations to automate several tasks, such as gathering meter and equipment status data and reporting key performance indicators regarding energy consumption to management. Without appropriate support from EMS, organizations cannot correctly measure energy usage and monitor the effectiveness of their energy improvement measures (Antunes et al., 2014).

Over the past two decades, significant advancements in digital technologies have contributed to improving energy efficiency in residential and commercial buildings and industrial processes. These technologies fall within the Internet of Things, Big Data, Artificial Intelligence, Edge Computing, Cloud Computing, and Blockchain (Vučković & Pitić, 2022). Energy-efficient technologies significantly promise to reduce financial costs and environmental damage associated with energy consumption. However, these technologies appear to be adopted by consumers and businesses to a lesser extent than would be justified solely on financial grounds. This phenomenon is referred to as the "energy paradox" or "energy efficiency gap" (Gerarden et al., 2017). The energy efficiency gap can be defined as the disparity between the cost-minimizing level of energy efficiency and the actual level achieved (Allcott & Greenstone, 2012). Market failures and barriers to energy efficiency can explain the gap between cost-effective energy efficiency measures and the measures implemented (Backlund et al., 2012). Numerous studies have demonstrated that overcoming internal barriers is crucial for improving energy efficiency within organizations.

Given the crucial role of energy in companies' competitiveness, there is a need to integrate energy management into strategic management. Strategic management has undergone significant changes in the 21st century due to market shifts brought about by the Fourth Industrial Revolution, necessitating organizations to create new business models that can timely and proactively respond to external challenges (Schwab, 2016). Consequently, modern organizations must redefine their management systems to be more customer-oriented, constantly innovate their products, improve efficiency, and address the community's and natural environment's needs.

The literature often describes the application of energy efficiency measures in organizations as a function of the energy management system and market conditions. However, the influence of general organizational factors, reflected in the maturity of strategic management and organizational characteristics, has not been adequately explored. Investigating these factors could shed light on the necessary organizational changes required to increase the adoption of energy efficiency measures. This approach would facilitate the establishment of a corporate foundation necessary for optimal energy efficiency improvements.

The remainder of the paper will focus on the theoretical and practical analysis of organizational factors influencing companies' adoption of energy efficiency measures. Firstly, this paper will provide a comprehensive review and comment on previous research on factors that influence decision-making when implementing energy efficiency measures in companies. Subsequently, the article will outline the methodology employed in this research. The main emphasis will be on presenting the findings, followed by a relevant discussion.

Literature Review

Based on an extensive literature review, Cagno et al. (2013) identified several organizational factors identified in research as barriers to decision-making regarding improving energy efficiency in companies. Those factors are complex decision chains, lack of internal control, information on costs and benefits, imperfect evaluation criteria, and lack of sharing objectives. Fresner et al. (2017) researched improving energy efficiency in small and medium-sized enterprises in Europe. They found that the lack of information, awareness, and financial resources is the main obstacle to the greater use of energy-saving potential. Based on a sample of 480 small and medium-sized enterprises in China, Kostka et al. (2013) found that apart from the previously mentioned barriers, small and medium-sized firms that lack clear management responsibilities for energy efficiency show less investment activity in energy-efficient practices and technologies. Through research on barriers to improving energy efficiency in the steel industry in Indonesia, Soepardi et al. (2018) determined that the managerial-organizational factor has the biggest direct effect on improvements and is the most significant factor. In this case, the managerial-organizational factor includes the low status of the in-house management program related to energy efficiency measures, resistance to change, and a complex decision chain. Blomqvist et al. (2022) point out that the main barriers to improving the energy efficiency in buildings in Sweden are: 1) a lack of time to work on energy efficiency or that other tasks are prioritized, 2) a tight working group, which may hinder the capability and know-how when investigating energy efficiency investments, 3) energy manager lacks influence, uncertainty about the future of the business, and management does not prioritize energy issues. Cantore (2017) finds that firms' internal management and organizational factors, rather than top-down or other external market conditions increase firms' likelihood to invest in energy-efficient technologies.

Moreover, experience in adopting energy-efficient technologies and the commitment of top management are also crucial in this regard. According to Olsthoorn et al. (2017), organizations that are more likely to adopt energy efficiency measures are those with energy managers in place and have also conducted energy audits in the past. Based on the previously presented research results, it can be concluded that organizational factors positively influence decision-making on implementing energy efficiency measures and can be considered barriers or drivers. In this regard, it is proposed to establish an energy management system in the organization, which would enable constant energy savings and carbon footprint reduction.

Several energy management maturity models are described in the literature, providing a systematic framework for benchmarking and performance improvement (Introna et al., 2014). These maturity models are mainly based on the principles of the international standard for energy management - ISO 50001 (ISO, 2018; Antunes et al., 2014; Introna et al., 2014; Jovanović & Filipović, 2016; Jin et al., 2021; Monteiro et al., 2022). When energy efficiency is perceived as a strategic goal, companies tend to have a high level of energy management. The better the energy management system is, the more likely the chances are for a positive decision on energy-efficiency investment (Cooremans & Schönenberger, 2019). The presented models highlight the importance of achieving high energy management maturity as a prerequisite for improving energy efficiency in organizations. However, these models do not sufficiently consider the possible influence of general organizational aspects on adopting energy efficiency measures. In this regard, there is considerable scope for research in this domain. As mentioned earlier, improving energy efficiency in an organization is a type of organizational improvement that can be compared to innovation. Accordingly, there is a basis to check whether organizational factors that affect innovation in companies also affect the implementation of energy efficiency measures.

According to Pitić & Vučković (2021), organizational factors that positively contribute to innovation in organizations are: 1) a formalized, written business strategy with clear key performance indicators, 2) production targets such as production volume, quality, efficiency, waste, or on-time delivery, 3) as many performance indicators that are monitored at the company, 4) internationally recognized quality certification, 5) regular implementation of formal training programs for company's permanent, full-time employees, 6) high awareness of management and employees about the company's production targets, 7) spending on the acquisition of external knowledge, 8) spending on research and development activities within the company. It was also found that organizations with many employees operate on the international market and have difficulties in achieving their goals, more often introducing innovations in their products and processes.

Methodology

Based on the literature review, it is evident that factors related to energy management systems play a crucial role in decision-making regarding adopting energy efficiency measures in organizations. Therefore, it is important to

identify and examine the influence of several of these factors. Additionally, considering the methodological similarity between implementing energy efficiency measures and introducing organizational innovations, it is worth investigating whether strategic management factors affect energy efficiency improvements in companies.

The analysis in this paper was conducted using a sample of 339 organizations obtained from The World Bank Enterprise Survey (The World Bank, 2019), which focuses on the business environment in Serbia. The World Bank provides access to the data collected in the survey at the individual company level, making it suitable for various statistical analyses. In this study, the raw data collected during the World Bank Enterprise Survey in Serbia were subjected to further statistical processing by the authors.

The World Bank Enterprise Survey in Serbia was conducted in 2019 and included companies from various industries and sizes regarding the number of employees. The survey covered topics such as general firm/establishment information, infrastructure, and services, sales and supplies, management practices, competition, innovation, capacity, time use of top management, land and permits, crime, finance, business-government relations, labor, business environment, performance, green economy module, and environment-related aspects. The sample consisted of companies ranging in size from five to 13 thousand employees (The World Bank, 2019).

The World Bank Enterprise Survey sample in Serbia was selected using stratified random sampling. The country was stratified by industry, establishment size, and region. As is standard for The World Bank Enterprise Surveys, the survey in Serbia employed the following establishment size stratification: small (5 to 19 employees), medium (20 to 99 employees), and large (100 or more employees). Regional stratification was carried out across four equally populated regions of Serbia. The industries covered by the survey included manufacturing, retail trade, wholesale trade, construction, hotel or restaurant, and services. The survey was implemented through a two-stage procedure. Initially, a screener questionnaire was conducted over the phone to determine eligibility and schedule appointments. Subsequently, face-to-face interviews were conducted with each establishment's Manager/Owner/Director. The questionnaires consisted of common questions (core module) as well as additional manufacturing- and services-specific questions. The response rate was 36.5% (The World Bank, 2020).

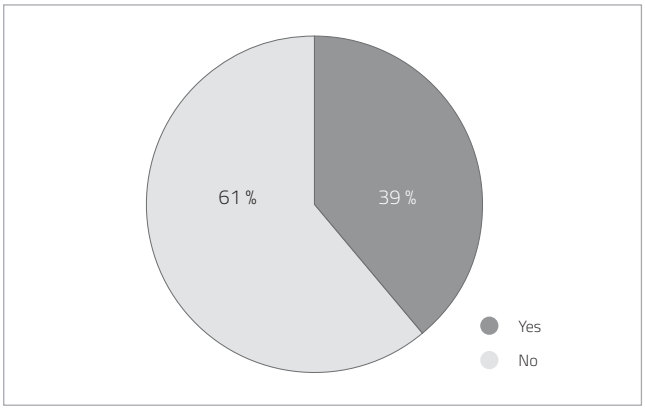
Based on the raw data collected as part of the World Bank Enterprise Survey in Serbia, the authors of this paper conducted a correlation analysis between organizational characteristics and the adoption of energy efficiency measures in companies in Serbia. The correlation analysis was performed using the Chi-square coefficient and Cramer's V test. Sixteen organizational characteristics, selected as independent variables, were derived from the questionnaire based on a review of relevant literature and the assumption that these characteristics may influence the adoption of energy efficiency measures. The dependent variable focused on whether a particular organization had adopted any energy efficiency measure in the previous three years. All variables were categorical since the questionnaire consisted of closed questions. The analysis was conducted using SPSS software.

Results and Discussion

Based on the raw data collected from the World Bank Enterprise Survey in Serbia, we discovered that more than half of the companies in Serbia did not adopt energy efficiency measures within 3 years before the survey (Figure 1).

Figure 1

Adoption of energy efficiency measures over the last three years

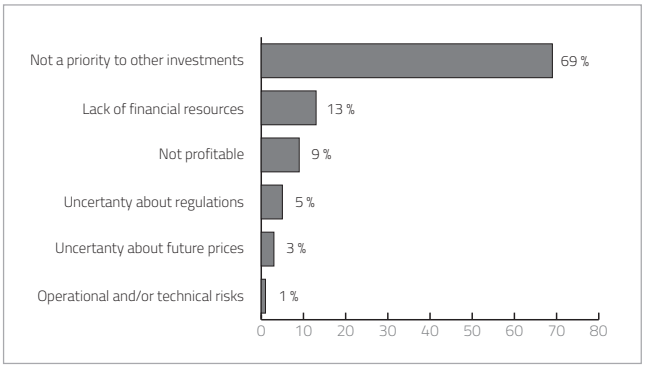


Source: The World Bank, 2019 and authors' calculation

As the most important reason for not adopting energy efficiency measures, the respondents pointed out that adopting these measures is not a priority relative to other investments (Figure 2).

The results presented in Figures 1 and 2 indicate that there is not a sufficiently raised awareness in Serbia of the need to reduce energy consumption and the multiple benefits that the implementation of energy efficiency measures brings.

Figure 2
Reasons for not adopting energy efficiency measures over the last three years



Source: The World Bank, 2019 and authors' calculation

Based on the raw data collected within the World Bank Enterprise Survey in Serbia, this paper further presents the results of the correlation analysis between certain variables of energy management, organization's management, and the adoption of energy efficiency measures within three years before the survey. Table 1 shows the results of the correlation analysis between these variables.

The correlation analysis presented in Table 1, reveals that the implementation of energy efficiency measures in companies is largely influenced by factors within the internal organizational environment. The research demonstrates that companies with a higher management maturity are more likely to have adopted energy efficiency measures in the past three years. Specifically, companies that implemented energy efficiency measures also had: 1) a formalized, written business strategy with clear key performance indicators, 2) strategic objectives that address environmental or climate change issues, 3) production targets related to volume, quality, efficiency, waste, or on-time delivery, 4) an internationally recognized quality certificate, and 5) a performance monitoring system. Additionally, the analysis indicates that companies that adopted energy efficiency measures in the past three years are predominantly large companies operating in international markets. However, the industry to which a company belongs does not appear to influence the adoption of energy efficiency measures.

Furthermore, the correlation analysis reveals that companies with a high energy management maturity are likelier to have adopted energy efficiency measures in the past three years. Specifically, companies that implemented energy efficiency measures also applied the energy performance standard and had: 1) a manager responsible for environmental and climate change issues, 2) an energy consumption monitoring system, and 3) targets for energy consumption. Moreover, the analysis demonstrates that companies that introduced product and/or process innovation in the past three years were more likely to have implemented energy efficiency measures during the same period.

Based on the correlation analysis results, each organizational factor's influence on adopting energy efficiency measures is explained in greater detail.

Having a formalized, written business strategy with clear key performance indicators positively affects an organization's adoption of energy efficiency measures. Namely, companies use strategy to define the direction of their long-term business and how they strive to achieve a sustainable competitive advantage. In this regard, companies, through their strategies, among other things, express their commitment to achieving business efficiency and in recent years, their commitment to reducing energy consumption and environmental footprint. Thus, the very existence of an organizational strategy is the basis for defining and implementing specific energy efficiency measures. Closely related to this factor is the one that indicates that having strategic objectives that mention environmental or climate change issues also positively affects the implementation of energy efficiency measures. Namely, with the growing problem of climate change, many organizations have decided to integrate their impact on the environment into their organizational strategies. An essential pillar of the strategy of many modern organizations is reducing energy consumption, waste in production and services, water use, and emission of harmful substances, and using more energy from renewable sources. In this way, companies can contribute to sustainable development. Accordingly, organizations aware of the importance and benefits of reducing energy consumption create strategies whose integral part is the implementation of energy efficiency measures.

Defining production goals regarding production volume, quality, efficiency, waste, and on-time delivery also positively affects the implementation of energy efficiency measures in an organization. Namely, business goals imply effectiveness and efficiency in performing business activities. Efficiency is measured as the ratio of invested input and achieved output, and organizations aspire to produce their products or services at the lowest possible costs. Energy costs in buildings and production processes also contribute to the organization's total costs. Therefore, organizations that strive for production efficiency also strive for energy efficiency. In other words, organizations that define clear and precise production goals

Table 1

Correlation between organizational factors and the adoption of energy efficiency measures

Energy efficiency / Organizational factors	Adoption of energy efficiency measures over the last three years (Yes/No)	
	Chi square	Cramer's V
Having a formalized, written business strategy with clear key performance indicators (Yes/No)	24.211**	0.272**
Having strategic objectives that mention environmental or climate change issues (Yes/No)	24.672**	0.273**
Having production targets such as production volume, quality, efficiency, waste, or on-time delivery (Yes/No)	4.535*	0.149*
Monitoring of performance indicators (Yes/No)	11.774**	0.242**
Internationally recognized quality certification (Yes/No)	23.203**	0.268**
The main market in which the company sells its main product (Local / National / International)	7.592*	0.151*
Company's size - number of employees (Small / Medium / Large)	10.093**	0.174**
Company's main activity and product (Manufacturing / Retail trade / Wholesale trade / Construction / Hotel or restaurant / Services)	10.673	0.179
Having a manager responsible for environmental and climate change issues (Yes/No)	18.976**	0.239**
Monitoring of energy consumption (Yes/No)	29.586**	0.299**
Having targets for energy consumption (Yes/No)	64.505**	0.441**
Application of energy performance standard (Yes/No)	26.639**	0.288**
Introduction of new or improved products or services over the last three years (Yes/No)	12.604**	0.196**
Introduction of new or improved processes over the last three years (Yes/No)	4.903*	0.122*

Source: The World Bank, 2019 and authors' calculation
Notes: A mark (*) indicates a correlation where the significance is less than 0.05, while (**) indicates a correlation with a significance less than 0.01. The brackets show the answers offered in the questionnaire for each question concerning the given organizational characteristics.

also strive to improve energy efficiency, thereby reducing their overall costs.

Monitoring performance indicators in the organization is another factor that positively affects the more frequent application of energy efficiency measures in organizations. Namely, the indicators include measuring various aspects of organizational performance, including those related to business efficiency. Organizations that strive to have insight into the efficiency of operations, i.e., consumption of resources concerning the achieved performance, inevitably try to look at energy costs as well. Insight into energy consumption and costs is a prerequisite for spotting room for improvement in energy efficiency. Therefore, only organisations that are aware of their costs and performance will strive to improve the organization's overall efficiency by implementing energy efficiency measures.

Correlation analysis has determined that organizations with a certified international quality management standard introduce energy efficiency measures more regularly. Namely, these standards prescribe establishing a management system in the organization based on principles that, among other things, imply the implementation of continuous improvements. These ongoing improvements are implemented to meet the needs of users better, but also to improve organizational efficiency. In

this regard, organizations whose management systems align with international quality standards systematically look for opportunities for continuous improvement, and energy efficiency measures are recognized as one of such opportunities.

Applying energy efficiency measures is more common in large companies and companies operating in the international market. Namely, large companies are also significant energy consumers, so they try to reduce costs in this domain as much as possible. Also, large companies, unlike small and medium-sized ones, often have sufficient financial resources to implement energy efficiency measures. However, it should be noted that many energy efficiency measures require minimal investment, and sometimes they are entirely free, so they can be applied even by organizations with smaller financial resources. Smaller companies can also improve their business in the long term by reducing energy consumption, but it is necessary to work on raising their awareness of this.

International companies more often apply energy efficiency measures when it comes to the market in which they operate dominantly. Namely, these companies compete with a significant number and stronger competitors than local or national companies, so they take more care of their costs and strive to improve efficiency wherever possible. The fact is that high energy costs make end products more expensive and reduce the competitiveness of companies, regardless of the market in which they operate. Therefore, improving energy efficiency could be a way for companies to strengthen their international position and accelerate their development in local or national markets.

The sector in which the company operates has no influence on adopting energy efficiency measures, which indicates that these measures benefit organizations in all industries. In other words, the adoption of energy efficiency measures can improve the business of both manufacturing and service organizations.

When it comes to variables related to energy management, the correlation analysis has shown that organizations, which monitor energy consumption, have goals related to energy consumption, have a manager responsible for the environment, apply energy performance standards, and have implemented energy efficiency measures recently. The prerequisite for implementing energy efficiency measures in an organization is a system for regular monitoring and energy consumption planning. In this regard, it is clear that the implementation of energy efficiency measures must be preceded by establishing an energy management system in an organization, which would be based on the principles of transparency, traceability, and repeatability.

In this research, it was shown that organizations that implemented product and/or process innovation three years before the research also implemented some of the energy efficiency measures in the same period. In other words, highly innovative organizations more often implement energy efficiency measures. This result can be interpreted as the fact that the modern business environment requires companies to be innovative and committed to sustainable development. Consequently, innovation and reducing energy consumption are often the pillars of proactive companies' strategies and therefore go hand in hand.

Conclusion

The problem of climate change is gaining momentum, and its negative consequences are becoming visible in every part of the world. In this regard, organizations worldwide are proactively or legally compelled to take measures to reduce their environmental footprint while ensuring their business results are not jeopardized. Caring for the environment also often contributes to a better organizational image and greater competitiveness. Improving energy efficiency in organizations leads to multiple benefits, including reduced energy consumption, lower energy costs, decreased emissions of harmful gases and particles, and improved comfort for building users. These benefits are crucial for organizations, and thus the adoption of energy efficiency measures represents a type of organizational improvement that positively reflects on the long-term competitive advantage of the organization in various ways.

This paper presents the results of a correlation analysis that examined whether and which organizational factors influence the adoption of energy efficiency measures in companies in Serbia. The research utilized raw data from the World Bank Enterprise Survey in Serbia in 2019. The correlation analysis revealed that higher management maturity positively contributes to implementing energy efficiency measures in companies. In other words, strategically oriented companies with functional energy management systems and innovative products and processes are more likely to apply energy efficiency measures. Furthermore, the analysis found that larger companies and those operating in the international market are more inclined to adopt energy efficiency measures. However,

the industry in which the company operates does not affect the application of energy efficiency measures.

Consequently, improving energy efficiency should become part of an organization's business strategy, strategic goals, and plans. Following the research results presented in this paper, including energy management in the business strategy, goals, and indicators of an organization's performance increases the likelihood that the organization will promptly implement measures to improve energy efficiency. In other words, including energy efficiency in the organization's strategic management serves as the foundation for a systematic and dedicated energy management approach.

Through the business strategy, organizations define the necessary actions to direct their business toward creating a long-term competitive advantage. A strategic framework is established for implementing energy efficiency measures that enable optimal energy consumption by including energy efficiency in the business strategy. However, to contribute to optimal results, energy management within an organization must align with the guidelines defining a functional management system. The guidelines for establishing a functional energy management system are outlined in the ISO 50001 Standard. Nevertheless, many organizations dedicated to optimal energy consumption can successfully manage their energy management systems without certification according to this standard. The energy management system is based on the same principles as any other management system within an organization. Therefore, it is possible to establish an energy management system that contributes to optimal energy consumption even without certification. Nonetheless, such a system must include elements defined by the ISO 50001 Standard, such as energy management system procedures, energy management goals, energy performance indicators, methods for planning, monitoring, and forecasting energy consumption, record-keeping of energy consumption, and the appointment of a responsible person for the energy management system. Adhering to these guidelines enables consistent implementation of the part of the business strategy concerning the organization's energy efficiency.

The analysis presented in this paper is limited exclusively to the factors of the internal organizational environment. However, scientific literature indicates that various external factors, such as energy prices, influence decision-making regarding implementing energy efficiency measures in companies. Therefore, future research should examine the combined influence of external and internal factors, particularly in today's technological development and global energy crises.

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Vpliv organizacijskih dejavnikov na sprejemanje ukrepov energetske učinkovitosti v podjetjih

Izvleček

Namen tega članka je raziskati organizacijske dejavnike, ki vplivajo na sprejemanje ukrepov za energetsko učinkovitost v podjetjih. Analiza je bila opravljena na vzorcu podjetij iz Srbije, vključenih v raziskavo Svetovne banke o podjetjih. Za analizo povezanosti med različnimi organizacijskimi dejavniki in izvajanjem ukrepov za energetsko učinkovitost so bili uporabljeni neobdelani podatki, ki jih je zbrala Svetovna banka. Analiza je pokazala statistično pomembno povezanost med zrelostjo upravljanja in izvajanjem ukrepov za energetsko učinkovitost v podjetjih. Te ugotovitve kažejo, da izboljšanje energetske učinkovitosti ni izoliran proces, temveč je tesno povezan z zrelostjo upravljalskih praks, kar poudarja pomen celovitega organizacijskega razvoja za doseganje optimalnega upravljanja z energijo.

Ključne besede: energetska učinkovitost, energetsko upravljanje, zrelost upravljanja, organizacijski dejavniki, Srbija